ROLE OF ENVIRONMENTAL EDUCATION IN ADDRESSING EFFECTS OF COAL MINING IN ZAMBIA'S MAAMBA TOWNSHIP.

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AUTHOR'S DECLARATION

I, Mavis Cheelo Siambwati, do declare that, with the exception of the references acknowledged, this dissertation represents my own work. It has not previously been submitted for any degree and is not being currently submitted in candidature for any other degree at this or any other university.

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CERTIFICATE OF APPROVAL

This dissertation of Mavis Cheelo Siambwati is approved as partially fulfilling the requirements for the award of the degree of Master of Education in Environmental Education
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ABSTRACT

The need for Environmental Education (EE) in sectors of the economy like mining cannot be over - emphasized. Though contributing to the revenue of the nation, mining produces negative effects which greatly affect people in mining towns. This study explored how Environmental Education could be used to address such negative effects of coal mining in Zambia's Maamba Township of Sinazongwe District. The study further assessed the availability and types of EE programmes and suggests alternative ways by which EE could be used among residents. The study used a qualitative approach, and specifically a descriptive survey, in data collection and analysis. Gaia theory on nature was used to guide the study. Respondents were drawn from various locations of Maamba Township, such as Maamba Hospital, Rural Council, Mine offices, Schools and the residential area. Data was obtained using open and closed ended questionnaires, semi-structured interviews, Focus group discussions as well as observations on site. Main findings of the study indicate that residents of Maamba Township received inadequate Environmental Education which did not even include the negative impacts of coal mining on their lives. The EE programmes that were in place did not involve the residents in any way. The study established that Environmental Education could be key to addressing negative effects of mining, such as polluted water, air and soils since EE's major role was to increase people's knowledge and awareness about the environment and associated challenges so as to develop necessary skills and expertise to address such challenges. To this effect, a programme was designed together with relevant stakeholders to try and minimize the identified negative effects. Based on findings of this study, key recommendations have been made. Firstly, all stakeholders, especially those at the grassroots like the residents should be fully involved from the planning stage up to evaluation stage of EE programmes. Secondly, EE programmes should include information about negative effects of coal mining on residents. Thirdly, there is urgent need to have EE as a standalone subject in schools so that it is taught from the foundation stage up to tertiary level.

DEDICATION

To my husband Charles Chileshe Ndoti, my late dad Judah Hamulindi Siambwati, my three lovely sons, namely, Chileshe, Mapalo and Nchimunya.

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ABBREVIATIONS AND ACRONYMS USED

ABS	Australian Bureau of Statistics
AMD	Acid Mine Drainage
AREZ	Advocacy for Environmental Restoration in Zambia
DCR	Development Compass Rose
ECZ	Environmental Council of Zambia
EE	Environmental Education
EIA	Environmental Impact Assessment
EMA	Environmental Management Plan
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
ESD	Education for Sustainable Development
MCL	Maamba Collieries Limited
NHC	Neighborhood Health Committees
NCF	Nigerian Conservation Foundation.
NGO	Non Governmental Organization
UGWA	Upper Guyandottes Watershed Association
UNESCO	United Nations Educational Scientific Cultural Organization
UNZA	University of Zambia
USA	United States of America
USSR	United Soviet Socialist Republic
SD	Sustainable Development
SEEDS	School Environmental Education Development Strategy
SPH	Stems Per Hectare
WWF	World Wide Fund
ZEMA	Zambia Environmental Management Agency
ZIMCO	Zambia Industrial and Mining Cooperation

CHAPTER ONE

INTRODUCTION

This chapter presents the need to conduct this research. It provides background information to mining in Zambia and the importance of Environmental Education in addressing effects of mining. The chapter states the specific problem under study provides justification of the study, points out the aim and specific objectives which were guided by specific research questions. Limitation and delimitations of the research are also presented while the last section of this chapter provides the structure of the dissertation.

1.1 Background to the study

Zambia is an inland country in southern Africa that is particularly rich in mineral resources, such as coal. Mining refers to the process of extracting metals and minerals from the earth. Gold, silver, diamond, iron, coal and uranium are just a few of the vast array of metals and minerals that are obtained by this process. In fact, mining is the source of all the substances that cannot be obtained by industrial processes or through agriculture (UNESCO, 1999). Mining reaps huge profits for the companies that own them and provides employment to a large number of people. It is also a huge source of revenue for the government. Despite its economic importance, Mining has negative effects on the environment. There is need, therefore, have the Environmental Impact Assessment in place as stipulated by the Zambian law to ensure the environment is protected. Studies done such as that of Chipatu (2011) and Kangwa (2008) show that mining activities have negative effects on the environment. Maamba collieries is the largest producer of coal in Zambia with an estimated coal reserve of 103 million tonnes of high grade coal and 70 million of low grade coal. For many years coal mining has supported the social and economic development of the country (AMG, 2011).

Mining has not however met the expectations of the government and citizens alike as the effects it poses to the environment by far outweigh the benefits it brings. This cannot be wholly blamed on the mining companies as it is the duty of the government to ensure Environmental Impact Assessments (EIAs) is done unreservedly as well as ensuring the compliance of such companies to the Zambia Environmental Management Agency (ZEMA) Act (2011). Most mining companies are capitalizing on the platform of a very weak implementation of the environmental policy and ZEMA cannot

adequately monitor and regulate companies that cause threats to the environment. Environmental Education (EE) refers to organized efforts to teach about how natural environments function and, particularly, how human beings can manage their behavior and ecosystems in order to live sustainably.(Palmer,1998). Environmental Education is a multi-disciplinary approach to learning that develops the knowledge, awareness, attitudes, values and skills that will enable individuals and the community to contribute towards maintaining and improving the quality of the environment. Adams (2006) contends that environmental awareness which increases public knowledge creates a platform to combat environmental problems that are being faced worldwide. This is further supported by contending that EE's role is to increase people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (UNESCO, Tbilisi Declaration, 1978).It is important to embark on sensitization programmes that will emphasize knowledge, awareness, skills and participation in environmental issues at all levels (UNESCO, 1999).It is in this regard that, this study will use Environmental Education to address the negative effects of coal mining in Maamba Township.

1.2 Problem statement

Inspite of studies having been conducted by different scholars such as Chipatu (2011) and Kangwa (2008) on the negative effects of mining operations on the environment and mitigation measures put in place, people in Maamba Township did not receive adequate Environmental Education. This is evidenced by the number of settlements erected near Mines, scavenging in the mine dump sites as well as the use of polluted water from mine effluents. Such a situation constitutes a problem because it poses serious threats to the health of the people, plants and animals. Kribec and Nyambe (2006) assert that increased levels of mining activities have impacted negatively on the environment and the ecosystem. In view of the above, there is need to find solutions to such problems and Environmental Education could be one such solution. This study, therefore explored how Environmental Education could be used to address the negative effects of mining in Maamba Township of Southern Zambia.

1.3 Aim of the study

The aim of this study was to explore how Environmental Education could be used to address negative effects of coal mining operations on residents and natural environment of Maamba Township of Southern Zambia.

1.4 Specific objectives

In order to address the aim of the study, the following specific objectives guided the study:-

(a) To establish the role of EE in addressing negative effects of coal mining as a way of improving the environment.
(b) To assess the availability and types of EE programmes to address negative effects of coal mining among Maamba residents.
(c) To determine alternative forms of EE that could be used among Maamba residents in addressing negative effects of coal mining.

1.5 General research question

The study adopted the following general research question;

How can EE be used to address negative effects arising from coal mining operations on the residents and natural environment in Maamba Township.

1.6 Specific Research questions

The following specific research questions were used in this study as a way of addressing the general research question:-

(a) What role does EE play in addressing negative effects of coal mining as a way of improving the environment?
(b) What type of EE programmes, if any, are being offered to Maamba residents to address negative effects of coal mining?
(c) In which alternative forms could EE be used to address the negative effects of coal mining?

1.7 Significance of the study.

Findings of this study may be useful to the government of the day for policy formulation. Environmentalists, researchers and all the other stakeholders may also need these findings to critically investigate more on the current state of Maamba environment and be able to take appropriate mitigation strategies. This will most importantly in turn benefit the people living in this township in that they will have healthy lifestyles. It is further anticipated that this study may help the planning department of The Ministry of Local Government and Housing to plan settlements of residents so as not to compromise on their good health. The researcher further anticipates that the study may contribute to knowledge available and also provide information to scholars who would be interested in carrying out further related research.

1.8 Theoretical Framework

Gaia theory of nature guided this study. This theory proposes that organisms interact with their inorganic surroundings on earth to form a synergistic self-regulating, complex system that helps to maintain and perpetuate the conditions for life on the planet. The chemist James Lovelock formulated this theory and it was co-developed by microbiologist Lynn Margulis in the 1970s.Gaia theory suggest that organisms co-evolve with their environment, that is, they influence their abiotic environment and that the environment in turn influence the biota by Darwinian process. In some versions of the Gaia theory, all life forms are considered part of one single living planetary being called Gaia. In this view, the atmosphere sees and the terrestrial crust would be results of interventions carried out by co evolving diversity of living organisms. The theory as a whole seeks a physical and chemical environment optional for contemporary life. Since the earth is the only planet currently known to harbor life, it is inevitable to ensure that people are made aware of some the environmental risks that may lead to loss of life and hence, enable them make informed decisions as to how they ought to take care of their environment to sustain good health. It should be mentioned here that, since organisms interact with their surroundings as the theory states, Environmental Education in this case is seen as the only way of developing an awareness of the environment and it is the most effective vehicle for persuading the human race to adopt a rational attitude towards the natural environment and avoid the deterioration of human life as a result of unwise exploitation and misuse of nature (Otiende, 1997).

1.9 Delimitation of the study.

Delimitations are used to address how studies can be narrowed down in scope (Kombo, 2006).

The study concentrated on some selected places within Maamba Township as some areas were not accessible. Research findings may not therefore, apply to all mining towns in the whole country.

1.10 Limitations of the study.

Time was limited to accurately observe and comprehend the behavior patterns and attitudes of the Maamba residents and that some of the data required was not availed. This did not however, hinder the reliability and validity of the collected data since other methods such as questionnaires were used. Permission to interview some people was tedious due to the bureaucracy in some organizations. Both the individual interviews and group discussions were not easy to organize as the respondents kept on postponing the meeting times and dates. As a result, the postponements dragged the research period, hence making it more costly for the researcher in terms of lodging logistics.

1.11 Structure of the Dissertation

There are five chapters in this dissertation. The first chapter provides the general introduction to the study and the background information to the problem being investigated. It further justifies the importance of such research. The chapter further outlines the objectives of the study, the research questions, operational definitions, scope of the study as well as a detailed description of the study area. The second chapter reviews different researchers who have looked at mining and how it is related to the topic under study. The third chapter discusses the methodology that was implored in the study. The study adopted the qualitative approach. The fourth chapter presents the findings of the study by arranging the data to make it clearly understood. The fifth chapter presents the discussion of all data collected and outlines how the objectives were achieved. The sixth chapter draws the conclusion and makes recommendations to the study.

1.12 Description of study area

This segment of the dissertation gives a detailed description of the study area in terms of geographical location, physical and social economic characteristics. This description is important to this study in that it describes the main features of Maamba Township with respect to context. By context, in this case, what is meant is a complex of factors of the environment in the study. Some responses could be influenced by what the respondents experience in their local environment. It is hoped that the description of the study area will account for the environmental effects suggested as being common in Maamba.
It also guides would be researchers to know which study would be appropriate. Maamba Collieries Limited (MCL) was incorporated in 1971 under the ownership of the Republic of Zambia through the Zambia Industrial and Mining Corporation (ZIMCO).

1.12.1 Geographical Description of study area

Maamba Township is located in Sinazongwe district of Southern Province which is about 350km from Lusaka, Zambia. MCL has operated under the current mining title since 1970. The mining title

encompasses approximately 7,900 hectares located on the Siankondobo coalfield in the Gwembe Valley, in the Southern Province of Zambia. Zambia possesses substantial coal resources and has been producing coal continuously since 1967.The bulky of the coal come from Maamba mine, an open cast operation in the southern part of the country near lake Kariba.

Climate of the study area

The Southern Province of Zambia lies predominantly between the elevation of 1,200m (for areas on the plateau like Choma, Kalomo and Monze) and 500m (for areas in the Gwembe valley like Siavonga, Sinazongwe and Maamba. The region has distinct dry (May to October) and wet (November to April) seasons. Rainfall mainly occurs in heavy thunderstorms producing typical precipitation events of 10 to 40 mm. Department of Meteorology indicated that the province used to get a lot of rainfall though now the amounts have reduced due to climate related issues and deforestation.

In 2011, MCL installed a weather station at their mine offices. The total annual rainfall recorded at MCL mine office for November 2010 - August 2011 was 1,220.70 mm. Temperatures are defined by the two seasons, cool and dry (May to September) and warm and wet (October to April).Maximum

recorded at MCL in November was 33.4°C and the lowest was 22.7 °C recorded in July. Mean monthly humidity in the project area range between 64.24 and 89.77%.

Air Quality

Spontaneous fires from the uncovered and loosely covered coal dust in disused overburden dumps, grassland and forest fires, charcoal burning and traditional slash and burn agriculture during the dry season generates smoke and dust and has caused a lot of pollution. This air pollution hangs over the area and forms a distinctive haze especially when it is cold. The haze layer is mainly visible from the air and worst during the coolest months (June and July) when temperature inversions tend to trap the smoke near ground level. The haze lasts until the weather becomes hot in the months of August or September. Localized air quality deterioration is also associated with village domestic fires. The size of airborne particulate matter of interest in air pollution studies usually range from 50μm down wards. Respirable particles of less than 10μm are of special concern due to health hazard potential. Particulates between 10 μm and 2 μm are referred to as coarse particles (MP10) while those of less than 2 μm are termed fine particles (PM2.5). High levels of suspended particulate matter increase chances of respiratory diseases. Environmental and Social Impact Statement Report for the Mining Operations (2011).

Hydrology

The elevations within Maamba vary. Some rivers and all the streams drain from the Zambezi escarpment. Along the side of these rivers and streams are rich floodplains of alluvial soils, which are cultivated by the local people. The two streams that drain the project area are Kazinze and Izuma. The Kanzinze stream is the main surface water channel which flows through the mine area and then flow southwards to Lake Kariba. Izuma stream is also another stream which flows through the open pits and then joins the Kanzinze stream in the south of the project area.

Land Use, Soils and Land Class Evaluation

The majority of land cover is degraded disturbed woodland. The project area is affected by shifting cultivation practices, burning and charcoal burning activities. A recent review of irrigable soils indicated that the area required for the mining lease tends to be rocky, with numerous bare back granite outcrops. As a result the mining lease is generally not suitable for large scale arable farming

activities, including irrigation, even though there are a lot of small scale agriculture activities taking place especially along the flat land found along the streams in the surrounding areas. Maize fields are common in the area and cultivated for up to five years before planting a drought resistant crop such as sorghum, millet etc. Animal husbandry is limited to the keeping of goats, pigs, chickens, ducks and cattle. Mountains dominate the land so much that land for settlement is only found in isolated pockets. However, most of the habitable land is used for agriculture. There is no manufacturing or any other industry within the mining license area, or within the larger area surrounding the project. Nearby urban areas include Sinazongwe and Choma. Traditionally, men control most of the land. They decide on the use of the land while women have limited say over what to do with the land.

Vegetation

Maamba basin forest comprises Riparian and Munga forest which seem to have regenerated. There are mainly tall grass and shrubs which are sparsely distributed. The tree species in the open pit are mainly those whose fruit are winged and dispersed by wind. The trees found growing on the site were multi-stemmed. This could be due to stresses exerted by the environment on the plants especially during the regenerative phase when soil moisture in the dry season can be quite constraining. The results show that there are 190 stems per hectare (SPH) in the whole assessed area.

According to the inventory results for Maamba, mopane, brachystegia and julbernadia species are the most common species and these are the species that regenerate very quickly by seed and are generally suitable for poles. But then, these trees can be utilised for fuel wood. The diameter and height analysis show that the forest structure of the assessed area of Maamba, defined by the height indicate an average height of 6m and diameter of 13cm. Timber production therefore, has little potential.

Economic and Social Situation

Coal mining is the dominant economic activity in the area. Maamba residents are mainly dependent on the coal mine for their survival. They either work for the mine or supply goods and services to the mine or to its employees. Diminishing activities at the Mine has caused a lot of suffering for locals as there are few alternative opportunities for them. Some have ventured into subsistence crop and pastoral farming. Most households in the area surrounding Maamba earn their living by keeping

Livestock, specifically cattle and goats and by fishing. The major crops grown are maize, cassava, sweet potatoes, sorghum, millet and vegetables. These crops are mainly grown for household consumption with a few sold within the communities and occasionally in Choma. Apart from vegetable gardening that goes on throughout the year, most agricultural activities are seasonal; conducted during the rainy season.

1.13 Summary

This chapter focused on the background information related to the study, statement of the problem, aim of the study, objectives of the study, research questions, significance of the study, limitations of the study, structure of the dissertation and shows the relevance of a detailed description of the study area. Having shown the introduction in the preceding chapter, the next chapter outlines the significance of this study in relation to the literature from other authors who did some studies in line with mining and its negative effects to mining townships.

CHAPTER TWO

LITERATURE REVIEW.

2.1 Introduction

This chapter focuses on literature reviewed on the background of Environmental Education, negative effects of mining on the environment and the use of Environmental Education in addressing the negative effects of mining on mining communities from a global and local perspective.

According to Bless (1996), literature review is defined as a crucial summary and an assessment of the current state of knowledge or state of the art in a particular field. Cowell (1999: 34), also defines literature review as, "summarized published information on a particular subject matter at a given period of time". From these definitions, literature review then can be defined as written materials on a specific topic involving getting information from such sources as journals, magazines, books, research dissertations and theses. Going through these written materials is indispensible before embarking on a research. The layout of the literature review in this paper starts from the global, continental (African) and finally the national perspective.

Zambia is an inland country in Southern Africa that is rich in mineral resources such as coal. Mining refers to the process of extracting metals and minerals from the earth.It is one of the major sources of income for most people as well as country in terms of providing revenue. In spite of mining being important and contributing to the social-economic development of the country, the effects it poses on the environment is a cross cutting issue.

2.2 History of Environmental Education.

A frame work for Environmental Education emerged from a conference which was held in Belgrade in 1975.Several experimental studies were then conducted and this led to information network on Environmental Education to be set up. In 1977, the first inter-governmental education was held at Tbilisi, USSR and this marked the inauguration of Environmental Education at an international level.

(UNESCO, 1985).Some of the Environmental Education guiding principles that were put across include enabling learners to have a role in planning their learning experiences and be in a position to discover the symptoms and real causes of environmental problems.(Mohana,2009).Mohana's

assertion is in line with what the study tried to achieve in that it called for involvement of learners in the planning stage of their learning experiences.

Environmental Education (EE) refers to organized efforts to teach about how natural environments function, and particularly, how human beings can manage their behavior and ecosystems in order to live sustainably. This clearly shows that EE plays a key role in addressing environmental issues that affect people and in this regard Maamba residents. The term is often used to imply education within the school system from primary to post-secondary. However, it is sometimes used more broadly to include all efforts to educate the public and other audiences, including print materials, websites, media campaigns. Related disciplines include outdoor education and experiential education. Environmental education is a learning process that increases people's knowledge and awareness about the environment and associated challenges. It also develops the necessary skills and expertise to address the challenges, fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (UNESCO, Tbilisi Declaration, 1978).

Mohana (2009), further contends that the feeling of many experts is that there can be no hope of finding solutions to environmental problems until and unless general education at all levels are suitably modified to enable people from all walks of life to comprehend the fundamental interaction and inter-relationship between man and his environment from childhood. It is through Environmental Education that a new global ethnic can be developed and an environmentally literate population created. This is more reason why this study used EE to address environmental issues experienced in Maamba Township in Southern Zambia.

2.3 Environmental Education and Mining- Global context.

Internationally, Environmental Education gained recognition when the UN Conference on the Human Environment held in Stockholm, Sweden, in 1972, declared environmental education must be used as a tool to address global environmental problems. The United Nations Education Scientific and Cultural Organization (UNESCO) and United Nations Environment Program (UNEP) created three major declarations that have guided the course of environmental education. (Palmer, 1998).

There is no other strategy that would to a larger extent reduce the injuries that have been done to the natural environment apart from embarking on mass environmental awareness programmes throughout the world as Tilbury (2005), observes that from global formulation of treaties, it should trickle down to the personal level. Environmental programmes in schools where the window of hope and the future leaders are found have been active in many countries of the world. The whole idea is to educate the society on developing values that would make them appreciate the environment they live in. Tilbury (2005) and Martha (2006) agree that schools in the world should be used to plan programmes that promote Environmental Sustainable Development (ESD).

2.3.1. A Case of Australia

According to the Australian Best Practice in Environmental Management in Mining (1995). 'Mining operations can have significant effects on the environment and community. Early planning will identify most environmental issues and a major development usually looks at effects on physical, biological and social environments through the life of the project'. It further highlights the possible effects of mining operations as follows;

2.3.1.1 Physical effect

Some of the physical effects are significant land disturbance, erosion, subsidence and instability, alteration of water courses, effects on quality, quantity or availability of surface water or underground, salination of water or land, acid drainage and heavy metal contamination.

2.3.1.2 Ecological effect

The direct effects on vegetation, are for example through massive clearing, loss of habitat, displacement of fauna, impact on ecological processes or the maintenance of them, Loss of biodiversity by effect on rare or endangered flora and fauna, potential for spreading plant diseases and noxious weeds, effect of toxic or hazardous materials and creation of new habitants.

2.3.1.3 Social effect

The large influx of population to mining areas has potential effect on health, safety, welfare or quality of life of individuals and communities through effects of traffic, odour, noise and dust. Dislocation or relocation of people, possible significant change in the level or nature of community resources such as cultural character, distribution of jobs and income and community identity are the other effects.

2.3.1.4 Infrastructure effect

Some of the infrastructure effects are significant load on services and infrastructure such as roads, power supply, water supply, housing, hospitals, education and social services.

The Australian Bureau of Statistics (2003) clearly states that 'the extractive nature of mining operations creates a variety of effects on the environment before, during and after the mining operations'. The extent and nature of the effects can range from minimal to significant depending on a range of factors associated with each mine. These factors include: the characteristic of the ore body, the type and extraction methods used in mining and the on-site processing of minerals as well as the sensitivity of the local environment. Apart from the direct physical effects of extractive activities, contamination of air, land and water may also result. However, mining in isolation may not be the main land use that upsets ecological systems as environmental effects are cumulative in nature and other past activities or events may have contributed these effects.

The Australian Bureau of Statistics (2003) has further elaborated the effect of mining industry on the environment as being dependent on the scale of exploration and what equipment is being used. Initial exploration may involve the use of satellites and aerial photograph with the impacting through noise and proximity to wildlife areas when conducted at low altitude. The majority of air emissions associated with the mining industry includes dust, oxides of nitrogen, sulphur dioxide and carbon monoxide.

2.3.1.5 Australian Environmental Management

In order to mitigate the adverse effects from mining activities mentioned above, the mining industry and government undertake environmental management measures. These measures are aimed at the prevention, reduction or elimination of pollution or any degradation of the environment. They include waste management and protection of biodiversity, landscape, air and climate (MCA 2002). Protection mechanisms are backed by environmental legislation from the states and, increasingly, the Commonwealth, which has been assuming more responsibilities and imposing standards on the states. In Australia, the state and territory governments own and administer mineral and petroleum rights over land, and seaward to three nautical miles from the sea baseline. In these areas, although the Commonwealth Government has some responsibilities regarding the environmental protection, the states and territories are the main authorities for environmental management of most mines within their respective jurisdictions. Environmental management involves the use of mechanisms in the development, operation and subsequent rehabilitation of mine sites. These mechanisms are supported by legislation. The mining industry has also introduced its own code for self regulation (ABS, 2000).

It is however, not mentioned as to what role Environmental Education can play here to reduce these effects and no mention of the communities that are affected as these are cardinal in mitigating the effects. This study adds more knowledge by emphasizing the use of Environmental Education and involvement of all stake holders especially the ones at the grassroots from the planning stage up to implementation and evaluation such as allowing them to suggest best ways they can help combat the environmental problems that affect them as is the case with this research.

2.3.2 A Case of China.

The Chinese government formulated a well calculated programme to encourage people look after the trees, animals and other important natural resources. To promote environmental awareness in the education system in China, schooling for Sustainable Development (SD) in the communities and schools had been a core response all meant to promote environmental protection that has been dwindling. China has been ranked one of the countries in the world with excessive poor environmental awareness but efforts are made through teaching the young ones on the need to use the resources sustainably (Barbier, 1987).

Barbier does not however, make mention of what strategies or methods of teaching that the young ones can use as they do not just need to be taught but also be involved directly. This study clearly explains how the learners are involved.

Malone (1999) assets that China is one of the countries in the World that has vigorously embarked on the school development through what is called School Environmental Education Development Strategy (SEEDS). SEEDS in the world is meant to inculcate a sense of responsibility in the young ones who are the future generations to learn to look after their fragile environment. It is in this regard that China has introduced Environmental Education in a bid to boost environmental awareness in the young ones. It is hoped that all countries could emulate this.

2.3.3 A Case of United States of America (USA).

In the United States of America (U.S.A), the principal minerals mined are coal, petroleum and copper. Mining operations and the resulting rock waste harm the environment. Environmental problems associated with mining for example, occur when freshly excavated coal beds are exposed to the air. According to Sklar (2008), sulphur-bearing compounds in the coal oxidize in the presence of water vapour to form sulphuric acid. When this sulphuric acid solution enters surface water and groundwater, it is detrimental to water quality and aquatic life. Coal burning produces harmful emissions such as carbon dioxide. Carbon dioxide is a greenhouse gas because it traps the earth's heat and may contribute to global warming. Other emissions from coal combustion can lead to air pollution. In response to the challenges caused by mining activities on the environment, Speight (2008) indicates that the U.S.A government has imposed stringent laws and regulation on mining enterprises. Some of the regulations demand that the mining companies submit plans detailing proposed methods for blasting, road construction, land reclamation and waste disposal before exploration. Land reclamation policies in the U.S.A, require mining companies to restore strip-mined landscapes to nearly premine condition. Besides land reclamation policies, the government implemented U.S Clean Air Act – a federal law regulating air pollution in the United States. This legislation has significantly reduced emission of sulphur oxides, known as acid gases (Speight, 2008). A mere mention of imposing strict laws alone is no solution to the harm that is done by coal mining activities to the environment. This is more reason why this study emphasises educating the people through EE as this could be the best solution to environmental problems that may arise.

2.3.3.1 USA Environmental Education Activities

The Environmental Protection Agency (EPA) of the U.S.A has put in place the EE Grant Programme. The EE Grant Programme provides seed funds to support EE projects that increase public awareness about environmental issues and provide them with skills to take responsible actions to protect the environment (EPA, 1999). As observed by Smith (1970) EE grant contributed to learning and teaching by extending the school curriculum to cover the outdoor learning in the mining communities of the U.S.A. Some of the programmes under EE grant include;

2.3.3.2 USA Acid Mine Drainage Awareness Education Programme

According to Mc-Cormick (2009) a total of $3,232 is given to friends of the Cheat Inc to coordinate EE activities. The programme enhances guided tours of the Acid Mine Development (AMD) an interpretative trail in Preston to educate the communities about the effects of coal mining on the Cheat River watershed and measures taken to bring back the Cheat River to its original state. Likewise, an Acid Mine Drainage (AMD) Awareness Education Programme for students at Preston High School, Bruceton School and Boy Scouts had been developed. The acid mine drainage awareness programme provides the participants with a comprehensive understanding of water quality issues, water sampling and the importance of restoring the Cheat River to health as a waterway.

2.3.3.3 USA Identification of PCB Hot Spots Programme

The Southern Appalachian Labour School Staff gets a funding of $5,000 for workshops, research and site identification (EPA, 1999). The Southern Appalachian Labour School staff works with community groups to identify sources of poly-chlorinated biphenyl (PCB) contamination from coal `mining operations and report “hot spots” to EPA. Through this programme, the general public learn about the health risks of PCBs and how to prevent the risks.

2.3.3.4 USA Outdoor Environmental Learning Centre Project

The Outdoor Environmental Learning Centre project creates an outdoor learning space where the public, children, and their guardians are educated about human health threats associated with environmental pollution. Lieberman (1998) suggests that the project gives special attention to providing information on how pollution affects children and how human exposure to pollutants can be minimized in order to preserve good health. Lieberman was shallow in his suggestion as he never mentioned exactly how community members are involved in the preservation of good health. This study clearly states how and ways in which community members are involved in preserving good health.

2.3.3.5 USA Community Stewardship Initiative

The Community Stewardship Initiative grant allows the Upper Guyandotte Watershed Association (UGWA) to reach further into the watershed issues through small community forums, public meetings, the media, stream cleanups and fostering meaningful partnerships. Apart from encouraging watershed stewardship, UGWA educates the community about the health risks surrounding untreated water and how to avoid hazardous contact.

2.3.3.6 USA Keep Well Water Programme

Under this programme, students in middle and high schools are trained in testing for the presence or absence of foreign elements in water samples in their own homes. Results of their findings are reported to the local media and also posted on Cacapon Institute's Web site. The public learn about the quality of community drinking water and about health concerns associated with contaminated drinking water through the reported results (Lieberman, 1998).

2.3.3.7 USA Grow with Us Programme

Preschool children are said to enjoy an outdoor environmental learning site. Stapp (1969) asserts that children are taken to the water site that is furnished with flowers and trees that attract birds and butterflies. The water site also houses fish, aquatic vegetation, frogs, tadpoles and some insects. The children learn about nature by observing plants and animals in their natural environment.

As seen from above, the U.S.A has elaborate EE programmes associated with the effects of mining on the environment. The programmes are diverse and cater for all members of the community. Interestingly, the young are also involved implying they will grow with EE and later pass on the knowledge to other generations to come. It is not mentioned by Stapp if at all just observing the natural environment is adequate in addressing issues of the environment and who chooses the suitable mode of learning. This study addresses all these concerns.

2.3.4.0 The Case of Guyana

In 1995, in Guyana, more than four billion litres of waste water that contained cyanide slipped into a tributary of the Essequibo; when the tailings dam, which was filled with cyanide waste collapsed. All the fish in the river died, plant and animal life was completely destroyed and floodplain soils were heavily poisoned, making the land useless for agriculture. The main source of drinking water for the local people was also polluted. This was a major set-back for the eco-tourism industry on the river. When trees are cut (forest clearing for the construction of roads and mines, wood for the immigrated people, workers, etc.) and water sources are contaminated, animal populations migrate or die. Moreover, hunters are hired to feed the people working at the mining sites (WWF, 2010).

Gold mining in Guyana is linked with the Greenstone Belt, an ancient metamorphic rock formation that cuts through the country. According to WWF (2010) mining attracted both local and foreign interests most of which are small to medium scale operations about 3000 to 4000 units. Negative effects of mining are due to the fact that the Greenstone Belt is poorly managed .To give weight to the argument; WWF (2010) further explains that poor management of the Greenstone Belt had resulted in extensive damage to the natural environment with considerable ecological, biological, physical and health effects. It further asserts that unsound gold mining leads to 500 tonnes of mercury being released annually into the environment. In the aquatic ecosystem, mercury collects and concentrates within the food chain, especially in carnivorous fish (Stephens, 2001). Consumption of

such fish may be harmful to the health of people. Similarly, the burning of gold in open flame without the use of protective gears contributes to harmful exposure from mercury vapour if inhaled. High intake of mercury vapours cause life threatening lung damage and fatal effects to the kidneys, nervous, digestive and respiratory system.

2.3.4.1. Guyana Environmental Education Activities

Through the WWF funding to the Guyana Geology and Mines Commission, a comprehensive education and awareness programme was developed and is executed throughout the mining districts in Guyana. WWF (2010) states that the programme concentrates on educating the local community and miners on the dangers of inhaling toxic mercury vapour, eating mercury contaminated fish, the use of proper mining techniques, and evaluation of possible mining sites before investing in equipment. Apart from this, the WWF funded a project of building awareness amongst medical practitioners on the implications of mercury use on human health and how to detect signs and symptoms and appropriate treatment procedures for mercury poisoning (Stephens, 2001).

The WWF Guyana education and awareness activities have resulted in more of the people being aware of the dangers of mercury and how to protect their environment from unsound mining practices. It should be echoed here that it has not been mentioned as to what extent the local community is involved as awareness of environmental problems does not constitute change of behaviour.EE is aimed at ensuring people are educated on the environmental issues affecting them, a change in behaviour as well as values towards having a better environment and lifestyle.

The UNESCO-UNEP (1987) agreed that Environmental Education to improve awareness especially in schools should simultaneously attempt to create in-depth comprehension of both the local and outside environment for appreciation and protection of both fauna and flora in the quest of promoting sustainable development. This should be done through transmission of information, teaching knowledge, developing habits and skills, promoting values, providing criteria and standards and presenting guidelines for problem-solving and decision-making.

Environmental awareness through both formal and informal education, therefore, aims at both cognitive and affective behaviour modification. The latter necessitates both classroom and field activities and the former comprehension of environmental issues. This is an action-orientated, project-centered and participatory process leading to self-confidence, positive attitudes and personal

commitment for environmental protection. Furthermore, the process should be implemented through an interdisciplinary.

2.4.0 Environmental Education and Mining-African context.

2.4.1 Nigeria Environmental Education Activities

Environmental Education is a major strategic approach of the Nigerian Conservation Foundation (NCF). Its main objective is that of promoting environmental education and awareness in all societies in Nigeria.NCF embraced three major thematic interventions to achieve the main objectives of environmental education. The thematic environmental intervention include a Nationwide Schools Conservation Programme; Community Based Education at Nigeria Conservation Fund Project sites and Promotion of environmental learning through publications, education materials and environmentally related events and campaigns. Highlights of events and activities of the Environmental Education Programme include World Wetland Day, World Environment Day, among others which the pupils from schools also take part so as to make them understand the importance of the events and that of the environment.

School Programmes that involve conservation clubs, continued to be an effective tool in the promotion of environmental education in Nigeria. Through this nationwide network of conservation clubs in schools, NCF has created awareness on environment and continue to sensitize the young on how to be responsible to their environment. These programmes have greatly promoted Environmental Education in Nigerian schools. In Africa, environmental awareness programmes, have been prevalent in a number of countries such as Sudan, Uganda and Egypt. (Adams, 2006).Suffice to comment here that Adams does not mention if these awareness programs do involve all the stakeholders from planning right up to implementation stage as mere awareness may not change the peoples' mind sets as compared to a situation where they fully participate.

2.5.0 Environmental Education and mining - Zambian context.

This section gives a review of the negative effects of mining, laws and regulations in the environment and mining sector as well as EE activities to address those effects are also highlighted.

2.5.2.1 Negative effects of mining on the Environment

2.5.2.1.1 Effects of mining on Land.

Deforestation: Mining requires large areas of land to be cleared so that the earth could be dug into by the miners. For this reason, large-scale deforestation is required to be carried out in the areas where mining has to be done. Besides clearing the mining area, vegetation in the adjoining areas also needs to be cut in order to construct roads and residential facilities for the mine workers. The human population brings along with it other activities that harm the environment. For example, various activities at coal mines release dust and gas into the air. Thus, mining is one of the major causes of

deforestation and pollution (Australian Bureau of Statistics,2000).

Loss of Biodiversity: The forests that are cleared for mining purposes are home to a large number of organisms. Indiscriminate clearing of the forests leads to loss of habitat of a large number of animals. This puts the survival of a large number of animal species at stake. The cutting down of trees in itself is a big threat to a number of plants, trees, birds and animals growing in the forests. **Soil Pollution:** Most of the soils in the mining areas more especially those nearby the mines have undergone or most likely to undergo serious pollution. Among the possible causes of soil pollution are mine slimes, mine slag, tailings, chemical effluents, acid water and other indirect causes such as burning. The contamination of soils unfortunately does affect the plants and animals that are found therein.

Noise pollution: The mine equipment through blasting, drilling and traffic movements is a source of noise around the mine areas as well as to the residents in the nearby settlements**.** This noise is very rampant in the night when people are sleeping while mining activities are intensified, hence giving rise to headache and insomnia (AREZ, 2005).

2.5.2.1.2 Effects of mining on water

Water Pollution.

Pollution: Chemicals like mercury, cyanide, sulfuric acid, arsenic and methyl mercury are used in various stages of mining. Most of the chemicals are released into nearby water bodies and are responsible for water pollution. In spite of tailings (pipes) being used to dispose these chemicals into the water bodies, possibilities of leakage are always there. When the leaked chemicals slowly percolate through the layers of the earth, they reach the groundwater and pollute it. Surface run-off of just soil and rock debris, although non-toxic, can be harmful for vegetation of the surrounding areas.

Loss of Aquatic Life: Release of toxic chemicals into the water is obviously harmful for the flora and fauna of the water bodies. Besides the pollution, mining processes require water from nearby water sources. For example, water is used to wash impurities from the coal. The result is that the water content of the river or lake from which water is being used gets reduced. Organisms in these water bodies do not have enough water for their survival (ABS, 2002).

Danger to human life: Sometimes the liquid waste that is generated after the metals or minerals have been extracted is disposed in a mining pit. As the pit gets filled up by the mine tailings, it becomes a stagnant pool of water. This becomes the breeding ground for water-borne diseases causing insects and organisms like mosquitoes to flourish (ABS, 2002).

2.5.2.1.3 Effects of mining on air quality

Air Pollution: Air pollution is one other serious effect of the mining operations. Smoky substances are prominent in the air in all the mining areas. This clearly showed that there was some toxic gases released from the mining activities in this case sulphur dioxides. Air should be colourless but this is not the case in mining townships. This sulphur dioxide gives rise to serious human health problems. This sulphur dioxide is hazardous to people's health, ecosystem, vegetation as well as infrastructure.

The effect of sulphur dioxide on vegetation is that when sulphur dioxide gas enters the intercellular tissue, it reacts with water to give sulphite ions which are 30 times as destructive as sulphate ions. The initial symptoms are darkening of the affected parts of leaves followed by flaccidity indicating

the internal breakdown of the cell structure and dying out to white dead tissue. The long term effect of sulphur dioxide on plant community can be quite significant. (AREZ, 2005).

Effects of mining on the environment may not be evident immediately; they are usually noticed after some years. Although the developed countries have tight norms regarding mining, such rules can be easily flouted in countries which lack strict monitoring of the procedures being followed for mining. The effects in such cases can be devastating for the environment. This highlights the fact that issues like mining's effect on the environment are worth some serious deliberation (MCA, 2002). Lorenzoni et.al (2005:6) supports this assertion by contending that "the risks that kill you are not necessarily the risks that anger and frighten you…but those that you might be less aware of because they accumulate over time and by the time they manifest, it might be too late". This is more reason why this research aimed at involving people through EE so that they are better placed to prevent the risks that come along with mining as they may cause irreversible health effects when discovered later.

2.5.2.2 Legislation on the Environment and Mining

Various pieces of legislation related to environmental management and protection as well as protection is in place in Zambia to try and minimize the effects on the environment from different

activities including mining. The following are some of the acts in place:-

- The Environmental Management Act No. 12 of 2011 and its subsidiary regulations;
- The Mines and Minerals Development Act and subsidiary regulations;
- The Public Health Act
- The Energy Regulation Act
- The Land Act;
- The Explosives Act;
- The Town andCountry Planning Act;
- The Forest Act;
- The Zambezi River Authority Act

- The Electricity Act; and
- The National Heritage and Conservation Commission Act.

The Environmental Management Act (EMA) is the principal legislation governing environmental management in Zambia. The act provides for the continuation and renaming of the Environmental Council of Zambia (ECZ) as ZEMA. The Agency is mandated to ensure the sustainable management of natural resources and protection of the environment and the prevention and control of pollution.

The Mines and Minerals Development Act, 2008 provides for the control of mining activities with regard to environmental protection.

It should be echoed here that for mining projects in Zambia, Environmental Impact Assessments are Mandatory .One would be made to wonder as to whether or not these assessments are properly done or not because the impacts are still a common phenomenon in mining areas.

Laws are there in place but are they being adequately implemented? This research through EE further equips the community members in Maamba with knowledge on how mitigative measures can be put in place including adherence to laws that are in place to protect the environment and all things therein.

2.5.2.3 Environmental Education Activities in Zambia

Environmental Awareness in Zambia is strengthened by the increase in the number and quality of environmental education and awareness campaigns and activities including environmental articles in the print media, environmental programmes aired on radio and television. The Inclusion of environmental education in training courses for journalists is good evidence of increased environmental awareness among the public in Zambia. Other activities include the formation of clubs in schools such as Chipembele club on world life related issues as well as the Mundawanga botanical gardens where people learn more about EE. The keep Zambia clean and green campaign activities also play a key role in educating the society on the need to live sustainably.

At the primary level, pupils learn environmental issues in science and social studies. At secondary level in Zambia, environmental issues are learnt in Geography and Biology. At tertiary level, the highest institution of learning, University of Zambia, Great East Campus offers environmental courses in the School of Natural Sciences, Department of Geography and the School of Education has designed a special Programme that concentrates on Environmental Education increasing the environmental awareness programmes in the country. All these programmes are meant to make it possible to disseminate the environmental knowledge to the people of Zambia so that they begin to appreciate environmental sustainability.

Despite all the activities mentioned, Zambia continues to face environmental problems. The major problem worth pointing out here is that the people at the grassroots are not fully involved hence a negative attitude towards some of these programmes and so the donors of these activities ought to find better strategies to ensure these programmes are community based. Previous researchers in related work such as Kangwa (2008) and Chipatu (2006) have been simplistic in their approach in that they did not clearly explain how people at the grassroots have been involved right from the planning stages of the EE programmes. This study emphasizes on involving people from the planning stages of all EE programmes. By so doing the objectives of EE will fully be addressed hence having a nation that will not only be aware but be able to prevent some of the Environmental problems faced in their respective communities such as negative effects of mining.

Suffice to mention here that effects of mining on the environment may not be evident immediately; they are usually noticed after some years. Although the developed countries have tight norms regarding mining, such rules can be easily flouted in countries which lack strict monitoring of the procedures being followed for mining. The effects in such cases can be devastating for the environment. Be it due to ignorance of the regulations or just a freak accident. This highlights the fact that issues like mining's effect on the environment are worth some serious deliberation.

2.6 Summary

The Chapter discussed in detail literature on Environmental Education and mining from Global, African to Zambia perspective. It has been observed that there are programs in place World over to embrace EE in a bid to reduce environmental Problems. However, in most cases it has not been stated clearly how the people at the glass roots are involved. This study clearly indicated how people at the grass roots, in this case the Maamba residents have been involved in coming up with programs that will help reduce the negative effects of mining.

Previous studies that have been done on mining in Zambia have all concentrated on the negative effects of mining on the environment on the Copperbelt Province of Zambia overlooking other mining areas in Zambia such as Maamba. These among others include Mopani Copper Mine (2004), Kangwa (2008), Chipatu (2011) and Muchanga (2009).The record of how many researchers have been to Maamba to use Environmental Education as a tool to address negative effects of mining remains unknown to date. The use of EE to address these problems and inclusion of people at the grassroots to plan, implement and also to evaluate the programmes have also been inadequately addressed in most cases. It is for this reason that the study concentrated on Maamba Township to use EE as a tool to address the negative effects of coal mining.

CHAPTER THREE

METHODODLOGY

3.1 Introduction

This chapter explains the methodology and structure used. These being research design, targeted population, sampling procedures, sample size, research instruments and data analysis.The study predominantly used a qualitative research methodology. Interview guides were used to get views from EE providers. Information from residents came from questionnaires. The collected data was analysed qualitatively.

3.2 Research design

Orodho (2003) defines a research design as the scheme, outline or plan that is used to generate answers to research problems. The study employed a descriptive survey. The major purpose of a descriptive research is description of the state of affairs as it exists. Descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals (Orodho, 2003).The study aimed at collecting information from the respondents on their opinions in relation to the negative effects of Coal mining in Maamba Township by interviewing and administering questionnaires to a sample of respondents. Qualitative method was used in order to obtain the most accurate and realistic picture of the problem situation. The research employed three qualitative methods of data collection; semi-structured interviews focus group discussions and observation. The qualitative approach allowed for in-depth interviews in one to one and Focus Group Discussions (FGDs). The data collected was used to generate frequencies, bar charts and pie charts.

3.3 Target Population

A population is a group of individuals, objects or items from which samples are taken for measurement. (Kombo, 2006).The target population for this study comprised people from all walks of life living in Maamba. These included the Head teacher, Deputy Head teacher, teachers, and pupils from both Maamba primary and secondary school. Some were environmentalists from Maamba Hospital, Safety Department officers of Maamba Collieries Limited and Maamba residents.

3.4 Research Sample size

A sample is a finite part of statistical population whose properties are studied to gain information about the whole (Webster,1985).The sample size comprised ten (10) people from EE providing institutions in Maamba and 90 residents from Maamba Township.

3.5 Sampling Techniques

Maamba Township was chosen based on purposive sampling as it is a recognized mining town. Sampling is a procedure a researcher uses to gather people, places or things to study. (Kombo, 2006). The ten (10) people from EE providing institutions were selected purposively. The other ninety (90) residents were selected using convenient sampling methods. The researcher toured various parts of the township and was administering questionnaires depending on availability and willingness to participate of the researched.

3.6 Research instruments

The instruments that were used to collect data from the field were semi-structured interview guides, questionnaires, focus group discussions, documental analysis schedule and observation schedule. Semi-structured interview guides were used so as to enable respondents to express themselves further where the researcher needed more information. Observation schedule helped the researcher to compare what the respondents were writing and what they were actually doing.

Primary data collection.

3.6.1 Semi-structured interview guides

These were used to get data through interviewing the EE providers.

3.6.2 Focus Group Discussions (FGDs)

Two groups of eight discussants were selected purposively from the residents bringing the total to sixteen. These included teachers, pupils, miners and clinical officers. Questions were asked in an interactive-group setting. Focus group discussions require a lot of skill and tact. This skill was applied so as to handle various people that were in the group such as introverts and the self appointed

spokes-persons.

3.6.3 Semi structured questionnaires

These were administered to the residents. Questionnaires were given to the respondents by the researcher and the assistant to make sure clarifications were made where respondents had difficulties in comprehending. Open and closed ended questions were asked so as to solicit for in-depth data.

3.6.4 Observation schedule

This data collection technique was also used as the researcher went round Maamba Township to see how the surroundings were as well as the non verbal behavior of the residents. The researcher physically went into the field to observe people's activities and effects of mining on Maamba Township. Unstructured observation guide was used to help understand behaviour patterns of the Maamba residents. Observations made it possible for the researcher to observe non verbal behaviour which is important in validating the respondent's answer as new data became known.

Secondary data collection.

3.6.5 Document analysis schedule

This involved reading the existing literature. Books, magazines, journals and many other written materials were used to help in the interpretation and discussion of data in the study. The documents that were analyzed were those that have information on Environmental Education and awareness in Zambia and the world over.

3.7 Data analysis

The data collected was analyzed qualitatively. Thematic analysis was employed where the analysis of data began during data collection exercise by arranging field notes according to the themes in relation to the objectives that were set. Verbatim was also used for data collected using semi-structured interviews and some extracts from focus group discussions.

3.8 Ethical Considerations

The purpose of the research was explained to the respondents in order to gain voluntary involvement.

The researcher sought written consent from the University of Zambia in order to carry out this study.

Respondents were also assured of high confidentiality. They remained anonymous and were not required to indicate their names as a way of respecting their privacy. They were further rest assured that the information provided was strictly for academic purposes only.

3.9 Validity issues

This refers to the degree to which the study conclusions based on the findings are empirically comprehensive. A pilot survey to test the instruments such as the questionnaires was conducted to Maamba residents and it was evident that the instruments were reliable and valid.

3.10 Scope of the Study

The scope of the study was confined to the Mining industry in Maamba Township of southern Zambia. The study focused on Environmental Education's role in addressing the effects of coal mining. The study further investigated if at all any institution was offering Environmental Education to the residents of Maamba on the negative effects of coal mining.

3.11 Summary

The chapter has discussed the methodology adopted in the study. It gave an explanation on the research design chosen and its relevance to the study. The Chapter also looked at a combination of sampling techniques applied in the study, key informants and research instruments used in data collection. In conclusion, the chapter discussed analysis procedures, ethical considerations and scope of the study. The following chapter presents findings of the study.

CHAPTER FOUR

PRESENTATION OF RESEARCH FINDINGS

The data derived from the research objectives and research questions were used to present findings of this study.

4.1 Introduction

This chapter presents findings of the study. The presentation of data refers to ways of arranging data to make it clearly understood (Kombo and Tromp, 2006). Thus, the purpose of data presentation in this chapter is in a bid to provide answers to the research questions set. Findings were obtained qualitatively using observations and interviews. Tables, graphs and percentages were also used. The most significant categories are represented by the views of the respondents that were in the majority. The results of the study are presented under subheadings derived from the study objectives and research questions. These include personal details of the respondents, Role of EE, Availability of EE and alternative forms of EE.

Findings are presented as follows;

4.2 Personal information of the Respondents.

4.2.1 Gender of Respondents

Findings of the details of the respondents are given in the table 1.

Table 1. Gender of respondents

Gender	Frequency	Percentage %
Male	**53**	**53**
Female	**47**	**47**
Total	**100**	**100**

Source: Field Data, 2016

The data collected from table 1 above indicated that fifty three percent (53%) were males whereas forty seven percent (47%) were females. The gender of the respondents was considered so as to strike a balance as both sexes are interdependent in national development. More so, that both were to give their views on the alternative way in which they would prefer EE to be delivered to them. Having dealt with gender of the respondents, the next point presents their age.

4.2.2 Age of Respondents

The ages of all the respondents are shown in table 2.

Table 2. Age of respondents

Age of respondents	Frequency	Percentage %
15 – 30	**32**	**32**
31 – 40	**24**	**24**
41 – 50	**25**	**25**
51 and above	**19**	**19**
Total	**100**	**100**

Source: Field Data, 2016

The data on age was very important as it helped to come up with appropriate ways of delivering EE to people of different ages. All the age groups that could respond were accorded the chance to participate in the research exercise as follows; thirty two percent (32%) were between 15 and 30 years, twenty four percent (24%) came from 31 to 40 years, twenty five percent (25%) were from the age group of 41 to 50.Those with fifty one years and above were nineteen representing 19%.

Having tabulated the age of the respondents, the next item dealt with respondents' education level.

4.2.3 Educational level of respondents

The education levels of all the respondents are shown in table 3.

Table 3. Educational level of respondents

Education level attained	Frequency	Percentage %
Primary	**23**	**23**
Secondary	**37**	**37**
Tertiary	**40**	**40**
Total	**100**	**100**

Source: Field Data, 2016.

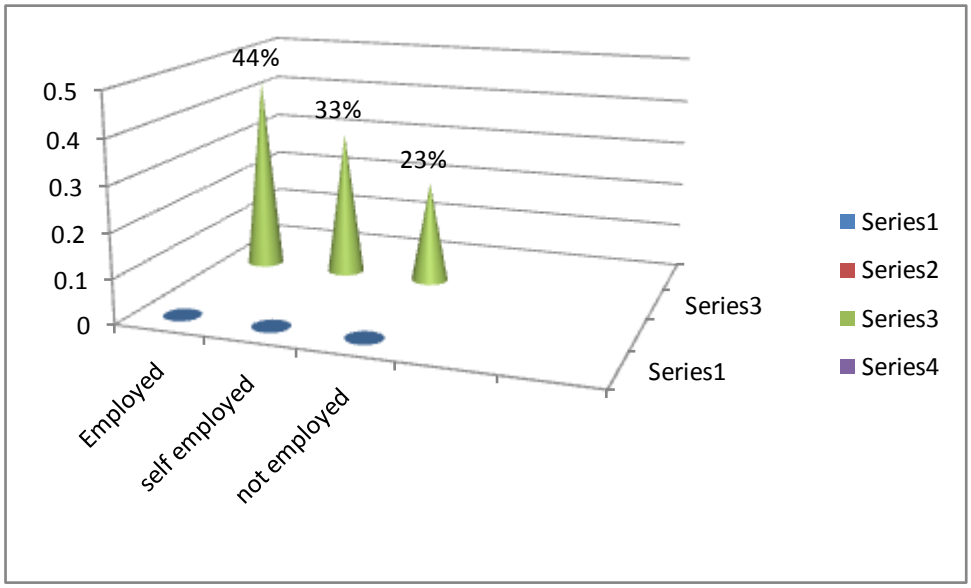
The educational level of the respondents was very important as the ideas obtained provided the researcher with guidance on how best EE could be given to the residents since a larger percentage of the respondents had attained education up to tertiary level. All the respondents could answer the questions since they all had attained some education. Out of one hundred respondents interviewed through questionnaires, twenty three percent (23%) attained primary level, thirty seven percent (37%) attained secondary level and forty percent (40%) attained tertiary level.

Having looked at the respondents' education levels, the next item presents their occupations.

4.2.4 Occupation of Respondents

Information on the respondents' occupation is shown in figure 1.

Figure 1. Occupation of respondents.



Source: Field Data, 2016

From figure 1 above, Findings from the questionnaires on the respondents' occupations reviewed that forty four percent (44%) were employed. Thirty three percent (33%) were self employed whereas twenty three percent were unemployed. The employed respondents were mostly civil servants such as teachers, council workers and medical personnel. Others were miners and Non Governmental Organizations (NGOs) officers. Those in self employment were mostly fish mongers and make shift stores (Tuntembas) proprietors whereas the unemployed were mostly grade twelve school leavers and graduates from colleges and Universities respectively. Knowing the economic status of the respondents was very cardinal as it helped in coming up with a suitable EE programme.

The next segment presents data on the respondents' period of stay in Maamba Township.

4.2.5 Period of stay in Maamba by Respondents

The respondents were asked to indicate on the questionnaires the period they had lived in Maamba Township and the responses are shown in table 4.

Table 4. Respondents' period of stay in Maamba.

Period of stay	Frequency	Percentage %
Less than 1 year	17	17
1 – 5 years	19	19
6 – 10 years	26	26
11 years and above	38	38
Total	100	100

Source: Field Data, 2016

Findings on how long the residents had lived in Maamba reviewed that seventeen percent (17%) had lived in Maamba for less than a year. Nineteen percent (19%) had lived in Maamba for 1 to 5 years respectively. Twenty six percent (26%) had lived in Maamba for a period of 6 to 10 years while thirty eight percent (38%) had lived in Maamba for a period of 11 years and above.

Having presented findings of personal details of the respondents, the next segment presents findings on the information about Environmental Education (EE) activities and its provision.

4.3 Role of Environmental Education.

In line with objective number one, the respondents were asked whether they understood the terms Environment and Environmental Education.

4.3.1 Understanding the term "Environment"

The respondents in the questionnaires were asked what they understood by the term "environment".

The responses are shown in table 5.

Table 5. Respondents' understanding of the term "environment".

Understanding the term "Environment"	Frequency	Percentage %
Had idea	**91**	**91**
No idea	**09**	**09**
Total	**100**	**100**

Source, Field Data, 2016

From table 5 above, out of one hundred respondents, ninety one percent (91%) had an idea of what the term "Environment" was whereas nine percent (9%) seemed to have no idea. The ninety one respondents related the term "environment" to surroundings. During focus group discussions, the discussants were also asked to explain what the term environment meant. One pupil stated that the environment is the surroundings where we live and all things in it e.g. plants, animals and rivers. However, some discussants seemed to have no idea at all. Understanding the term was cardinal in that it helped the researcher in coming up with an alternative way of offering EE since learners acquire skills and values easily when they already have an idea of what is to be learnt.From the researcher's observations, it was evident that the majority of the respondents had an idea of what the environment was all about since they stressed with emphasis and cited practical examples when responding.

4.3.2 Knowledge about Environmental Education

The respondents' understanding of Environmental Education is shown in table 6.

Table 6. Respondents' understanding of Environmental Education

Respondents' Understanding EE	Frequency	Percentage %
Had an idea	**69**	**69**
Had no idea	**31**	**31**
Total	**100**	**100**

Source: Field Data, 2016

Respondents from questionnaires were asked on knowledge about EE.Findings revealed that sixty nine percent (69%) of the respondents had an idea whereas thirty one percent (31%) completely had no idea of what EE meant. From focus group discussions, a miner under safety department said:

> Environmental Education is the type of education where one learns about their environment, how to protect or safe guard oneself and all the things found in the environment.

From the observations, the researcher noticed that the EE that the residents talked about was merely on paper and not in reality since heaps of uncollected garbage was visible around their homes, some of their homes were just next to where mines dump waste. Polluted water was also used to water their backyard gardens.

This information was very important as it greatly helped to come up with content and methods that would make the respondents fully understand EE hence understanding all the environmental problems they would face and be in a position to prevent them.

4.3.3 Environmental problems experienced in Maamba

The respondents from the questionnaires, cited air, water and land pollution as major problems they faced as a result of the mining operations. They also mentioned poor sanitation, coughing, sneezing and poor refuse disposal. The other form of air pollution apart from that which emanated from the mines was dust from the township roads which are being used by mine trucks to ferry heavy equipment for the new thermal plant which is under construction. One of the residents from the focus group discussions Mr.Mweemba was quoted as saying *''Tulapenga kuno ku Maamba akambo ka lusuko luzwa ku myota itola zibulo ku Mine''*. Meaning we suffer a lot here in Maamba owing to the dust emanating from vehicles that take some equipment to the mines. Another discussant from Focus groups was quoted saying:

> The other problems we face in Maamba are coughing, sneezing, chest pains, polluted streams where we get water for household use and our backyard gardens and poor refuse disposal.

In line with the second objective, this section shows the availability and types of EE programmes.

4.4 Availability and Types of EE Programmes

Respondents were asked whether EE programmes were available to them.

Table 7. Availability of EE programmes

Response	Frequency	Percentage %
EE being offered	**30**	**30**
EE not being offered	**70**	**70**
Total	**100**	**100**

Source, Field data, 2016

Findings on the provision of EE showed that out of one hundred respondents, thirty percent (30%) agreed that it was being offered to them while seventy percent denied receiving any EE.

One discussant was quoted saying; *I have lived in Maamba for a long time now and i completely have no idea as regards any EE programs being offered to us. Probably it is being offered at the mining premises only.* After an interview with MCL environmentalists it was made clear that EE was offered to the miners at the mine area and this was not yet implemented in the township to the other residents. The EE being referred to by those who agreed receiving EE was that which was being provided by health personnel, Rural Council and some NGO's though these did not elaborate on the negative effects that the mines caused to the residents, land, animals and water.

As for the miners, they said that safety in the mines was being taught to them at work. One discussant was quoted as follows:

> We have a programme at Maamba Collieries under safety department where we are sensitized on issues to do with the environment such as effects of mining on the environment. This is however, not offered to the residents.

4.4.1 Issues covered when offering Environmental Education to Maamba residents.

On the topics covered, the respondents that had agreed receiving EE said they learnt things such as prevention of malaria and cholera refuse disposal and indiscriminate cutting down of trees. One EE provider from focus group discussions, a clinical officer said:

> Environmental Education is being offered to the general public as they come to Maamba Hospital. The topics that we teach are prevention of malaria, cholera and how to dispose of refuse in order to prevent diseases.

These topics guided the researcher as to which topics to include in the alternative EE programme.

4.4.2 Language used when teaching Environmental Education to the residents.

It was revealed from the focus group discussions that the methods that were used to offer EE to the residents who claimed to receive EE were health talks by experts, mobile radios (Keep Zambia Clean campaigns) and group discussions. One discussant said:

> We learn EE through health talks at the clinic from health personnel and sometimes a vehicle goes round the township with people from the councils to teach us using the microphone how to keep our environment clean. This is usually done in English and Tonga as they were the common languages spoken in Maamba Township.

From the observations, it was clear that the content of EE that was given to Maamba residents did not include Negative effects of mining and the methods used to them were not appropriate.

This information on the methods and languages used were very useful to the researcher as it gave guidance on which methods and languages would be best suited in delivering the alternative form of EE to the residents.

4.4.3 Participation In and Environmental Education activities by Maamba residents.

Findings from questionnaires on participation indicated that thirty percent (30%) of the respondents were involved in EE activities while seventy percent (70%) said they were not involved at all. Those who claimed to be involved cited tree planting, spraying of houses, garbage management and Neighborhood Health Committees (NHCs) as some of the activities they were involved in. The entire respondents denied being involved in planning and evaluation of EE programmes. A teacher from the focus groups said:

> This new Management at Maamba Collieries has nothing to do with us the residents as compared to the previous management in terms of incorporating us in programmes that concerns our health. We are not involved in any EE activity as residents since Maamba Management's interest is the co business of maximizing on profit.

From the observations made by the researcher, Maamba residents did not actively participate in EE activities for instance, they did not plant any trees as they claimed to have been taught but instead concentrated on backyard gardens with vegetables only.

This information was also useful to the researcher as it guided on how the alternative programme would involve all the residents from the planning stage to implementation and evaluation if at all the alternative EE programme was to be viable.

4.4.5 Extent of coverage by Environmental Education.

On ways of avoiding negative effects, ninety percent (90%) of the residents said the EE offered did not cover ways of avoiding effects of coal mining on the resident, soil, water, air and animals. Only ten percent agreed that the EE provided covered ways of avoiding these effects.

One discussant was quoted saying; *we do not have and have never had any EE programs to sensitize us as residents on the negative effects of coal mining on our health and our surroundings*.

This information was equally very important as it formed the basis of the study. It guided the researcher on the content to be included on the alternative way of providing EE to the residents.

Having presented the respondent's understanding and provision of Environmental Education, the next segment which is in line with objective number three present findings on alternative ways of using Environmental Education to address negative effects of coal mining.

4.5 Alternative forms of EE

The respondents were accorded a chance to suggest how best EE could be provided to them.

4.5.1 Maamba residents' Interest in learning and teaching Environmental Education on negative effects of mining.

Research findings from questionnaires and focus group discussions showed that one hundred percent (100%) were all interested in learning and teaching of EE on negative effects of mining. This information was useful and equally formed a basis of an alternative way of offering EE to the residents.

4.5.2 Proposed topics to be covered in Environmental Education

Responses on the proposed topics are shown in table 8.

Table 8. Proposed topics by Maamba residents

Proposed topic	Frequency	Percentage %
Pollution of water, soil and air	**88**	**88**
Waste Management	**06**	**06**
Sanitation	**06**	**06**
Total	**100**	**100**

Source: Field Data, 2016

The respondents were asked to suggest some of the topics they wanted to be included in the alternative EE programme. The topics suggested were pollution (water, air and land) waste management and sanitation. Eighty eight percent (88%) of the respondents proposed pollution, six percent (6%) proposed sanitation, and another six percent (6%) proposed waste management.

From the interviews more than fifty percent of the respondents were for the idea that negative effects of coal mining are addressed as well.

4.5.3 Preferred ways of teaching Environmental Education proposed by residents

This information was very useful in designing a new EE programme which would use the suggested ways of teaching residents.

This information is shown in table 9

Table 9. Preferred ways of learning EE by residents.

Prefered way of learning EE	Frequency	Percentage %
Discussions	**40**	**40**
Lecture	**10**	**10**
Role plays	**10**	**10**
Radio and Television	**20**	**20**
Posters and Charts	**20**	**20**

Source: Field data, 2016

Findings obtained from questionnaires reviewed that the respondents suggested discussions with experts and fellow residents, lectures by resource personnel, radio programmes, posters, charts and role plays as preferred ways of learning. One discussant from focus group said;

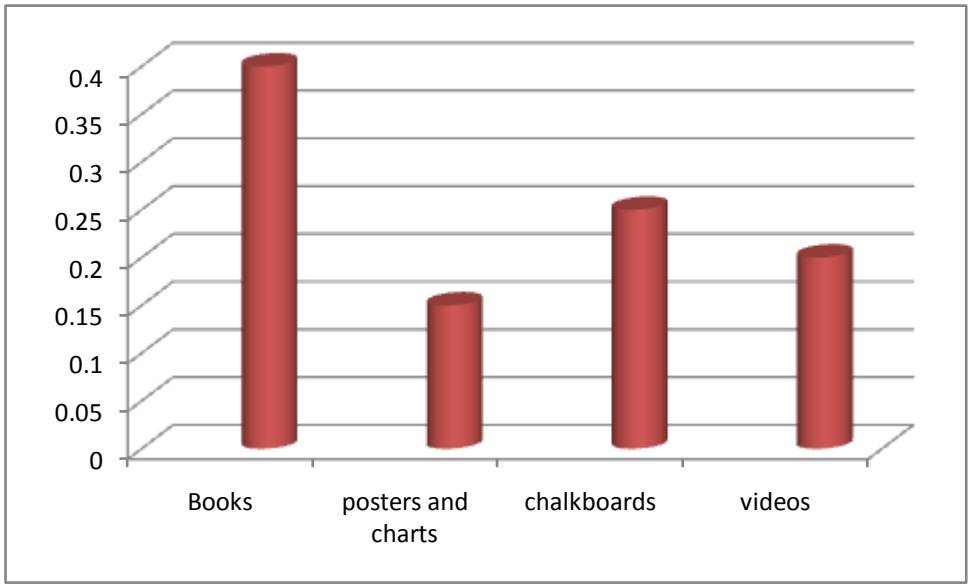
> Management from the Mines must engage us into discussions from time to time to sensitize us on Environmental issues. We can also be put in small groups to dramatize what we've learnt and this can be showcased to other residents on special days such as Independence day, Labour Day and youth day.

4.5.4 Proposed best teaching and learning materials to be used in Environmental Education

Respondents were asked to propose teaching and learning materials.

This information is shown in figure 2

Figure 2. Proposed teaching and learning resources by respondents.



Source: Field Data, 2016

Respondents were accorded a chance to suggest best teaching and learning resources for the alternative EE programme. Forty percent (40%) of the respondents favoured the use of books, Fifteen percent (15%) suggested posters and charts, Twenty five percent (25%) suggested chalkboards and twenty percent (20%) chose videos.

4.5.5 Suggested ways of evaluating the achievements attained in Environmental Education.

From the questionnaires, respondents were asked to suggest ways of evaluating EE

This is shown in table 10.

Table 10.Preferred evaluation methods by the respondents.

Suggested evaluating mode	Frequency	Percentage
Tests	**35**	**35**
Questionnaires	**50**	**50**
Physical checking	**15**	**15**
Total	**100**	**100**

Source: Field Data, 2016.

Findings on suggested ways of evaluating EE showed that thirty five percent (35%) of the respondents favoured writing tests while fifty percent (50%) preferred questionnaires. Fifteen percent (15%) preferred physical checking or monitoring.

4.6 Summary

The chapter has presented the compiled data that was collected and justified the purpose of data presentation. The chapter used interviews, focus group discussions, observations, graphs, charts, tables and verbatim to present the data that was gathered. Research findings revealed that Maamba residents did not receive EE regarding negative effects of coal mining. The study also found that these residents were not involved in planning and implementation of programmes concerning environmental problems that were being faced in Maamba. The next chapter discusses findings after examining the data that has been presented.

CHAPTER FIVE

DISCUSSION OF FINDINGS

This chapter presents the discussion of research findings that were presented in the previous chapter.

5.1 Introduction

These findings have been reached at after employing the appropriate data analysis procedures discussed in chapter three. Findings are discussed in light of the objectives and the research questions set in chapter one of this dissertation and at the same time, they are acting as subthemes of the discussion. These discussions will help to come up with an understanding of the current situation regarding the effects of mining in Maamba Township hence, justifying the need for alternative ways of EE that could be used to address these effects.

The set research questions to be answered were:-

(a) What role does EE play in addressing negative effects of coal mining as a way of improving the environment in Maamba?

(b) What type of EE programmes, if any, are being offered to Maamba residents to address negative effects of coal mining?

(c) In which alternative forms could EE be used to address the negative effects of coal mining in Maamba?

5.2 Personal information of respondents

5.2.1 Gender of Respondents

There were more males with a representation of fifty three (53%) compared to the females who accounted for forty seven percent (47%). This enabled the researcher to have diverse views of the respondents based on gender. The representation by women shows that to date women are unlike in the past where they would leave all decisions concerning what affected them to be made by the male folk. Suffice to mention here that, this representation by women entails easy inculcation of environmental education values and attitudes as the English adage goes “When you educate a woman

you have educated the whole nation". This implies that educated women are more likely to pass on the knowledge they acquire to their children unlike the male folk.

5.2.2 Age of Respondents

As stated in Chapter four, thirty two percent (32%) of the respondents were between 15 and 30 years while twenty four percent (24%) were from 31 to 40 years. Twenty five percent (%) of the respondents came from the age group of 41 to 50 years. Nineteen percent (19%) percent of the respondents came from 51 years and above. The larger percentage of the respondents came from the youth making it very ideal to come up with suitable ways of delivering EE to them as the values and attitudes are better inculcated in the young so that they grow with such values unlike changing someone who is already very old. This is also good assurance that whatever will be learnt will be passed on easily to the coming generations. Age is also a factor when it comes to methods to use when delivering EE as a method for adults may not be ideal for the young ones. This is supported by O'Donoghue (2007) who contends that learners have different learning styles and using a variety of methods increases the chance of everyone learning and also allows a variety of educational purposes and outcomes to be addressed.

5.2.3 Educational level of Respondents

Most of the respondents had some educational background which enabled them to identify some of the problems they faced as a result of the mines. As observed in chapter four, those that attained primary level were twenty three representing twenty three percent (23%) while thirty seven respondents representing thirty seven percent (37%) percent came from the secondary level. Those who reached tertiary level were forty, representing forty percent (40%). Despite the respondents being able to identify the environmental problems faced, it was still recommendable to come up with alternative ways of delivering EE which would not only end with awareness but acquisition of necessary values, skills and attitudes which would enable the learners live by what they will have learnt. One of the objectives of EE stress the acquisition of skills by the learners which will enable them not only be aware of environmental problems, but be able to identify and solve them,(Mohana,2012).Having discussed the respondents educational level, the next item looks at the respondents' occupations.

5.2.4 Occupation of Respondents

As observed from the previous chapter, findings on the respondents' occupation indicated that the employed respondents were mostly civil servants such as teachers, council workers and medical personnel. Others were miners and Non Governmental Organizations (NGOs) officers. Those in self employment were mostly fish mongers and makeshift stores (Tuntembas) proprietors whereas the unemployed were mostly grade twelve school leavers and graduates from colleges and universities. Knowing the economic status of the respondents was very cardinal as it helped in coming up with a suitable EE programme which promotes sustainable use of all activities the respondents would be involved in such as sustainable fishing methods and unpolluted water since the unemployed were mainly fish mongers.

5.2.5 Period of stay in Maamba of Respondents

Findings in Chapter four show that the residents who had lived longer were the majority hence, in a better position to give reliable information regarding the environmental problems and type of EE they had received and also in suggesting one which they would prefer most.

Having discussed findings of personal details of the respondents, the next section discusses findings in line with the first objective on information about Environmental Education (EE) activities and its provision.

5.3 Role of Environmental Education

In line with the first objective, the respondents were asked whether they understood the terms Environment and Environmental Education.

5.3.1 Understanding the term "Environment"

Findings from the questionnaires revealed that more than ninety percent (90%) of the respondents had an idea of what the term "Environment" was. They related the term ''environment'' to surroundings and health. From focus group discussions it was further revealed that respondents understood the term by relating it to the surroundings they lived in. Mohana (2009) defines the environment as ''anything immediately surrounding an object and exerting a direct influence on it''. A similar study carried out by Chipatu (2011) also revealed that one hundred percent (100%) of the respondents had an

understanding of the environment. It must be stated here that the respondents who did not have an idea were in the minority. This could be attributed to lack of exposure or accessibility to information as they were seemingly illiterate. Namafe (2006) gives a critical understanding of the environment using the Development Compass Rose (DCR) by contending that the environment should be understood as an interaction between the physical, social, political, economic and personal perspective. By using the DCR, the environment can be understood in different dimensions. Understanding the term was cardinal in that it helped the researcher in coming up with an alternative way of offering EE since learners acquire skills and values easily when they already have an idea of what is to be learnt.

5.3.2 Knowledge about Environmental Education

Findings from chapter four reviewed that sixty nine percent (69%) of the respondents had an idea whereas thirty one percent (31%) completely had no idea of what EE meant. It was observed that those who had knowledge of EE were mostly those in EE providing institutions such as the Mine safety department which had a deliberate policy to sensitize its staff on Environmental issues. However, this gesture was not extended to the residents in Maamba Township. This information was very important as it greatly helped to come up with content and methods that would make the respondents fully understand EE hence understanding all the environmental problems they would face and be in a position to combat or prevent them. The failure by some respondents to have knowledge of EE could be attributed to scarcity of a comprehensive EE programme in place.UNESCO (1985) agrees with this assertion and outlines a twofold purpose of EE as that of educating citizens capable of being responsible to the environment and make various populations more conscious of the eco-system and social cultural environments they live in and by activities they are engaged into.

5.3.3 Environmental problems experienced in Maamba

The residents attributed the environmental problems they faced to lack of care from the new MCL management. They claimed that new management had done nothing for the residents as compared to the past years when there was corporate social responsibility and all social services were offered freely to the township residents. The respondents cited air, water and land pollution as major problems they faced as a result of the mining operations. They also mentioned poor sanitation,

coughing, sneezing and poor refuse disposal. The other form of air pollution apart from that which emanated from the mines was dust from the township roads which are being used by mine trucks to ferry heavy equipment for the new thermal plant which is under construction.

An interview with one of the trainee environmentalists confirmed the residents' complaints that indeed the MCL management did nothing for the welfare of the residents in terms of reducing effects of mining on them even though they had an Environmental Management Plan (EMP) which was just on paper and not yet implemented. There is need therefore, to educate the residents on human health threats associated with environmental pollution. Lieberman (1998) suggests that outdoor learning gives special attention to providing information on how pollution affects children and how human exposure to pollutants can be minimized in order to preserve good health. Related studies by Kangwa (2008) on the Copperbelt Mines equally show that mining communities were affected by the mines with environmental problems such as air pollution, water pollution, land pollution. On the contrary to study findings from Maamba, Copperbelt Mine communities were actively involved in Mine programmes and supported when it came to corporate social responsibility.

Suffice to mention here, that these environmental problems arising from Mining could be curtailed by educating residents in mining communities through EE as they will acquire knowledge that will help combat these problems.

In the context of the second objective, the next segment discusses the availability and types of EE programmes.

5.4 Availability and types of EE programmes

On the provision of EE, thirty percent (30%) of the respondents agreed that it was being offered to them while seventy percent (70%) denied receiving any EE. After an interview with MCL environmentalists it was made clear that EE was offered to the miners at the mine area and this was not yet implemented in the township to the other residents. The EE being referred to by those who agreed receiving EE was that which was being provided by health personnel, Rural Council and some NGO's though these did not elaborate on the negative effects that the mines caused to the residents, land, animals, air and water. In a related study by Chipatu (2006), there was equally a mismatch on the responses from the researched regarding availability and types of EE programmes in place. This gave an indication that there were no serious programmes offered to residents in mining towns to

sensitize them on the negative effects of mining. Suffice to mention here that lack of such knowledge deters people from changing their attitudes and being alert to environmental issues that affect them hence living in danger. On the contrary Environmental Protection Agency of the USA put in place a grant programme which funds EE projects that increase public awareness about Environmental issues and provide them with skills to take responsible action to protect the environment (EPA,1999). EE is seen as the only way of developing an awareness of the environment and it is the most effective vehicle for persuading the human race to adopt a rational attitude towards the natural environment and avoid the deterioration of human life as a result of unwise exploitation and misuse of nature (Otiende,1997).This information was vital as it helped to come up with an alternative EE programme which would be comprehensive and stand the test of time in terms of changing the people's attitudes on the environmental issues that affect them. There is urgent need therefore that residents are aware of the environmental problems they face as the repurcations may be great in future. Lorenzoni et.al (2005:6) supports this assertion by contending that "the risks that kill you are not necessarily the risks that anger and frighten you…but those that you might be less aware of because they accumulate over time and by the time they manifest, it might be too late".

Provision of Environmental Education to Maamba residents in this regard is inevitable as Mohana earlier alluded that it is only Environmental Education that a new global ethnic can be developed and an environmentally literate population created.

5.4.1 Issues covered when offering Environmental Education to Maamba residents.

The issues which were cited by the respondents included prevention of malaria and cholera, refuse disposal and indiscriminate cutting down of trees. As for the miners, they claimed safety in the mines was being taught to them at work. It was evident from this information that the topics and issues tackled did not include negative effects of mining on the residents, soils, water and animals. World Bank (2003) contends that the majority of residents in the mining communities had information on issues such as maintaining clean surroundings except on mine pollution these topics guided the researcher as to which topics to include in the alternative EE programme.

5.4.2 Language used when teaching Environmental Education to the residents.

It was learnt from findings in chapter four that the methods that were used to offer EE to the residents who claimed to receive EE were health talks by experts, mobile radios (Keep Zambia Clean campaigns) and group discussions. The languages used were mainly English and Tonga. This information on the methods and languages used were very useful to the researcher as it guided on which methods and languages would be best suited in delivering the alternative form of EE to the residents. The use of local language added value to the study as the researcher used it where the respondents had little understanding of English. This was evident that once their local language is embraced then they will be eager to participate in all the activities that will be lined up in the alternative EE programme to be availed to them.

5.4.3 Participation In and Environmental Education activities by Maamba residents.

Findings reviewed that thirty percent (30%) of the respondents were involved in EE activities while seventy percent (70%) were not. Those who claimed to be involved cited tree planting, spraying of houses, garbage management and Neighborhood Health Committees (NHCs) as some of the activities they were involved in. All the respondents denied being involved in planning and evaluation of EE programmes. This was also useful to the researcher as it guided on how an alternative programme would involve all the residents from the planning stage to implementation and evaluation if at all the alternative EE programme was to be viable. The residents would feel part of the programme if they are involved right from the beginning of any given programme. If not involved they don't feel part of the programme as they see it to be alien as was the case in Maamba as regards to EE programmes. There is need for community based programmes. Mohana (2009) supports this by emphasizing that one of the guiding principles of Environmental Education is to enable learners to have a role in planning their learning experiences.

Implementation of the environmental values among the young and other people in society can be carried out by giving them the experience through activities which promote team work. In this regard, there are some ideologies and philosophies such as "green consumerism" by the consumer association and "green chemistry" that were introduced by the chemists in order to reduce the effect of environmental damage (Richards, 1999). All these can be achieved through the introduction of Environmental Education and awareness programmes in the society.

5.4.4 Extent of Coverage by Environmental Education provided covering ways of avoiding effects of coal mining on residents, soil, water, air and animals.

As observed in Chapter four, ninety percent (90%) of the respondents said EE that was Provided did not include ways of avoiding effects of coal mining on the residents, soil, water, air and animals.

After focus group discussion it was evidently clear that there was no EE given to Maamba residents regarding ways of avoiding negative effects of Coal mining on the environment.

This information being the basis of the study greatly helped the researcher in coming up with content to be included in the alternative way of offering EE.Once people receive EE related to problems affecting them, they will be better placed to find means of preventing such problems unlike what the case was at the time of data collection.

Having discussed the respondents understanding and provision of Environmental Education, the next section discusses findings on alternative ways of using Environmental Education to address negative effects of coal mining. In line with objective three, the next section discusses the alternative forms of EE that could be used.

5.5 Alternative forms of EE

The respondents were accorded a chance to suggest how best EE could be provided to them.

5.5.1 Maamba residents' Interest in learning and teaching Environmental Education on effects of mining.

As observed from findings in the previous chapter, one hundred percent (100%) percent of the respondents were interested in learning and teaching EE on the impacts of mining. This information was very useful in coming up with the content that the residents themselves had an input in that, the respondents were given the opportunity to make suggestions as to how they wanted the alternative EE programme to be designed and offered to them

5.5.2 Proposed topics to be covered in Environmental Education

Findings from chapter four indicated that eighty eight percent of the respondents proposed pollution to be indicated in the alternative EE programme to be offered to the residents. This confirmed the earlier assertions that the major problem respondents complained about was pollution in all forms that is, water, land and air. This guided the researcher as to which topics to include in the new EE programme since the topics suggested by the respondents were directly linked to the effects of mining.

5.5.3 Preferred ways of teaching Environmental Education proposed by residents

The respondents were also asked to suggest ways in which they wanted EE to be delivered to them. They identified group discussions, lectures, radios, posters, charts and role plays. The majority of the respondents identified discussions as the most suitable way. This was useful to the researcher as it pointed out the importance attached to having varied teaching methodologies as different people learn differently. It was cardinal to involve the respondents in suggesting best ways of learning EE in a bid to involve them irrespective of their educational levels and consequently change their attitudes towards their environment. Oduro (1992) postulates that successful implementation of EE programmes require consideration of the target population in the formulation and implementation stage as this is viewed critical as far as conservation is concerned. He further alludes to the fact that a non literate adult could as well be reached through radio and television programmes such as discussions, talks, sketches and relevant films.

5.5.4 Proposed teaching and learning resources to be used in Environmental Education

The researcher wanted to know which teaching and learning resources would be best suited for the residents. The respondents cited books, posters, charts, chalk boards and the use of videos. This information was valuable as it gave the researcher an idea of which learning and teaching resources to use when offering EE to the residents.

5.5.5 Suggested ways of evaluating the achievements attained in Environmental Education.

The learning and teaching process would not be complete without ascertaining what the learners have comprehended. This can be done by evaluating the learners. The respondents suggested ways in which they would like to be evaluated such as through tests, questionnaires and physically checking

what was obtaining on the ground or monitoring. The need to evaluate every learning process cannot be over emphasized if at all the learners are to attach some importance to the learning activity. Most importantly, what is learnt should be put into practice and not mere memorization.

5.6 Proposed Environmental Education (EE) programme to address negative effects of Coal Mining on Maamba residents.

This proposed EE programme is an alternative form of EE in line with objective three and aimed at addressing negative effects of coal mining. There are a number of environmental problems in Maamba Township that need to be researched on so that people can be made aware of the negative consequences. Since change of behavior is not as easy as one could imagine, Environmental awareness programmes therefore become indispensable in the quest of formulating mitigation measures to reduce any environmental degradation that may arise as this is one way of empowering them to act responsibly as residents. One such problem in Maamba is that of negative effect of mining on the people, animals, land and water. This alternative programme is a long term one aimed at disseminating EE on the negative effects of coal mining operation in Maamba Township through a well designed education programme so that they can make informed decisions thereafter.

Description of the area where the teaching programme will be implemented and the target group.

The programme will be implemented in form of a long term educational exercise in various venues of Maamba Township such as the community halls, Kanzinze stadium and Maamba Secondary School main Hall.

Target Audience and Facilitators

The largest audience will be all Maamba residents from the age of fifteen (15) years and above. Teachers from various schools will play a major role of educating the audience. Police Officers for maintaining law and order, Medical staff for their expertise, Ward counselors, MCL environmentalists, Council Staff, NGOs, agricultural extension officers, Southern Water and Sewerage staff and Youth club representatives.

Programme Outline

The programme will have a main aim and objectives. The stakeholders will share ideas and roles in implementing this programme so that it is not seen to be imposed on the residents by the facilitators but that it is community based especially that they had an input of what they want to learn in the programme. This programme will be a long term one so that the knowledge acquired will be well understood, hence spilling over to the coming generations. It is further anticipated that after the sensitization exercise, the audience shall be well informed on the negative effects of mining operations and take responsible attempts to think globally and act locally.

Aim of the Programme

The main aim of the alternative programme is to enable the audience to have a broader understanding of the negative effects of mining and accord them a chance to come up with practical measures that will be used to reduce the risks resulting from the negative effects of mining.

Objectives of the Programme

(a) To use EE to sensitize the Maamba residents on the effects of coal mining.

(b) To enable the Maamba residents to be actively involved in programmes aimed at reducing the effects of coal mining.

Teaching and Learning Resources

Books, pictures, posters, power point projector, micro phones and chalk boards will be used.

Methodology to be used

Since Environmental Education is a value based subject, a value based approach will be implored as it necessitates the use of methodologies that target change of attitudes, values, beliefs and practices. Interactive and participatory methods which are learner centered methods will mostly be used so as to get maximum participation from the audience. In so doing, the rate of comprehending what is taught will be high as learners become motivated where they feel they are involved in the learning process.

Some of these methods include among others discussions, question and answer, role plays and lectures. The discussions will use the Development Compass Rose (DCR).The DCR is called the Development "rose" because it is shaped like a rose flower with four petals and is used to enable learners have a broader understanding of a given topic as it looks at any topic in different angles such as economic, natural, political, social and to a larger extent personal.

Roles of actors in the programme

- **Teachers _** Help in facilitating as these are trained in various methodologies and usually taken as role models in every given society.
- **Police Officers –** Help maintain orderliness as a big gathering may be potential threat to peace at any given occasion.
- **MCL Environmentalists –** EE Main Facilitators / Programme Coordinators
- **Ward chairpersons –** Facilitators and mobilizing the residents.
- **Council Staff –** EE Facilitators
- **NGOs –** Funding of the programmes each time there is a sensitization programme.
- **Local Community –** actively participate in all programmes as these will easily educate their peers if sensitized correctly.
- **Agricultural Extension Officers -** EE Facilitators

Programme Evaluation

Evaluation will be done in manageable group discussions then later by all the groups as a whole. Teachers will take up the roles of group leaders to help manage the respective groups. During presentations, the facilitators will also be asking individual questions so as to be at the same pace with the learners.

PROPOSED EE PROGRAMME ON NEGATIVE EFFECTS OF MINING.

SCHEDULE OF ACTIVITIES.

This programme is in response to the third objective of determining an alternative form of EE that could be used among Maamba residents in addressing negative effects of coal mining.

TOPIC	**METHODOLOGY / ACTIVITY TEACHING AND LEARNING AIDS**	**FACILITATORS OR ACTORS**	**EVALUATION LSBAT**
• Planning for the meetings and putting all logistics in place.	• Discussions	• Programme coordinators • NGOs (Funding) • Other stake holders	Participate in the planning process.
• Welcoming remarks and formulation of ground rules to be followed.	• Lecture • Discussions	• Programme coordinators	
• Introduction of the topic to be discussed that is negative effects of mining on the	• Lecture	• Programme coordinators	

people, animals, land, water and air Maamba Township. • Explain the use of the Development Compass Rose (DCR)			
• Defining Pollution • Define a pollutant	• Lecture • Question and answer • Discussion	• EE Facilitators	• LSBAT Define pollution. • Identify a pollutant.
Types of Pollution • Air Pollution • Water Pollution • Land Pollution	• Lecture • Discussion • Question and answer • (posters, pictures, video to show types of pollution)	• EE Facilitators	• State the types of pollution

Air pollution • Negative effects of mining on air. • Main air pollutant (Sulphur dioxide (SO4) and its side effects. • Sources of air pollution. • Legal provisions such as ZEMA act (2011) on pollution and its regulations. • Licensing or Permit • Environmental Impact Assessment (EIA) • Diseases associated with air pollution	• Role play Figure 3 dust raised from heavy trucks ferrying mine equipment in the township  Source: Field data,2016 • Group discussions • Lecture	• Youth in the audience • MCL staff • EE facilitator • Clinic Staff	• Identify air pollution • State other sources of air pollution. • Describe the ZEMA act on pollution.

• Prevention of air pollution. • Use DCR to explain air pollution. • Penalties for non compliance to Act / license regarding air pollution.	• Lecture • Discussions • Question and answer • Group discussions • Discussions • Role play	• EE facilitator • Residents	LSBAT Take appropriate action against the Companies that do not adhere to laws and policies put in place on air pollution.
Water Pollution • Definition • Sources of water	• Discussions • Question and answer	EE Facilitators	LSBAT • Define water pollution. • Identify sources of water.
• Uses of clean	• Discussions	• Southern	• State uses

water • Negative effects of mining on water sources (mine effluents) • Consequences of polluted water to humans, animals and plants.	• Lecture • Question and answer • Discussions/talk • Role play, posters Figure 4 mine effluents being deposited in a nearby stream.  Source: Field data, 2016	Water and sewerage technicians • EE facilitator • Residents	of clean water • Identify polluted water and state dangers involved.
• Act on water pollution control	• Lecture • Discussions		Take appropriate action when water is polluted.

Land pollution • Definition • Causes of land pollution	• Discussions • Pictures depicting polluted land	• EE facilitators • Residents	LSBAT • Identify land pollution and its causes
• Land degradation and its effects • Scavenging in mine dumping sites.	• Discussions using DCR • Question and answer • Role play to show effects of scavenging in mine dump sites. • Pictures depicting degraded land.	• MCL Staff • EE facilitators	• Describe effects of scavenging in Mine dump sites

	Figure 5 degraded land due to Mining activities.  Source: Field data,2016		
• Polluted soils • Vegetation growth on polluted soils	• Posters showing polluted soils. Figure 6 polluted soils from sulphuric acids  Source, Field data,2016	• Agricultural extension officers	

• Land reclamation	• Question and answer. • Discussions		LSBAT • Describe what land reclamation is. • State benefits of Land reclamation using DCR.

5.7 Summary

The chapter has discussed the findings and answered the research questions of the study. This was done by discussing the findings in the light of the objectives and research questions set. The chapter has successfully discussed Environmental Education‘s role in addressing effects of coal mining operations in Maamba Township.

The next chapter will explain in detail how the set aim, specific objectives and research questions have been met. Conclusions and recommendations of the study will thereafter be given.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter is a summary of all the chapters of this dissertation and recommendations based on the major findings are given. The research aimed at exploring how Environmental Education can be used to address negative effects arising from coal mining operations on the residents and natural environment of Maamba Township of southern Zambia. In pursuit of this, the research was guided by the following objectives:

- To establish the role of EE in addressing negative effects of coal mining as a way of improving the environment.
- To assess the availability and types of EE programmes to address negative effects of coal mining among Maamba residents.
- To determine alternative forms of EE that could be used among Maamba residents in addressing negative effects of coal mining.

The study comprised six chapters. Chapter one introduced the problem under study and justified why the problem was worth investigating. It outlined the aim of the study; objectives set and research questions to be answered. Chapter two presented the literature reviewed which had a bearing on the study. This literature reviewed showed that not many studies are being carried out in the field of mining and in particular negative effects on mining Townships.

Chapter three presented the methods used in the study, research site, research design, and the techniques in data collection and analysis. Primary data was collected in Maamba while secondary data was collected from the University of Zambia library as well as the Internet. Chapter four presented the findings of the study while Chapter five discussed them in order to answer the research questions and achieve the objectives set. Conclusions and recommendations were made in Chapter six.

6.2 Conclusion

The study achieved its objectives by successfully answering the research questions set in order to justify the Role of Environmental Education in addressing negative effects of coal mining operations in Maamba Township. Having examined the views of the respondents, the following were the major findings of the study:

The findings revealed that EE was being offered to some residents of Maamba Township. However, the type of EE provided did not include the negative effects of coal mining. The EE provided involved topics such as prevention of cholera and malaria as well as good hygiene practices. Findings further showed that Maamba residents were not involved in planning and implementation of these programmes. Considering the content of EE that was being offered, it was inevitable that an alternative EE programme be formulated and this was to address the negative effects of coal mining on the residents, animals, water, land and soils. It was also imperative to involve the residents by letting them suggest suitable topics, methods of teaching, teaching and learning resources and ways of evaluating the learnt content.Findings suggested that teaching methodology, assessment strategies and community participation in all EE activities play an important role in enhancing learning. It can therefore, be conclusively stated that the use of different teaching and learning methods, assessment strategies and community involvement will enhance the quality of EE programmes for Maamba residents.

6.3 Recommendations

Based on findings of the study, the following are the recommendations;

From findings, the respondents could not adequately explain what Environmental Education was.

There is need, therefore, to consider having EE as a stand alone subject so that it is learnt from the foundation stage of education right up to tertiary level. By so doing, residents will grow up with values and attitudes that will in turn be transferred to the generations to come, hence having a responsible citizenry.

It was clear from findings that EE providers never involved the residents in the planning of EE programmes. It is recommended that all stakeholders, including those at the grassroots like the Maamba residents, are fully involved from planning stage up to evaluation stage if at all any EE programme is to yield positive results. By involving the residents, they will feel part and parcel of the whole learning exercise.The EE programmes should include the negative effects of coal mining on the residents as this is the major issue affecting them. Dust in the township was cited as a major problem arising from Maamba Collieries Mine trucks ferrying equipment .The EE providers should seriously adhere to stipulated laws and guidelines as regards what the mining companies should follow to avoid causing harm to the environment.

There is need for further related research to investigate if primary school pupils in Maamba are aware of Environmental Education, if so, what is the content and does it include the negative effects of coal mining. This will be very helpful as these are the future generation who need to be involved in EE activities from an early stage of life. This is supported by Thapa, (1999) who states that one of the best ways of environmental conservation is by creating environmental awareness among society especially the young as they are future leaders and educators of the environment.

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APPENDICES

APPENDIX 1: QUESTIONAIRE FOR MAAMBA RESIDENTS.

My names are Mavis Cheelo Siambwati – Ndoti, a post graduate student at the University of Zambia (UNZA) and conducting a research on the role of Environmental Education (EE) in addressing the effects of coal mining on the residents, plants, animals, water, and soil of Maamba Township. You have been selected to participate in this very important study in which we wish to obtain an understanding of the current practice of Environment Education in Maamba Township. Your responses will help the researcher to suggest to the providers of Environmental Education and their institutions how best to effectively provide EE programmes. Your responses will be highly confidential and shall only be used for academic purposes.

Instructions: Please, answer by ticking and filling in the spaces provided

Section A: Personal Information

1. Sex Male [ ] Female [ ]

2. Age: 15-30 [ ] 31-40 [ ] 41-50 [ ] 51 and above [ ]

3. Education Level attained: Primary [ ] Secondary [ ] Tertiary [ ]

Other (specify) ……

4. What is your occupation? ……...

5. How long have you been living in Maamba Township?

Less than 1 year [ ] 1-5 years [ ] 6-10 [ ] 11years and above [ ]

B: Information about Environmental Education (EE) Activities

6. What do you understand by the term environment?
……..

7. What do you know about Environmental Education?
……..
……..
8. What environmental problems do you experience in your area?
……
……

9. Is there any company or organization offering Environmental Education in your area?

Yes [ ] No [ ]

10. In which ways is Environmental Education taught?
……
…….

11. List down the topics which are covered?
……
……
…….

12. State the environmental issues, which providers of EE have taught you about your area.
……
……
…….

13. Which language/s do the EE providers use when teaching you?
……..

14. Do you participate in EE activities?

Yes [ ] No [ ]

15. If yes to question 14 above, what type of EE activities do you participate in your area?
……
……
…….

16. Are you involved in planning for the learning activities?

Yes [ ] No [ ]

17. If yes to question 16 above, explain how you are involved

……
……..
……
……
…….

18. Does the EE provided cover ways of avoiding effects of coal mining on the residents,

soil, water, air, and animals? Yes [ ] No [ ]

Section C Educational Implication

19. Would you be interested in the Environmental Education teaching and learning process?

on the negative effects of mining if at all it was to be introduced? Yes [ ] No [ ]

20. If yes to question 19 above, which topics or issues would you like to be covered?

……
……

21. What ways of teaching would you like to be used?

……
……

22. What type of teaching materials would be best for such type of education?
……

23. In which ways would you evaluate the achievements of such type of education?
…….

THE END. THANK YOU FOR YOUR TIME

.

APPENDIX 2: INTERVIEW GUIDE FOR EE PROVIDERS.

UNIVERSITY OF ZAMBIA

SCHOOL OF EDUCATION

DEPARTMENT OF LANGUAGE AND SOCIAL SCIENCE EDUCATION

Topic of Research: Role of Environmental Education (EE) in addressing effects of coal mining operations in Maamba Township of Southern Zambia.

Date……..

Name of Institution……..

Position held……..

Sex…….

1. Have you been trained in Environmental Education?

2. Which institution where you trained at?

3. How long was the training?

4. What are your institution guidelines on the environment?

5. Do such guidelines include Environmental Education?

6. What type of Environmental Education do you offer if any?

7. Does it include EE on the effects of coal mining on the social and natural environment?

8. What methods do you use when educating the learners?

9. What topics do you address when educating the learners?

10. What activities are the learners involved in?

11. What methods are used to evaluate the learning and teaching activity?

12. What problems do you experience in delivering Environmental Education?

13. What positive change, if any is seen in the learners' behaviour?

14. Suggest ways in which EE can best be provided.

END OF INTERVIEW, THANK YOU FOR YOUR TIME.

APPENDIX 3: UNSTRUCTURED OBSERVATION CHECKLIST.

UNIVERSITY OF ZAMBIA

SCHOOL OF EDUCATION

DEPARTMENT OF LANGUAGE AND SOCIAL SCIENCE EDUCATION

Topic of Research: Role of Environmental Education (EE) in addressing effects of coal Mining operations in Maamba Township of Southern Zambia.

What to look out for;

1. Observations made on respondents during interviews**.**
    - Facial expressions
    - Body movements
2. Scavenging in Mine dump sites
    - People around these areas
    - Activities carried out around these areas
3. Quarrying activities near coal mining area
    - People are quarrying around these areas.
4. Water sources used for domestic purposes
    - Colour of the water
    - Impurities in the water

5. Physical inspection in relation to the physical environment of Maamba Township

    - Cleanliness of the physical environment
    - Involvement in planting trees or other crops

6. Nature of EE activities in place

    - Content of programmes
    - Methodology used
    - Participation input

APPENDIX 4: UNSTRUCTURED INTERVIEW GUIDE FOR FOCUS GROUPS.

UNIVERSITY OF ZAMBIA

SCHOOL OF EDUCATION

DEPARTMENT OF LANGUAGE AND SOCIAL SCIENCE EDUCATION

Topic of Research: Role of Environmental Education (EE) in addressing effects of coal Mining operations in Maamba Township of southern Zambia.

1. What do you know about EE?
2. Does any company or organization offer EE in your area?
3. What mode of EE is used?
4. What topics are covered if it's offered?
5. Do you face any problems from mining activities?
6. Who do you think should be in the fore front of delivering EE?
7. What would you recommend to be done for EE programmes to be sustainable?

Thank you for taking part in this discussion.