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An Assessment of the Effectiveness of Government Policy on Mining in Managing Lead Poisoning: A Case of Kabwe District

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Abstract

Lead mining in Kabwe started around 1904 and continued until June 1964 when the mine was temporally shut down. Over the years, the mine has changed ownership several times. The study was conducted to assess awareness campaigns put in place by government regarding lead poisoning. The study was informed by the following objectives: to assess awareness campaigns put in place by government regarding lead poisoning effects in Kabwe District; to determine the effectiveness of government funding in lead poisoning remediation; to assert effectiveness of the mine and mineral environment policy on decommissioned dumps and to identify limitations in the mining management of dumps. The study adopted a descriptive design and targeted residents, council officers and WARMA, health personnel and staff from ministry of green economy. The study has revealed a significantly low

level of knowledge in lead precautionary measures. The study has revealed that the government has been doing its best in ensuring that people are sensitized and moved out such places, however, some members of the community indicated that the effort from the government is not enough there is need to increase the funding so that the effectiveness of the policy and measure the government has put in place can effectively perform their intended purposes. Despite the efforts from the government, the implementation of the policy has come with some limitation and among the common limitation are resistance from community members to move out of the areas affected by lead and limited funding among others. The study has recommended that Kabwe District Municipal Council should stop giving out plots in high lead exposure areas without putting in place measures that prevent lead poisoning.

Keywords: Effectiveness, Government Policy, Lead Poison, Mining, Environment

1. Introduction

The City of Kabwe, then Broken Hill, named after a mining city in Australia, is the first mining town in Zambia. The discovery of lead and zinc deposits with lead concentrations as high as 20% in 1902 by T.G. Davey sparked the formation of the Rhodesia Broken Hill Development Company in 1904, which set the impetus for widespread mining in 1906. In 1915, pig iron production commenced, and two years later, the Company commissioned a blast furnace for smelter operations. In 1928, an electrolytic zinc plant with an annual capacity of 15,000 metric tons was installed. The 1940s saw the beginning of underground mining operations. In 1946, the mine started producing ore that fed the blast furnace. In 1954, lead production peaked at 26,550 metric tons per year. These milestones were followed by installing an imperial smelting furnace (ISF) to produce lead and zinc from sulfide ores.

Additionally, the discovery of mineral deposits and the full-scale mining operations catalyzed the city's economic development, which evolved into one of the most known mines in Africa. In the 1990s, ZCCM started to wind down its mining operations because the mine was no longer economically viable.

The toxic waste mountain, dubbed locally as the black mountain, has created a legacy of catastrophic and extensive environmental contamination and human exposure to mass lead pollution, leaving many residents, particularly children, dead and thousands more poisoned. Employees and the residents did not have access to information about the dangers of exposure

to heavy metals to avoid legal liability. In 2013, the United Nations listed Kabwe as one of the ten most polluted cities in the world (The New Humanitarian). Kabwe, the fourth largest city in Zambia, is located about 150 kilometers north of the nation's capital, Lusaka. A 2006 health study discovered that, on average, children's blood lead levels in Kabwe exceeded the recommended levels by five to ten times. This was the result of contamination from lead mining in the area, which is situated around the Copperbelt. In 1902, rich deposits of lead were discovered, leading mining and smelting operations to run almost continuously for over 90 years without the government adequately addressing the potential dangers of lead.

Smelting was largely unregulated throughout the 20th century in Kabwe, and these smelters released heavy metals in the form of dust particles, which settled on the ground in the surrounding areas. While the mine is currently closed, artisanal activity at tailings piles continues. In spite of these efforts, the site still poses an acute health risk (Annette *et al* 2021).

1.1 Statement of the problem

In recent past (2021), rich deposits of lead (Pb) have been discovered, leading mining and smelting operations to run almost continuously for over 90 years without the government adequately addressing the potential dangers of lead. Since 1902 smelting has largely been regulated throughout the 20th century in Kabwe District, and these smelters released heavy metals in the form of dust particles, which settled on the ground in the surrounding areas of Chowa, Mutwe-wansofu, Kasanda, Makandanyama and Makululu. While the mine is currently closed, artisanal activity at tailings piles continues. On the other hand the natural blood-lead level in humans is about 0.0016µg/dl but if it exceeds it often result into death, (Chilongo, 2014). It appears that policy implementations levels of preventive measures from government and among residents of Kabwe has been very low at 40% despite the residents staying in high lead poisoning exposure residential areas.

It is believed that many people in this area are not aware about the high levels of lead poisoning preventive measures and government too has been reluctant on the policy

implementation measures among residents of this mining area. Although the Zambian government has made progress in dealing with the issue, particularly through a World Bank and Nordic Development Fund USD 26 million remediation program from 2003 to 2011 the site still poses severe health risks to people in the said areas of Kabwe District Annette *et al* (2021). Hence, the paper seeks to assess the effectiveness of government Policy in managing the lead poisoning in Kabwe. Thus, this study shall seek to assess the effectiveness of government policy in managing the lead poisoning in Kabwe District.

1.2 Objectives of the study

1.2.1 General Objective

To Assess the Effectiveness of Government Policy on Mining in Managing Lead Poisoning

1.2.2 Specific Objectives

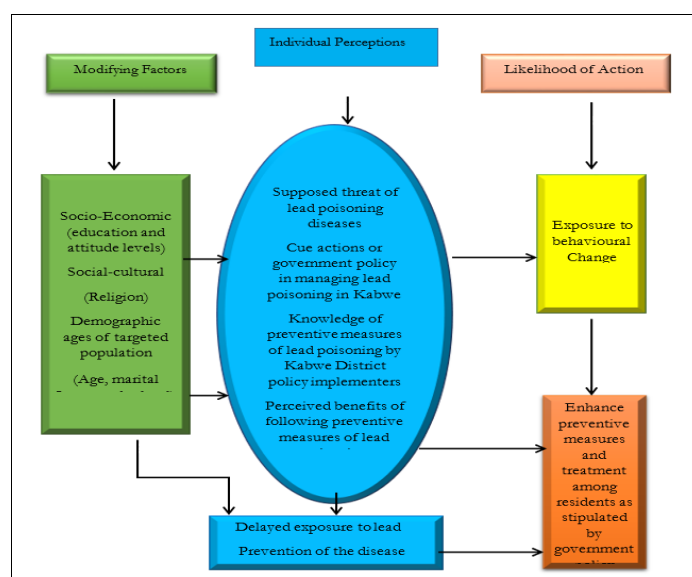
1. To assess awareness campaigns put in place by government regarding lead poisoning effects in Kabwe District.
2. To determine the effectiveness of government funding in lead poisoning remediation.
3. To assert effectiveness of the mine and mineral environment policy on decommissioned dumps.
4. To identify limitations in the mining management of dumps.

1.3 Research questions

1. What awareness campaigns has the government put in place regarding lead poisoning effects in Kabwe District?
2. How effective is government funding in lead poisoning remediation?
3. How effective is the mine and mineral environment policy on decommissioned dumps?
4. What limitations are in the mining management of dumps?

1.4 Conceptual Framework

This study used the following conceptual framework summarized in the figure below



Sources: (Author, 2024)

Fig 1:

The framework shows the relationship among variables and the variables are modifying factors, individual perception and likelihood of action.

The framework plays an important role in guiding the entire process of the research study. The Health Belief Model (HBM) shall be used to help this researcher assess and understand the effectiveness of Government Policy on mining and managing lead poisoning and environmental health in Kabwe District. As such the Health Belief Model was developed in the 1950s by social psychologists Rosenstock, Hochbaum and Kegeles. It is a tool used to explain and predict health behaviors and managing such effects while, focusing on the attitudes and beliefs of individuals. Based on the framework, an individual's willingness to change behaviors and follow health recommendations is determined by personal beliefs or perceptions about a disease. The theory has six (6) major constructions that play important roles in influencing people's decisions and these includes; Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Cue to Action and Self.

Perceived Susceptibility-Personal risk or susceptibility is one of the more powerful perceptions in prompting individuals to adopt healthier behaviors or undertake risk-prevention measures. This implies that the greater the perceived risk, the greater the likelihood of engaging in behaviors that decrease the risk.

Perceived Seriousness-This construct is about an individual's belief about the gravity or severity of a disease and its consequences. People will engage in preventing lead poisoning if they perceive threats of kidney problems, cardiovascular problems, and hematological disorders for the last few months and they are exposed to lead and sources of lead. When individuals recognize personal susceptibility, action will not occur unless the individual perceives the severity to be significant enough to lead to serious consequences.

Perceived Benefits-The construct relates to an individual's opinion about the value or usefulness of a new behavior in decreasing the risk of developing a disease. Individuals adopt healthier behaviors when they believe the behaviors will decrease their risk of developing a disease. In relation to this study, people will know the benefits of preventing lead poisoning when they see delayed exposure to lead and prevention of diseases.

Perceived Barriers- For a new behavior to be adopted, an individual need to believe that the benefits of the new behavior outweigh the consequences of continuing the old behavior. If many people in the community do not engage in activities that prevent lead poisoning such as planting grass, suppressing dust by watering the surrounding it can be very difficult for one to start making their environment green. Continuous education on the measures to prevent lead poisoning is therefore, important to the community.

Cues to action-In this model or pattern people will be able to utilize the measures of preventing lead poisoning or make decision to change behavior after receiving information of prevention and health effects, these could be through the media, posters and a reminder from the doctor or nurse or concerned loved ones.

Self-efficacy-In this construct an individual sets higher

goals and becomes more committed and their behavior becomes more favorable. People will be confident to engage in preventive measures after receiving information. They will thus successfully negotiate the measures.

1.5 Significance of the study

It is hoped that the findings of this study would provide a basis from which the ministry of mines, ministry Healthy and other stake holders like ZEMA and WAMA will provide basic skills and knowledge for the residents of Kabwe to prevent themselves from high lead exposure and all the residents of Kabwe District to implement government policy on healthier ways of managing mining lead in the area. Additionally, the purpose of this study was to assess the extent of knowledge of precautionary measures against lead poisoning among child-bearing age women in high lead poisoning exposure residential areas. This research is significant because it has a bearing on policy formulation and has an impact on the health of the residence in lead endemic areas of Kabwe. Furthermore, it will contribute to the pool of knowledge on performance management system and prompt stakeholders to conduct further investigations into the challenges facing the implementation of government policy in effective ways of managing lead mining and disposal in Kabwe District.

1.6 Scope of the study

This research study composed of five chapters. Chapter one provides the background, statement of the problem and the objectives. It outlines the scope of the study, research questions, significance of the study and theoretical framework which shall be used for this study. Chapter two provides the literature review based on the three thematic areas drawn from the three objectives of this research study.

1.7 Operational definitions of concepts

Lead-a very corrosion-resistant, dense, ductile and malleable blue-grey metal that melts at 327°C and boils at 1620°C with a symbol Pb

Lead poisoning- medical conditions as a result of excessive lead exposure to the human body

Exposure-Proximity and /or contact with a source of a disease agent in such a manner that effective transmission of the agent or harmful effects of the agent may occur (Last, 1995).

High lead poisoning exposure area- residential areas where the median soil lead concentration was exceeding 500mg/kg in the Kabwe survey (ZCCM-IH, 2006).

Knowledge – ability of the interviewee to list or mention at least eight ways of preventing lead exposure in homes

Precautionary measures – Preventive ways of avoiding lead come into contact with people

Implementation-is defined as the phase in which systems and procedures are put in place to collect and process the data that enable the measurements to be made regularly.

Elemental lead-The chemical symbol for lead is Pb (from the Latin name for lead, plumbum). Lead has an atomic number of 82 and an atomic weight of 207.2. It is a bluish-grey metal that tarnishes easily in air to a dark grey. The density of lead is 11.34 g/cm It has a low melting point of 327.46 °C or 621.43 °F.

2. Literature Review

2.1 Awareness campaigns and measures put in place by government regarding lead poisoning effects

As part of a citywide effort to increase lead poisoning awareness within the city of Hartford, Connecticut, the Hartford Health Department implemented a multifaceted public health campaign involving several novel elements and partnerships, including the use of municipal sanitation trucks to disseminate lead-poisoning prevention messages throughout the city. To evaluate campaign reach and effectiveness, Health Department personnel collected measures of lead-poisoning knowledge, recall of campaign components, and reports of steps taken to prevent lead poisoning from 180 largely ethnic minority parents of preschool-age children. Key results were as follows: a) Recall of campaign components ranged from 21.5 to 62.6%, with newspaper advertisements and signs on buses and billboards recalled most often and a video broadcast on public-access television recalled least often. b) More than 45% of respondents reported that they took steps to prevent lead poisoning because of at least one of the campaign components, with the newspaper advertisements being the most effective component in terms of prompting lead-poisoning prevention behavior. c) Respondents' awareness was particularly low in terms of how medical personnel and procedures can and cannot detect and prevent lead poisoning in children. This campaign prompted caregivers to take steps to prevent lead poisoning and may help public health professionals in other communities to develop novel ideas through which to embark on similar initiatives (Owen, 2014).

Hill (2022) conducted a study to evaluate the level of awareness and the effectiveness of the methods used. Lead poisoning knowledge. The specific items that were used to assess lead poisoning knowledge and the percentages of respondents answering "true" to each statement. They noted that knowledge in our sample was particularly low regarding the facts that a) some folk remedies may pose lead poisoning hazards and b) lead exposure can be reduced by using cold water for cooking and drinking. It was particularly notable that 96% of respondents incorrectly endorsed immunization as a way to prevent lead poisoning in children. More than 60% of respondents indicated that they believed, incorrectly, that lead poisoning can be "easily detected by having a doctor examine the child."

We also noted that certain aspects of lead poisoning knowledge varied according to income. For example, those respondents earning > \$30,000/year were significantly less likely ($p < 0.05$) than the other groups to indicate (incorrectly) that immunization is one way to reduce the risk of lead poisoning in children.

To overcome dynamics or challenges affecting implementation of lead poisoning and mining in any given mine Bartlett, (2000) affirms several measures which can be implemented to improve effectiveness lead poisoning management. These include: professional development, review environmental assessment of the mining area and linking it the health impacts of the residents in a given area. As such lead (Pb) is a heavy metal which was actively mined in Kabwe, in Zambia's Central Province and to a lesser extent, on the Copperbelt. Though the lead-zinc mine in Kabwe closed almost three decades ago, the risks associated with chronic exposure to the toxic heavy metal have not been addressed and remain a source of grave

concern.

However, Kabwe still remains one of the most lead contaminated towns in the world. Studies have shown that lead levels in soil, water and sediment far exceed permissible limits set by the World Health Organization. Recent investigations on the children under the age of seven in the mining towns have revealed alarming levels of lead in their blood. Similarly, high level of lead has also been recorded in livestock in the same towns. Lead affects all organs of the body, particularly the nervous system. The paper seeks to investigate mitigation measures in place to protect people and livestock from excessive exposure to lead in Kabwe. As such lead is one of the substances symbolizing the tradeoff between industrial and economic development and environmental pollution.

Lead poisoning is the most significant and prevalent disease of environmental origin among US children. Despite over 100 years' knowledge of the special hazards of lead exposure for young children, it has taken over a century for effective primary prevention to be adopted. Obstacles to primary prevention have included deliberate campaigns by industry to prevent restrictions upon such uses on lead as plumbing, paints, and gasoline additives; influence of industrial support of biomedical research at major US medical schools; lack of appropriate policy mechanisms to identify and control lead exposures; and opposition to investing resources in lead poisoning prevention. The removal of lead from gasoline, which began in the United States in 1972 and was completed in 1995, has resulted in almost fourfold reductions in median blood lead levels in US children from 1976 to 1991. Increased screening and interventions to identify and abate lead sources, such as lead in housing, also contributed to this major public health success.

Nevertheless, lead exposures remain prevalent, although increasingly less generally distributed. Perhaps because of the renewed "ghettoization" of lead, support for lead poisoning prevention has waned. Objections to investing public and private resources in screening and source abatement have challenged the continuing commitment of public health officials to prevention. The demonstrable success and social benefits of preventing lead toxicity are cited in support of continued preventive health policies.

2.2 Government funding in lead poisoning remediation

Lead is one of the most abundant heavy metals and its toxic effects cause environmental and health problems because of its stability in contaminated site and complexity of mechanism in biological toxicity, particularly dangerous for children leading to mental retardation when exist with abnormal concentration in body fluid. Knowledge and awareness of the problem are essential to limit the risk of lead exposure. This article focuses on the adverse effect of lead on various components of the environment like soil, water and human being. Lead is a naturally occurring bluish-gray metal available in small amounts in the Earth's crust.

Throughout our environment some amount of lead is found. An increased amount of lead in our environment comes from human activities including burning fossil fuels, mining, and manufacturing. In the United States, the most common source of exposure for lead-poisoned children is lead-based paint, while the majority of adult cases are workplace-related. Lead occurs naturally in the environment. However,

most lead concentrations that are found in the environment are a result of human activities. Due to the application of lead in gasoline an unnatural lead cycle has consisted. In car engines lead is burned, so that lead salts (chlorides, bromides, and oxides) will originate. Lead is one out of four metals that have the most damaging effects on human health. Sources of lead pollution in India may be divided into two major categories: Industrial and domestic.

The industrial lead exposures are mainly due to the particulates generated by coal burning and roasting of minerals i.e. iron pyrites, dolomite, alumina etc. The domestic lead exposures come mainly from cooking by use of the solid fuels (i.e. coal, biomass, agriculture waste, etc.), paints, and ceramic glazes, cosmetic and fold remedies, drinking water and food, etc. Increase amount of lead creates measure environmental health problem in India. Lead is a potent poison and is harmful in even very small amount.

As noted by Williams (2017) leaders in federal and state government have recognized the importance of eradicating lead poisoning through an approach that emphasizes primary prevention with continued screening of high-risk populations. In 2000, the Secretary of Health and Human Services serving on a Presidential Task Force on Environmental Health Risks and Safety Risks to Children recommended a \$230 million annual investment over 10 years in HUD's Lead Hazard Control Grant Program to eliminate lead poisoning. Despite this recommendation, it now appears unlikely that the federal government will eliminate lead poisoning by the year 2010. Federal funding of the Lead Hazard Control Grant Program has only increased from \$60 million in fiscal year 2000 to \$140 million in fiscal year 2003.

Lead is an important environmental contaminant because of its known toxicity to humans and other living organisms. Lead is one of a limited class of elements that can be described as purely toxic. Many other elements, including heavy metals such as chromium, manganese, molybdenum, nickel, and selenium, although toxic at high levels, are actually required nutrients at lower levels. This is clearly not the case for lead. Lead is a relatively corrosion resistant, dense and malleable metal that has been used by humans for at least 5000 years.

During this time, lead pollution has increased from an estimated 10 tons per year to 1,000,000 tons per year, accompanying population and economic growth. Lead is a well-known non-biodegradable toxic metal in the environment and now, it has become a global health issue. Lead poisoning occurs when people are exposed to lead and chemicals that contain lead, breathing air, taking drinks such as water and milk, eating foods such as fruits, vegetables, meats, grains and seafood, swallowing or touching dust or dirt that contains lead (Williams, 2017).

2.3 Mine and mineral environment policy as a tool in addressing contamination from lead

Despite the negative effects of lead contamination on human health, no significant remediation has been carried out to mitigate lead exposure or clean-up the contaminated areas. A 2003 World bank funded project which provided lead chelation therapy has run its course and therapy is currently unavailable (Caravanos *et al.*, 2014). Other attempts from the same project involved surface soil removal with

replacement, soil remediation and relocation residents from lead contaminated communities (Caravanos *et al.*, 2014; Human Rights Watch, 2019). Studies are on-going, most exploring the chemical remediation of HM contaminated environments such as lead. This includes the use of chemical immobilizers like raw dolomite, calcined dolomite and magnesium oxide by Tangviroon *et al.*, (2020).

Tangviroon *et al.*, (2020) showed that immobilizers precipitate of hydroxides of lead and zinc, decreasing their leaching concentration below regulated values. The hydroxides of lead are however, not entirely safe either. They possibly act like ionic lead, are suspected carcinogenic when inhaled or swallowed, affect fertility and are toxic to the developing foetus (Tangviroon *et al.*, 2020). It is therefore imperative that non-chemical methods of remediation are explored to mitigate the effects of lead toxicity on human health. Leteinturier *et al.*, (2001) investigated a phytogeochemical approach to Pb remediation and proposed that phytostabilization using identified indigenous taxa, is the only viable solution to mitigating the effects of lead contamination.

Another study by Kachenga (2017) explored the phytoremediation potential of indigenous plants growing at tailings dams contaminated with copper and suggests that more research is needed to identify indigenous plants with potential for phytoremediation of HMs including Pb. Furthermore, Uchida *et al.* (2017) concluded that some indigenous plant species remain viable during the dry season and can consequently be used for phytoremediation of HMs. A more recent study by Festin *et al.*, (2019) proposed expanding the pool of plant species for phytostabilization as well as the phytostabilization potential of organic amendments such as biochar.

According to section of environmental management act no.12 of 2011 holds that, every human person has the right to clean, safe and healthy environment cap. (1) Subject to the Constitution, every person living in Zambia has the right to a clean, safe and healthy environment. The right to a clean, safe and healthy environment shall include the right of access to the various elements of the environment for recreational, education, health, spiritual, cultural and economic purposes. As such a person may, where the right referred to in subsection (1) is threatened or is likely to be threatened as a result of an actor omission of any other person, bring an action against the person whose act or omission is likely to cause harm to human health or the environment.

The action referred to in subsection may seek to prevent stop or discontinue any activity or omission, which threatens, or is likely to cause harm to, human health or the environment; compel any public officer to take measures to prevent or discontinue any act or omission, which threatens, or is likely to cause harm to, human health or the environment; require that any on-going activity or omission be subjected to an environmental audit or monitoring; require the person whose activity or omission threatens, or is likely to cause harm to, human health or the environment, to take measures to protect human life or the environment; compel the person responsible for any environmental degradation to restore the degraded environment, as far as practicable, to its condition immediately prior to the damage; and provide compensation to any victim for the harm or omission and the cost of beneficial uses lost as a

result of an activity that caused harm to human health or the environment.

Every person has a duty to safeguard and enhance the environment and to inform. Additionally, the Agency of any activity or phenomenon that affects or may affect the environment. Lead ranks as one of the most serious environmental threats to human health, especially in developing countries. Young children especially with iron deficiency anemia are more susceptible since their digestive systems absorb heavy metals rapidly and they may ingest lead-contaminated soil by putting their fingers in their mouths. The most devastating effect of lead poisoning in growing children is on the mental development. Children in developing countries are more at risk due to high prevalence of anemia and malnutrition, which intensifies lead absorption. High blood lead levels in adults can cause high blood pressure, damage the kidneys, the nervous system and reproductive system. In 2000 the World Health Organization estimated that 120 million people had blood lead levels of 5-10 µg/dl and about the same number had levels above 10 µg/dl. Data for the children in this study showed that 40% had blood lead levels above 5 µg/dl, and 20% above 10 µg/dl. Less than 10% of the children had levels above 20 µg/dl, but 99% of them lived in developing regions.

Ekena (2018) reported that in some African countries, lead has not yet been banned from petrol. The number of cars and industries using lead in large cities is increasing. Also, lead has not been banned from paint or plumbing fixtures. Most of that water supply lines in cities like Karachi and Lahore are quite old and may be an important source of contamination of lead in our water. A study by Aga Khan University in Karachi showed that 80% of children aged 36 to 60 months had blood lead concentrations 10 µg/dl and that living near the city centre, application of hand to mouth activity were associated with elevated lead concentrations in blood. A survey for lead poisoning in lead factory workers in Pakistan showed median blood lead levels of 61.20 micrograms/dl. In this issue of JPMA, Agha *et al* present their study on blood lead levels in traffic policemen in Islamabad which shows that these policemen have markedly elevated blood lead levels.

3. Methodology

3.1 Research Design

This study seeks to collect data from respondents on attitudes and opinions in relation to the topic of study. The use of single sample design was chosen on the basis of the researcher's intention to conduct the study in a limited geographic scope which is Kabwe District.

Therefore, the design was aimed at ascertaining views, attitudes, values and opinions on the impact of performance appraisal. The researcher interacted with participants particularly teachers during the focus groups discussions. The use of oral interviews was to collect views from the respondents and enabled the researcher to collect more insights by probing and also to assess the opinions of the participants regarding the research problem. In this study, qualitative methods shall be used in data collection. Stone (1991) pointed out that qualitative methods are research methods which seek answers to a question and produces findings that are applicable beyond the immediate boundaries of the study.

3.2 Target Population

According to Kombo and Troup (2006), a population is a group of individuals, objects or items from which samples are taken for measurements. The target population of the respondents for this study were school leaders, and households of Katondo township of Kabwe, staffs from the Ministry of Green Economy, Mines and Healthy with other cooperating partners like ZEMA and WARMA in Kabwe District.

3.3 Sampling Method

Patton (2002) defines Sampling as the procedure a researcher uses to gather people, places, and things to study. The number of people selected in the population should have characteristics that are found in the entire population Orodho *et al.*, (2002). As such Patton, (2002) suggests that it is important to select your sample in a systematic way so as to ensure that the community or users or external actors see it as credible and inductive sample. He further recommends that samples in qualitative research are usually purposive. In this study the researcher used non-probability sampling technique specifically during the process of sample selection which was used to select respondents among residents of Kabwe District.

3.4 Sample size determination

This study considered using the following sample size of six (06) government departments in Kabwe District; this researcher conducted some interviews with four (04) officers from Kabwe District ZEMA, (06) Head teachers or deputy head teachers, (04) officers from the Ministry of health, (04) officers from the Ministry on mines, (05) officers from the Ministry of Green Economy (13) teachers, (30) Households of Katondwe township in Kabwe district or local residents, (16) pupils within the affected areas and (03) WARMA staff. As such the total sample size of respondents will be eighty-five (85). Finally, the said samples were provided the required information for this research study.

3.5 Data collection methods

Data collection instruments refer the devices or tool or instruments used to collect, measure, and analyze data related to one research interests, such as questionnaires and focus groups (Aina, (2004). As the custodians of the curriculum delivery, financial and physical development of the school, head teachers seem to be at a good position to fulfill the needs of the research. The choice of questionnaire technique was informed by (Gray, 2004) and Orodho, (2010) asserts that, questionnaires have the ability to collect large amount of information in a reasonably quick space of time, from a large number of people and the questions can be easily analyzed. Furthermore, Gray (2004) observes that through questionnaires, the respondents are not influenced or tempted to impress by exaggerated responses or socially desirable responses hence able to achieve higher response rates. Questionnaires were administered to eighty-five (85). The researcher used open ended questionnaires an interview schedule as the primary data collection instruments. Additionally, the researcher administered the questionnaires to the respondents within 30 working days. The (30) selected households were visited randomly and the questionnaires will be administered to the respondents. The

respondents were assured that strict confidentiality will be maintained in dealing with the responses. The interviews were used to get opinions from the stated respondents. Secondary data was obtained from official records, reports, internet, dissertations, books available in the libraries and journals. Additionally, the interviews of this study will be conducted to Kabwe residents, healthy administrators in the selected compounds (Makululu and Chowa) in Kabwe District.

3.6 Data Analysis

The data gathered was systematically coded in Microsoft Excel spread sheets and then subjected to statistical analysis using STATA in order to generate tabulations and cross tabulations. This was so after receiving raw data from various selected schools, data were coded, checked for completeness and analyzed manually using descriptive statistics.

3.7 Triangulation

To facilitate validation of the data, the collected data were cross-verified by comparing it to the data that would be obtained from a parallel source that would involve respondents that were not holding any administrative positions. Triangulation refers to the use of multiple methods or data sources in qualitative research to develop a comprehensive understanding of phenomena (Patton, 1999). Triangulation of data sources in this study warranted the exactness of findings. In summation the continuous feedbacks between the researcher and the supervisors led to the revision in amending problems in the instruments of this study.

3.8 Limitations of the study

This study involved only two (2) selected areas affected by lead poisoning of Kabwe District precisely, Chowa and Makululu. Consequently, its results may not be generalized to all areas or compounds in Kabwe District. Other study limitations may be finances and time that limited this researcher in collecting data as most of our intended respondents were in far distances this researcher to visit all affected areas by lead poisoning. However, the findings from this study can still be of great use in the management, awareness, measures, planning and effective policy implementation on lead poisoning in Kabwe District.

3.9 Ethical considerations

The study was guided by the following ethical considerations: participants were allowed to decline or to participate freely through the use of a consent form; names of participants were kept anonymous; confidentiality of the participants were assured in that the information obtained from participants and respondents were not to be used for any other purposes other than the ones intended for in the study; derogatory statements that could harm the respondents were avoided because dealing with human beings in research requires that research ethics are adhered to. According to Houtenville, (2003) research ethics are important in social sciences.

4. Results and Discussion

4.1 Presentation of results on background

a) Respondents being aware of the lead contamination

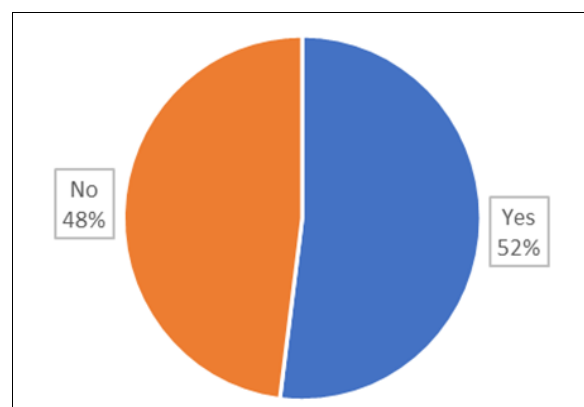


Fig 2: Respondents being aware of the lead contamination

Participants were asked to whether they are aware of contamination caused by lead and it was revealed that 52% were aware of lead contamination while 48% of the respondents denoted that they were not aware, this entails that most respondents were aware of the presence of lead contamination and they stayed long time in the study area. Those not aware 48% meant that that were no deliberate follow ups programs in the study area intended to educate residents on lead poisoning.

b) Respondents being aware of awareness campaigns on lead contamination

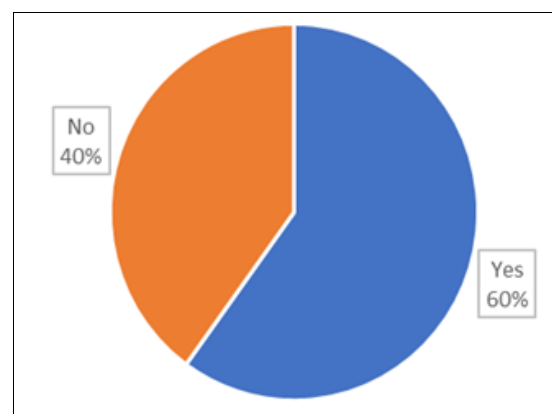


Fig 3:

Participants were asked to whether they are aware of campaigns being conducted to sensitive the public about lead poison contamination in the and it was revealed that 60% were aware of lead contamination campaign while 40% of the respondents denoted that they were not aware, this entails that most respondents were aware of the presence of lead contamination and they stayed long time in the study area.

c) Sources of information on lead contamination

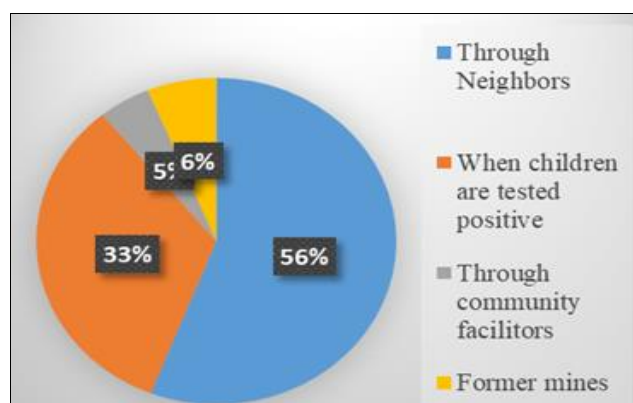


Fig 4:

Having established the state of awareness among the respondents, the next item examined was the source of information for residents. Accounting for 56% indicated through neighbors', 33% indicated when children are tested 6% indicated through community facilitators and 5% former miners, however, the data revealed that the majority of respondents 56 became aware through neighbors.

d) Availability of sensitization programs

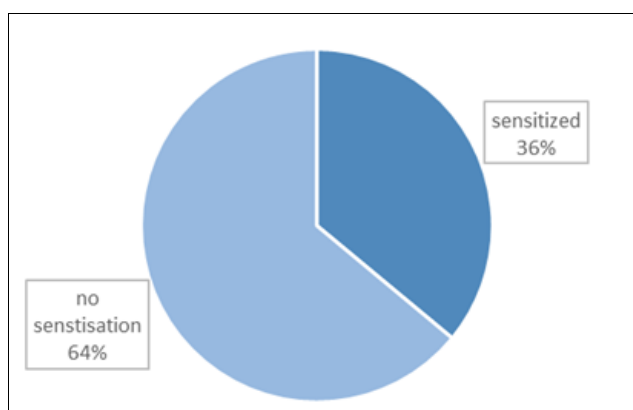


Fig 5:

With regards the availability of sensitization programs on contamination by lead poison, 64% of respondents indicated that there are no such programs in the area while 36% indicated that the sensitization programs are available.

e) Accessibility of information



Fig 6:

The respondents were required to state whether or not it was easy to access information on the effects of lead poison, the majority of respondents 53% stated that there was easy access information on effects of lead contamination, while the 47% indicated that it was not accessible.

f) Level of implementation of government policy in managing the lead poisoning

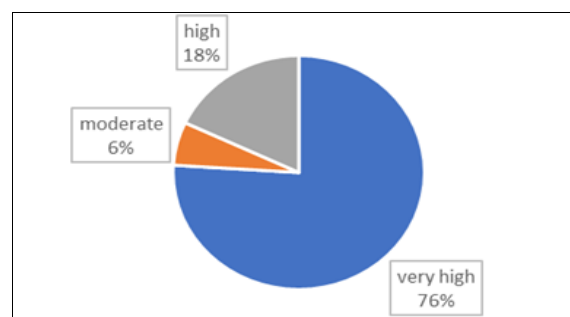


Fig 7:

Figure above shows that, about 50% of the respondents responded the Zambian government has clearly acknowledged full responsibility for remedying the ongoing harms caused by the now defunct Kabwe mine. On the other hand, 13% of the respondents argued that the local authority has started or developed a program for sustainable, comprehensive lead remediation, testing, and treatment in Kabwe. However, 6% of the respondents said that this program for lead contamination remediation among affected Kabwe residents will establish a fund to support ongoing nutrition and health care needs for long-term lead affected residents of Kabwe through local clinics supported by the ministry of health. About 5% of the respondents of this research study said that, they were not sure of any implementation by government policy in managing the lead poisoning among affected Kabwe residents. Additionally, about 16% of respondents said that the local authority in collaboration with officers from ZEMA, ministry of mines, local donors and ministry of healthy have on off season paved roads in contaminated townships of Chowa and Makululu of Kabwe District to reduce dust. About 10% respondents said that, the government has on occasion times conducted regular monitoring of soil and air lead levels in Kabwe District, and published the results and inform miners about precautions they should take to protect themselves and their families from lead.

g) Availability of government funded programs aimed at reducing the impact of lead poisoning

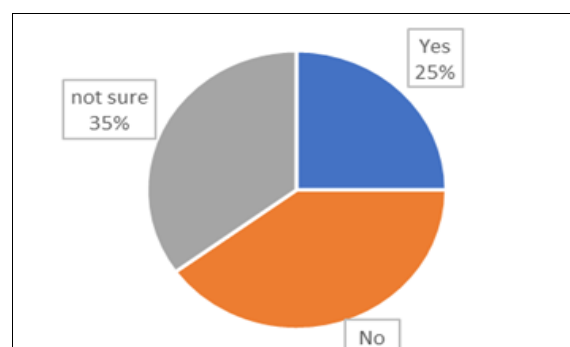


Fig 8:

Participants were asked whether there are funded programs aimed at reducing the impact of lead poison in Kabwe district and to this question, 40% indicated that they are not aware of such programs while 25% said they have an idea of such programs and the rest representing 35% were not sure whether such programs were there or not.

h) Usefulness of the programs in reducing the impact of lead poison

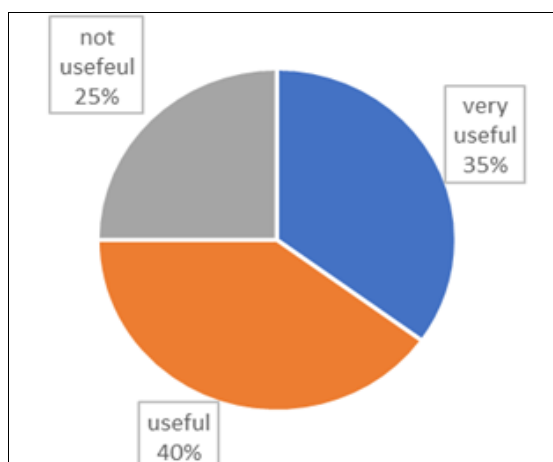


Fig 9:

With regards the usefulness of usefulness of the programs in reducing the impact of lead poison, 40% stated that the programs are useful, 35% indicated that the program is very useful and the rest representing 25% said the programs are not useful because very few individuals no about the problems that lead has on the environment.

i) Extent to which government funded programs help in mitigating the impact

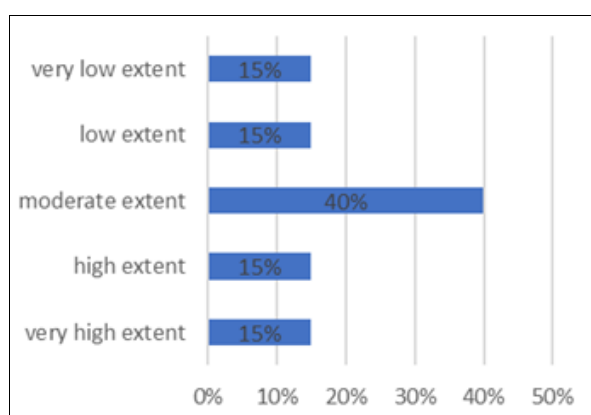


Fig 10:

Concerning the extent to which government funded programs help in mitigating the impact of lead poisoning, 15% said the extent is very low, the other 15% indicated that the extent is low, those who said it is moderate represent 40% while the 15% indicated that the extent is high and the other 15% said it is very high.

j) Effectiveness of government funded programs in mitigating the impact

Concerning the effectiveness of government funding in mitigating the impact of lead poisoning, 35% indicated that

the funding is very effective, 25% indicated that the funding is effective, while 15% said it is not effective and the rest representing 15% said the funding is not effective.

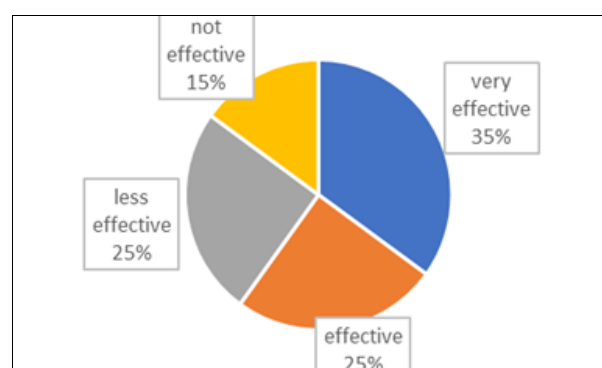


Fig 11:

k) Awareness on the availability of the mine and mineral environment policy

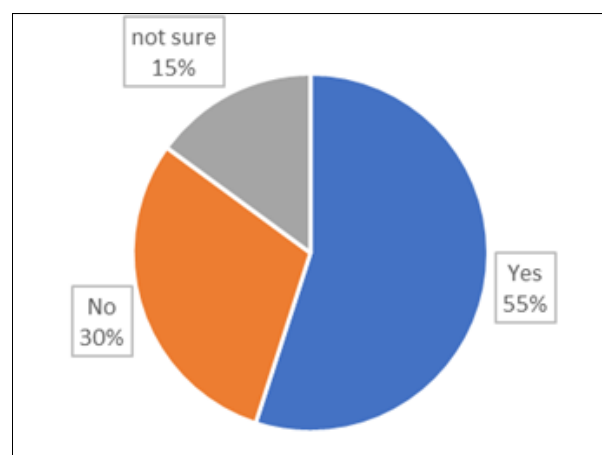


Fig 12:

Participants were asked whether they are aware of the mine and mineral environmental policy aimed at mitigating the impact that comes with lead poisoning, 30% indicated that they are not aware of such policy while 55% said they aware of its availability and the rest representing 15% were not sure whether such a policy exists.

l) Preventive measures by government and stakeholders on lead poisoning effects

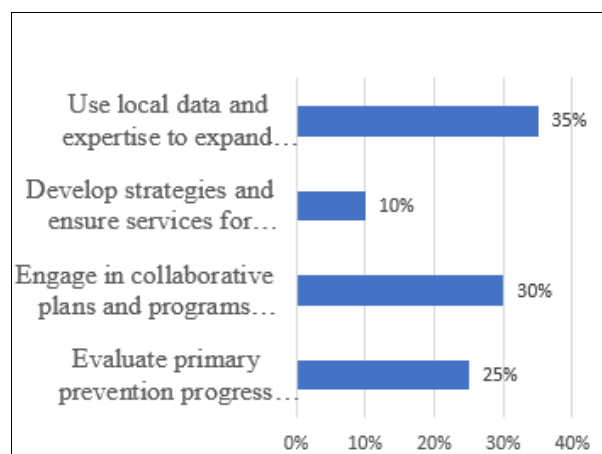


Fig 13:

The study has revealed that various measure has been put in place and 35% indicated that use of local data and expertise to expand resources and motivation action, 10% indicated that developing and implementation of strategies which are aimed at ensuring services for creating lead safe housing, 30% indicated that engaging in collaboration plans and other appropriate agencies and the rest 25% said evaluating primary prevention progress and identify research opportunities. Other respondents said that, ZEMA and the Ministry of Healthy publish existing data on lead levels in soil, air, and elsewhere in the environment in affected areas of Kabwe District. Additionally, the Ministry of Mines and Minerals has 12% assurance that the remediation of contaminated hotspots and any other efforts are comprehensive and sustainable.

m) vailability of Factors that affects government policy in managing the lead poisoning

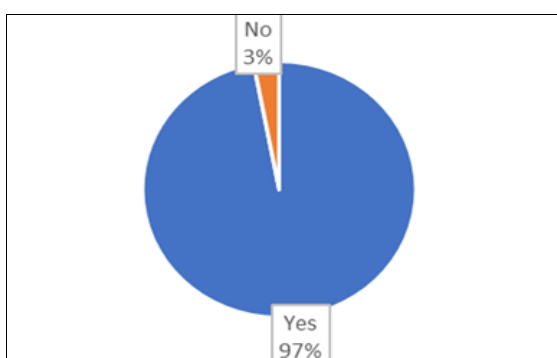


Fig 14:

It has been pointed out that there are indeed factors affecting government from managing lead poisoning in Kabwe effectively, accounting for 97% indicated that there are factors while 3% indicated that there are no such factors.

n) Factors affecting government in effective managing of lead poisoning

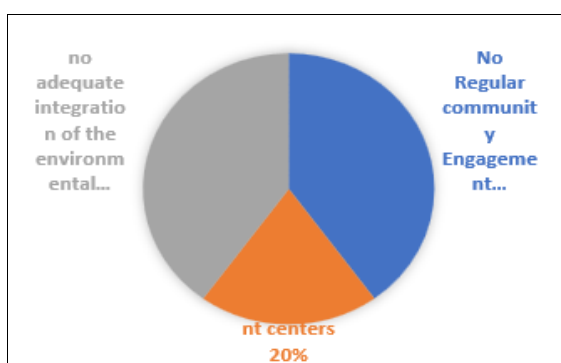


Fig 15:

Local residents do not promote regular community engagement and information-sharing under the Zambia. There is no adequate integration of the environmental education on lead into the school curriculum in Kabwe, and no insurance of teachers receiving additional training to understand how lead can affect learning and the future of the learners at large. Finally, there are no District Assessment Centre to request lead tests for children in homes, schools and markets.

o) Effectiveness of government policy in mitigating the impact of lead poisoning

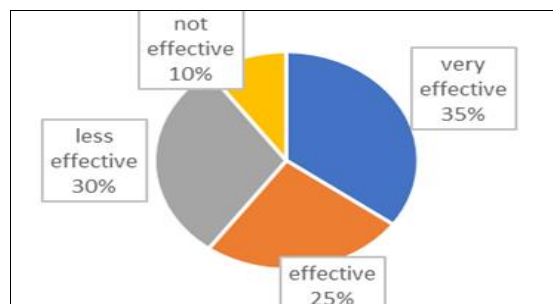


Fig 16:

Concerning the effectiveness of government policy in mitigating the impact of lead poisoning, 35% indicated that the funding is very effective, 25% indicated that the funding is effective, while 30% said it is less effective and the rest representing 10% said the funding is not effective.

p) Limitations associated with policy implementation

Resistance to relocate from affected areas	20%
Illegal mining of lead	10%
Failure to comply by community members	25%
Failure to make follow ups on reported cases of lead poisoning	15%
Limited funding	20%
Lack of effective sensitisation	10%

With regards the limitations associated with mining and environmental policy are numerous according to participants and 20% stated that there is resistance from local residents when it comes to relocation and this have posed a challenged in ensuring effective implementation of the policy, 10% stated that there has been illegal activities in the affected areas which usually makes it almost impossible to keep the community away from the exposure, 25% said there has been failure to make follow-ups on those have been exposed before while 15% revealed that funding has been limited making it impossible to effectively conduct sensitization and promote a healthy population and the rest representing 10% said there has been lack of effective sensitization.

q) Health personnel educate patients about lead poisoning

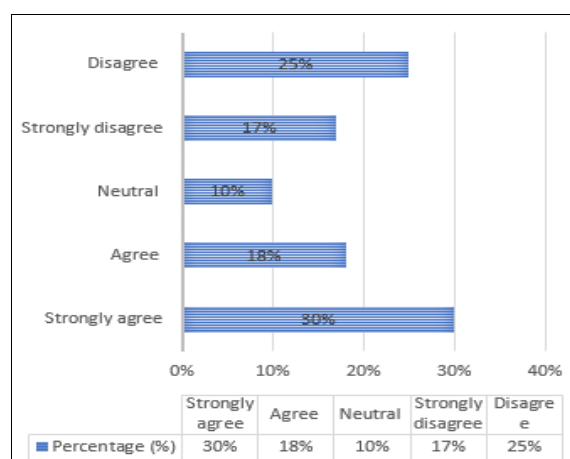


Fig 17:

It is evident that most respondent didn't agree that when they go the clinic health personnel educate them on lead poisoning accounting for 17% strongly disagreed while 25% disagreed, 18% agreed and 10% neither agreed nor disagreed.

r) Condition of government screening and testing for lead poisoning

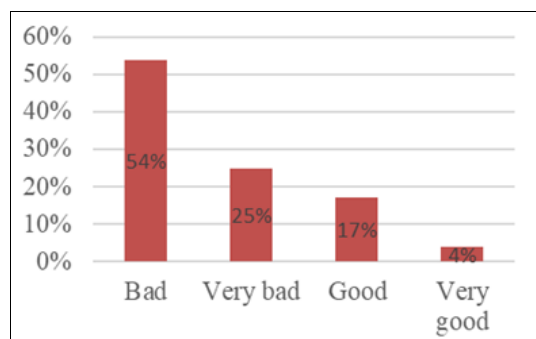


Fig 18:

The researcher asked the respondents to rate the public health situation in schools and the results were as shown, very good (4%), Good (17%), Bad (54%) and very bad (25%). According to the respondent the situation is bad because school environments are not protected as it should be in Kabwe.

4.4.9 Measures to be put in place by government

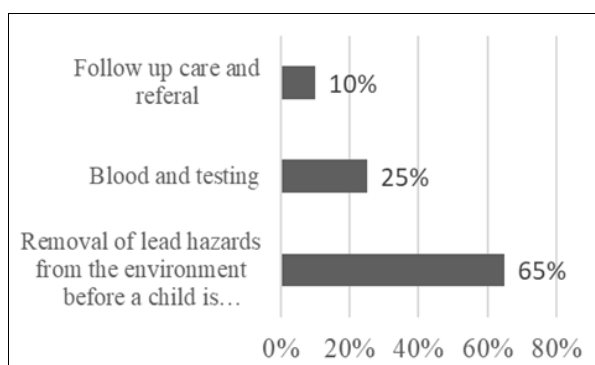


Fig 19: Measures to be put in place by government

Protecting children from exposure to lead is important to lifelong good health. No safe blood lead level in children has been identified. However, preventive measures include removal of lead hazards from the environment before a child is exposed as they are the most vulnerable. Removal of hazards is the most effective way to ensure that children do not experience harmful long-term effects of lead. With 65% as the majority indicated removal of lead hazards from the environment.

4.2 Discussions of findings

This study characterized the respondents according to their age groups to clearly understand the spread of the thesis of the problem at hand. The reason behind this concept was that, age gaps in most cases disturb perception and attitudes towards something. Additionally, the following were respondents age ranges who participated in this research study; 15 to 20 years of age who were represented by 31%.

However, those respondents who were between 21 to 45 years old represented 42%. In addition, 18% represented those respondents who were 45 to 65 years, while 50 to 65 years old were represented by 9%.

It was reviewed that 62% of the respondents of the respondents were married and 21% were single. Very few were widowed 10% and divorced 7% respectively.

The study showed that, the majority of the respondents had formal education up to primary level 20% and those that went up to secondary 36%. About 8% of respondents reported as never been to school, college and university education was only with 17% of the women, 10% represented those who attended skills trainings after secondary education while about 3% represented respondents who were not sure of whether, they even entered any formal school.

The responded were asked to indicate the type of occupation they did, from the data above, the majority of respondents belonged to business in the area of research, accounting for 25% were students while 20% were non-working, 25% were civil servants and business had 30%. From the findings this meant that a lot of respondents were not employed in formal jobs.

The respondents were further asked to signify the period of stay in the area, the majority had lived in the area for three years with 32% while 30% lived in the study area for a year and 18% lived for five years and 5 lived for two years, people usually move out the area for fear lead contamination. The responses were important to the study because it would show whether the activities exposing residents to lead contamination were done by new members in the study area who did not understand the environmental issues of areas. It was discovered that 46% of the respondents were from unplanned settlement while 28% were from planned settlements. Thus 17% of the respondents in the informal house structures were not knowledgeable about lead poisoning precautionary measures compared to 9% of those in the formal house structures. However, there was significant association between residence and knowledge level about lead poisoning measures.

The low knowledge level of the lead precautionary measures among women in high lead poisoning exposure residential areas may be attributed to not given enough information of lead poisoning prevention or getting information from non-established sources such as friend and spouses that may not have accurate information. The low knowledge levels of child bearing age women about lead precautionary measures in endemic or widespread areas can be a danger to the households in the community because of lead exposure side effects including anemia. Although there was inadequate information on the prevention of lead poisoning in homes, 94.3% of the respondents believed that lead poisoning was a serious problem in Kabwe.

It is very important to know the socio-demographic characteristic of the respondents because it helps to assess the representativeness of the sample. This may have a bearing on how the study participants responded to the questions on lead poisoning. This research study revealed that out of the 80 respondents interviewed, the majority (70%) fell in the age group 15-50 years and the least was below 16 years at 5%. This may be reflective of the Zambia's social demography that shows that the majority of the population is young (CSO, 2012). The 16-50 age group is

sexually active and the most productive meaning the triple roles of the women is most prominent; they are domestic workers, child minders, and child bearers.

Therefore, the findings of this research study are likely to have a significant bearing on the prevention of lead poisoning in homes. Most of the respondents were involved in selling at the market and keeping children at home. At the market, some respondents were selling vegetables that may have been grown in lead contaminated soils even mere soil from old mining area that some pregnant women were fond of eating in homes. The majority of the respondents had their own homes and, therefore, was decision makers in the homes about lead poisoning precautionary measures. Only 10 respondents were below 16 years old and they were included so that the same age group that was included during the lead poisoning prevalence studies conducted by ZCCM-IH were also captured for the knowledge levels (ZCCM-IH, 2005). 63.7% of the respondents were married and 21.4% were single which is reflective of figure 7 that shows the majority of the respondents were influenced by their spouses or self on lead poisoning. Very few were widowed or divorced at 9.8% and 5.1% respectively.

The survey revealed that 68% of the respondents were from unplanned settlement while 32% were from planned settlements. 41% of the respondents in unplanned settlement were not knowledgeable about lead poisoning precautionary measures compared to 16% of the respondents in planned settlement. However, there was significant association between residence and knowledge level about lead poisoning precautionary measures. This could be attributed to few numbers of established sensitizations points that were being conducted in the communities by Lead Treatment Support Groups and other health promoters in Makululu, Kasanda and Chowa.

4.2.1 Awareness campaigns put in place by government regarding effects of lead poisoning

The study has revealed that majority of community members are aware of the awareness campaigns which the government has embarked on, however, the minority indicated that they have not yet come across such campaigns. Local authorities talked to explained that awareness campaigns are conducted by the government in ensuring that every member is aware of the dangers that come with exposure to lead.

The study revealed that the Zambian government has clearly acknowledged full responsibility for remedying the ongoing harms caused by the now defunct Kabwe mine. On the other hand, some of the respondents argued that the local authority has started or developed a program for sustainable, comprehensive lead remediation, testing, and treatment in Kabwe. The study has revealed that some community members are not sure of any implementation by government policy in managing the lead poisoning among affected Kabwe residents. Additionally, some local authority talked to said local authority in collaboration with officers from ZEMA, ministry of mines, local donors and ministry of healthy have on off season paved roads in contaminated townships of Chowa and Makululu of Kabwe District to reduce dust. About 10% respondents said that, the government has on occasion times conducted regular monitoring of soil and air lead levels in Kabwe District, and published the results and inform miners about precautions they should take to protect themselves and their families

from lead.

4.2.2 Effectiveness of government funding in lead poisoning remediation

Concerning the effectiveness of government funding in mitigating the impact of lead poisoning, 35% indicated that the funding is very effective, 25% indicated that the funding is effective, while 15% said it is not effective and the rest representing 15% said the funding is not effective. Findings cleared indicate that the government has been doing its best in promoting good health via funding of projects aimed at reducing the impact of lead poisoning, this can be seen from the tiring of the road to reduce duct in some residential areas.

The World Bank (2020a) notes that progress has been made towards remediation under the Zambia Mining and Environmental Remediation and Implementation Project. Through overall implementation progress is rated as 'moderately unsatisfactory' as of December 21ST, 2020, there has been some success. One success story involves the remediation of Mine Primary School which lies a mere 198.12 meters from the dumpsite under the ZMERIP (The World Bank, 2020b). The report is however silent on the nature of remediation underway.

4.2.3 Effectiveness of the mine and mineral environment policy on decommissioned dumps

Local residents do not promote regular community engagement and information-sharing under the Zambia. There is no adequate integration of the environmental education on lead into the school curriculum in Kabwe, and no insurance of teachers receiving additional training to understand how lead can affect learning and the future of the learners at large. Finally, there are no District Assessment Centre to request lead tests for children in homes, schools and markets

Concerning the effectiveness of government policy in mitigating the impact of lead poisoning, 35% indicated that the funding is very effective, 25% indicated that the funding is effective, while 30% said it is less effective and the rest representing 10% said the funding is not effective.

It was discovered that 46% of the respondents were from unplanned settlement while 28% were from planned settlements. Thus 17% of the respondents in the informal house structures were not knowledgeable about lead poisoning precautionary measures compared to 9% of those in the formal house structures. However, there was significant association between residence and knowledge level about lead poisoning measures.

Preventive measures put in place by government through local authorities and stakeholders regarding lead poisoning effects.

The study indicated that local government officers or respondents argued that, there are major preventive measures that government has and is implementing to the residents of Kabwe District regarding lead poisoning. About 50% respondents said that, ZEMA and the Ministry of Healthy publish existing data on lead levels in soil, air, and elsewhere in the environment in affected areas of Kabwe District. Additionally, the Ministry of Mines and Minerals has 12% assurance that the remediation of contaminated hotspots and any other efforts are comprehensive and sustainable.

Bwalya (2019) reports that according to section of environmental management act no.12 of 2011 holds that, every human person has the right to clean, safe and healthy environment cap. (1) Subject to the Constitution, every person living in Zambia has the right to a clean, safe and healthy environment. The right to a clean, safe and healthy environment shall include the right of access to the various elements of the environment for recreational, education, health, spiritual, cultural and economic purposes. As such a person may, where the right referred to in subsection (1) is threatened or is likely to be threatened as a result of an actor omission of any other person, bring an action against the person whose act or omission is likely to cause harm to human health or the environment.

4.2.4 Limitations in the mining management of dumps

Local residents do not promote regular community engagement and information-sharing under the Zambia. There is no adequate integration of the environmental education on lead into the school curriculum in Kabwe, and no insurance of teachers receiving additional training to understand how lead can affect learning and the future of the learners at large. Finally, there are no District Assessment Centre to request lead tests for children in homes, schools and markets.

Assessing awareness put in place by government regarding lead poisoning effects

The figure revealed that more respondents accounting for (66.67%) strongly agreed to this fact as opposed to the minority representing 9 (7.5%) disagreed. This would help better response as Kabwe indeed happens to be among the places contaminated with lead poison.

In Zambia, there is no adequate integration of the environmental education on lead into the school curriculum in Kabwe, and no insurance of teachers receiving additional training to understand how lead can affect learning and the future of the learners at large. Finally, there are no District Assessment Centre to request lead tests for children in homes, schools and markets

The respondents were required to state whether or not it was easy to access information on the effects of lead poison, the majority of respondents stated that it was easy access information on effects of lead contamination. This shows that despite the challenges, Government has been trying its best in ensuring that the impact that led has is mitigated.

James (2018) in his study reported lack of modern waste equipment, financial resources from the local authority, legal and administrative enforcement of environmental regulations and lack of community willingness to the polluter pay principle. Together with these issues, this study established the lack of public awareness and environmental ethics that result in un-sustained solid waste management and disposal.

5. Conclusions

The study was conducted to assess the extent of knowledge of precautionary measures among child-bearing age women in high lead exposure residential areas in Kabwe. However, using both qualitative and quantitative techniques, this study revealed a number of key issues that should be addressed in the sensitization of the communities that stay in high lead residential areas of Kabwe. However, the women's knowledge on lead poisoning precautionary measures was only 40% in the respondents. This revealed a significantly

low level of knowledge in lead precautionary measures. The low level of knowledge may explain why there is high number of children and child bearing age women with high blood lead levels in the population. It may also explain why people are building houses in the highly lead contaminated areas. Some of the residents in the lead endemic areas are involved in the selling of contaminated soil, vegetables or crushed stones and sand. The study has revealed that the government has been doing its best in ensuring that people are sensitized and moved out such places, however, some members of the community indicated that the effort from the government is not enough there is need to increase the funding so that the effectiveness of the policy and measure the government has put in place can effectively perform their intended purposes. Despite the efforts from the government, the implementation of the policy has come with some limitation and among the common limitation are resistance from community members to move out of the areas affected by lead and limited funding among others.

Based on the findings of this study, the following recommendations were made;

The Zambian government has clearly acknowledged full responsibility for remedying the ongoing harms caused by the now-defunct Kabwe mine. Develop a program for sustainable, comprehensive lead remediation, testing, and treatment in Kabwe. The program should establish a fund to support ongoing nutrition and health care needs for long-term lead-affected residents of Kabwe.

6. Acknowledgments

First and foremost, I would like to thank the almighty God for granting me the strength, perseverance and patience throughout this process. I would like to sincerely thank my supervisor, Mr. Kelvin Chibomba for his professional guidance throughout this study. He availed his time, insight and scholarly support not only during the course of this study but throughout my educational career. To him I am highly indebted. My sincere gratitude goes to the authorities of the organisations visited for granting me permission to collect data from them. I wish to extend my gratitude to all my colleagues that contributed in one way or the other in the completion of this study. Their contributions have been extremely helpful. I would also like to thank all the respondents and informants for their time in answering the questionnaires and interview questions and also for their cooperation and support in the provision of vital information that was needed to complete this study.

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