

**THE IMPACT OF MERCURY USE IN THE SMALL-SCALE GOLD
MINING SECTOR ON WOMEN OF REPRODUCTIVE AGE: A CASE
STUDY OF KADOMA**

BY

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**A DISSERTATION SUBMITTED TO THE DEPARTMENT OF GEOGRAPHY AND
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REQUIREMENTS OF THE BACHELOR OF SOCIAL SCIENCES HONOURS DEGREE
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MAY 2018

Declaration

I confirm that this is my original work and the material used from other sources to compile this dissertation has been acknowledged.

.....

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Approval Form

The undersigned persons certify that they have read and therefore recommend Midlands State University to accept a dissertation entitled: *The impact of mercury use in the small-scale gold mining sector on women of reproductive age: A case study of Kadoma*. The dissertation is submitted by R144471M in partial fulfilment of the requirements for the attainment of a Bachelor of Social Science Degree in Geography and Environmental Studies.

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Dedication

This dissertation is dedicated to my loving family. Your love and support overwhelms me.

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I wish to acknowledge my personal Lord and saviour Jesus Christ for allowing me to reach this far. I would also want to thank my Work-Related Supervisors Mr. Wiseman Muzorori and Mr. Average Muzorori for their assistance during this research. Moreover, I wish to extend my gratitude to my supervisor Dr V Madebwe for his guidance and professional expertise, my lecturers as well as my friends from the department of Geography and Environmental Studies for their support and inspiration. I also want to thank all the people who provided me with some useful information for this study the likes of Mr. Ruzvidzo from Small Scale Miners Association of Kadoma. Lastly, I am humbled by the unwavering financial and emotional support of my family throughout the course of this degree programme, I wish to thank my brother Kudakwashe, my sisters Pieter and Mavis as well as my parents Mr. and Mrs. Manga. May God richly bless you and give you your hearts desires!

Abstract

The aim of the study was to analyse the impact of mercury use in the small-scale gold mining sector on women of reproductive age in Kadoma, Zimbabwe. A mixed research design was used for this study, whereby both quantitative and qualitative data collection techniques were applied. Purposive sampling technique was used to determine a cohort of 85 respondents and data was collected through self-administered questionnaires, interviews with key respondents from Small Scale Miner`s Associations of Kadoma and Environmental Management Agency as well as direct field observations. Research findings showed that 63% of the women participating in gold mining activities are between the ages 25 and 35, 56% are married and 68% have household sizes of between 7 to 9 people. The findings also revealed that 40% of the women in the 30-35 year age group are exposed to mercury through amalgam making, 96% of the women in the 36-40 year age group exposed to mercury through amalgam burning while 33% are exposed to mercury through purifying mercury using nitric acid and others exposed to mercuric vapour due to their proximity to amalgam burning places. Strategies employed to reduce exposure to mercury include use of retorts and rotating of mining duties. Recommendations were made that the women of reproductive age should refrain from using mercury and adopt the use of other methods which reduce exposure to mercury like the “Kitchen Bowl” retort.

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Acronyms

EMA	Environmental Management Agency
EPA	Environmental Protection Agency
WHO	World Health Organisation
UNEP	United Nations Environmental Programme
PPE	Personal Protective Equipment
UNIDO	United Nations International Development Organisation

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Artisanal and small-scale gold mining has a close link with the global emission of mercury. The emission of mercury is a growing environmental concern. According to Dozolme (2017) an estimated 10-15 million miners in 70 countries worldwide survive on small scale gold mining, and of that population 3 million are women and children. Small scale gold mining produces approximately 15% of the annual global gold production.

The United Nations Industrial Development Organization (2012) asserts that an estimated 100 tons of mercury through the small-scale gold mining sector is released each year into the water, soil and air. Mercury is used in the process of purifying gold from gold ore through amalgamation. During amalgamation, miners can inhale toxic mercury vapors which has fatal health effects to human beings. Mercury causes severe and permanent damage to the nervous system leading to mental retardation, vision and hearing loss, memory loss and delayed development. It also has harmful effects on the digestive and immune systems, and also affects developing embryos, (WHO 2008). The current health concerns of mercury use can be traced back to the methylmercury poisoning in Minamata, Japan in 1950 where many people died due to the consumption of fish that was contaminated with mercury from the gold mining effluent.

Boney (1999) describes mercury as a persistent substance which originates from natural and anthropogenic sources, it is the only metal which is a liquid at room temperature and pressure and a solid if it freezes at -38° and a gas if boiled at 674°F . Mercury blends easily with various metals like gold, silver and tin, hence forming a mixture or an amalgam. It is therefore used to extract metallic gold from gold ore through the burning of the amalgams.

According to Veiga (1997), mercury is found in three forms namely elemental (metallic) mercury, organic mercury and inorganic mercury compounds. Elementary mercury $\text{Hg}(0)$ is the form of mercury that is used in amalgamation of gold, it is a liquid and it also volatilizes quickly,

in humans it can be measured in hair or urine samples and its effects include respiratory failure and insomnia.

Inorganic mercury is formed when mercury combines with other elements like Sulphur and oxygen to form compounds like mercuric sulphide $Hg(S)$ and mercuric oxide $Hg(O)$, it is relatively the least toxic of all the other forms of mercury. Lastly, organic mercury which is formed when mercury combines with carbon, examples include dimethylmercury and monomethyl mercury which are found in the environment and accumulate in the food chain (EPA 2009).

Small scale gold mining, as explained by Jennings (2012) is mainly poverty driven and is practiced by people with little or no employment alternatives or people who lack employment in the formal sector and it is largely practiced in most rural areas of developing countries, and is characterized by low capital. In relation to this assertion, miners make use of mercury in gold mining because it is regarded as the most cost effective and the easiest method of gold separation.

According to EPA (2012), small scale gold mining is the largest demand for mercury globally and approximately 14000 tons of mercury in 2011 were used in small scale gold mines globally. Colombia was named as the largest worldwide mercury polluter per capita due to small scale gold mining, while Zimbabwe is also one of the top ten users of mercury in small scale gold mining with an average of 25ton per year (Cordy and Veiga 2012)

Van Straaten (2000) indicates that 70 to 80% of the mercury used during gold mining is lost to the atmosphere during the processing stage while 20 to 30% is lost to tailings, soil and water. For every 1g of gold produced, therefore, approximately 1,2 to 1,5 g of mercury are lost to the environment. A study by UNEP (2012) estimates that 3,5 million people are exposed to the health impacts of small scale gold mining and 2,5 million are in Africa.

Mining operations have been carried in Kadoma since the 1940`s but small-scale gold mining activities have been practiced in Kadoma after 1980 but operations have increased since 2000.

Women involved in small scale gold mining in Kadoma are approximately 11 % of the total miners and their participation in gold mining have been increased by lack of employment in the formal sector. Mercury is used in small scale gold mining because it is relatively cheap, easily accessible and easier to use than other methods of gold processing.

1.2 Statement of the problem

Mining is traditionally a male dominated field, but due to the economic hardships, unemployment and declining agricultural production there is an increase in the number of women who are participating in small scale gold mining. Kadoma lies within one of the largest gold belts of Zimbabwe and miners use mercury to separate gold from the gold ore, and during this process, they are exposed to mercury. By its nature, mercury does not break down in the environment, but is rather cycled between the air, water and land and the mercury vapour can travel large distances from its source, and hence the people nearby are exposed to inhaling the mercury vapour. The mercury which is washed into the rivers is converted to methylmercury found in fish and the consumption of the fish results in mercury contamination in humans causing various health problems.

According to Veiga and Shoko (2004) women consist of 11% of the miners in the small-scale mining sector of Kadoma. Women perform various tasks at the mines which include crushing, transporting and the burning of amalgam. During the burning of amalgams, the miners are exposed to mercury vapors and the inhalation of this mercury leads to some health effects, neurological damage, kidney damage and immune damage. Some effects on women of reproductive age include pre-term deliveries, still births, abortions, poor development of the embryos in pregnant women. Traces of mercury in breast milk of breastfeeding mothers also poses neurotoxic health effects on the babies.

Studies that have been carried out on the Claw dam indicate elevated levels of mercury contamination. According to Chara (2017) some of the residents of Kadoma that were interviewed complained of the poor metallic taste of the fish from Claw Dam as compared to fish from other areas, this therefore is an indication of mercury contamination in the water bodies. Boese- O`Reiley et al (2004) indicates that samples which were tested among the small scale

gold miners in Kadoma showed alarming levels of mercury in the hair, urine and the blood of the miners and millers from various mines and mills in Kadoma.

1.3 Objectives of the study

1.3.1 General Objective

To analyse the impact of mercury use in the small-scale gold mining sector of Kadoma on women of reproductive age.

Specific Objectives

- To analyse the demographic characteristics of the women engaged in small scale gold mining in Kadoma.
- To identify the gold processing activities that expose the women of reproductive ages to mercury.
- To evaluate the strategies used to reduce the exposure to mercury during gold mining in Kadoma.

1.4 Justification of the study

Mercury contamination has been and still is an environmental problem that has been posing major threat to plants, humans and wildlife. The area under study lies within the largest gold belts of Zimbabwe and has the highest density of small scale gold miners. Small scale gold miners mainly rely on mercury use since most of them cannot afford the more developed methods and machinery of gold processing and purification. Mercury exists in the environment through natural causes like volcanoes and anthropogenic causes like mining and manufacturing and while it may not be practical to try and control natural sources of mercury, it is however possible to control the anthropogenic sources of mercury in the environment. It is the thrust of this study to identify the mining activities performed by the women of reproductive ages which expose them to mercury as well as make recommendations to reduce mercury exposure and pollution.

According to WHO (2017) elemental mercury is highly toxic and causes various health effects to human life. Inhalation of mercury dust causes harmful effects on the digestive, nervous and

immune system. Lungs and kidneys maybe completely damaged. Inorganic mercury particles are corrosive to the skin, eyes and gastrointestinal tract. During the burning of amalgam, the miners are exposed to mercury vapors and the inhalation results in it building up in the kidneys and causing severe kidney problems like increased protein in the urine and kidney failure. According to Boese- O`Reiley et al(2004), samples that were collected and tested in Kadoma from the illegal and small-scale gold miners showed a higher level of mercury in their urine, hair and blood. This therefore rises concern on the accelerated use of mercury in gold mining.

Chara (2017) indicates that mercury is readily available in Kadoma for purchase in pharmacies and hardware shops, to purchase it there is no licensing that is required and it is very cheap for the small-scale miners and any other person who intends to buy. It calls for a study to be undertaken to investigate the ways of exposure to mercury for the miners as well as its impact on their health.

This study will benefit Kadoma city council as it will provide information on the use of mercury within their city. It will produce information on the gold mining activities that are exposing women to mercury and hence it will ultimately be useful for the Kadoma Health Department in formulating ways to manage the health issues arising from mercury. Furthermore, the study will be beneficial to the researcher as enlightenment will be brought out on the impacts of small scale gold mining using mercury on women of reproductive ages. Policy makers will be informed on the mining activities which expose miners to mercury, therefore assist them on formulating more policies regarding this situation.

1.5 Description of Study Area

The area under study is Kadoma City, located in the Mashonaland West Province of Zimbabwe. The geographical coordinates are 18.33° South, 29.92° East, with an elevation of 1192 meters. and it is located 166km southwest of Harare, the capital of Zimbabwe. The climate of Kadoma is warm and temperate and when compared with winter, the summers have much more rainfall. The average annual temperature is 20.4 °C in Kadoma while the average annual rainfall is 750 mm.

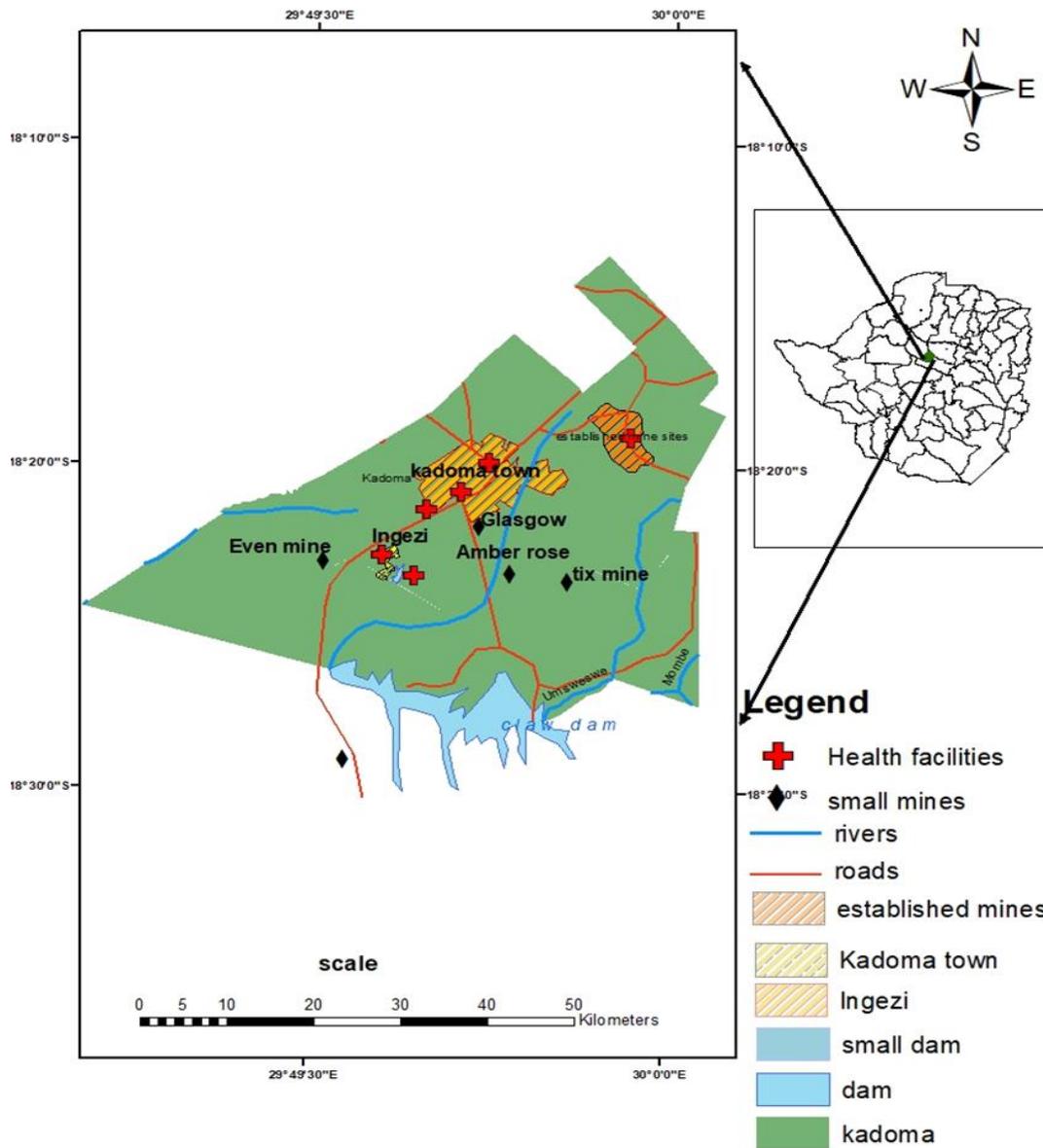


Figure 1.1 Physiographic Map of Kadoma District, Mashonaland West

Kadoma has an estimated 79 880 inhabitants and the majority of the economically active people in the study area are involved in small scale gold mining. According to Shoko and Veiga (2004) Kadoma District has one of the largest gold belts deposits in the country and it also has the highest number of small scale gold miners of the country's gold belts. The mining area extends to both sides of the town, and the mining activities in this town date back to before 1980 and increased since 2000. Most adults in mining communities are concentrated in the 20-40 year age

group. The main economic activities carried out in the study area include agriculture, manufacturing and mining, which is predominantly small-scale gold mining. Amongst the farmers, the dominant age group is 21-30 years. Some of the large mines found in the area include Golden Valley, Cam and Motor and Dalny mine. More than 20 00 people engage in small scale mining in Kadoma, and of these an estimated 11% are women.

CHAPTER TWO

LITERATURE REVIEW

2.1 Global overview of small scale gold mining

Artisanal small-scale gold mining is defined by Hinton et al (2003) as mining activities that involve the use of rudimentary processes to extract gold from ore on a small scale. UNEP (2014) is of the view that small scale gold mining is conducted by individual miners or small enterprises who have limited capital investment and poor mechanization. Growing numbers of economically crippled people in the world have turned to small scale gold mining for their livelihoods. The small-scale gold mining sector is characterized by labor intensive work with the miners usually under equipped, unskilled and generally not well informed about occupational safety as well as environmental protection. This type of mining is practiced in over 70 countries by estimated 10-15 million miners, including approximately 4-5 million women and children (Telmer and Veiga 2003).

Dreschler (2003) alludes that small scale gold mining is diverse and can be classified into two categories of mining activities, namely the informal and formal small-scale mining activities and it may also be operated legally or illegally. However, small scale gold mining in most cases is usually illegal and informal and is hardly tolerated by the authorities. According to EMA (2016), illegal small-scale gold mining is mining activity done on unregistered claims in terms of the Mines and Minerals Act. The miners often use poisonous and toxic materials like mercury as well as harmful methods of gold extraction, thereby exposing themselves, their families as well as the neighboring communities to certain health effects as well as the environment to the certain pollution and degradation. UNEP (2013) estimates that 3,5 million people are at risk of suffering from certain health complications related to small scale gold mining, of which 2,5 million of them are in Africa.

The use of mercury in gold mining poses several immune and neurological health problems to miners who are exposed to mercury vapors during the burning of amalgam. Mercury is used to extract gold ore by forming an amalgam, which is then heated in order to evaporate the mercury from the mixture and hence isolating the gold (UNEP2013). Pregnant and breastfeeding women

who are exposed to mercury also expose the fetuses, while the breastfeeding women who are exposed to mercury transmit the mercury to their breastfeeding babies and hence leading to severe deformities or even death to the babies (WHO 2011).

Buxton(2013) is of the view that small scale mining activities can be long-term, seasonal, or can be carried out all year round. In many communities worldwide, small scale gold mining is practiced by families, whereby the men, women as well as the children play distinct roles during the gold mining process. The World Bank (2001) ascertains that 90% of the small-scale gold miners are economically crippled, lack employment in the formal sector and hence turn to mining to escape poverty and unemployment. Small scale gold mining, is however a vital source of livelihood for more than 13 million workers and it sustains 80- 100 million people worldwide (Logan 2004).

2.2 Small scale gold mining in Zimbabwe

2.2.1 Background of small scale gold mining

Gold mining in Zimbabwe antecedes the dawn of colonialism in 1890. The small scale gold mining and milling industry started in the late 19th century when Cecil Rhode`s British South Africa Company received charters from the British Crown to administer Southern Rhodesia in 1889 and Northern Rhodesia in 1890. The British South Africa Company supported small scale gold mining activities. Britain reclaimed control of Southern and Northern Rhodesia from the British South Africa Company but nevertheless gold production remained a priority for the colonial administration.

Mining in the pre-colonial era mainly entailed small works in the extraction of gold as well as other valuable minerals like copper and iron, but it was however restricted to whites during this time. Indigenous populations mined the region between the Limpopo river and Zambezi river for nearly 2000 years. By the end of the colonial rule in 1980, new small-scale mines were formed in accordance with the Ministry of Mines and the number of registered claims between 1983 and 1990 increased from 1000 to 10000 (Tambo 2017). After Independence in 1980, small scale gold mining increased due to poverty, recurrent droughts and the economic situation which resulted in massive retrenchment from both the public and private sector. Around 2000 due to the

economic challenges, and as the inflation rose in 2006, the government of Zimbabwe imposed that gold miners were to sell their gold output to the Republic Bank of Zimbabwe at a portion of the international gold price market. In 2006 the government also revoked the Statutory Instrument 275 of 1991 which allowed Rural District Councils to issue gold permits. Operation ‘Chikorokoza Chapera’ was then launched by the government to stop illegal gold mining and as a result, gold production declined from 11tons to 7 tons in 2007 (Legal Resources Foundation 2003)

2.2.2 Current state of small scale gold mining

The continual lack of employment in the formal sector and the escalating poverty being faced by most of the people in the rural areas as well as the urban areas has led to the increase in the small scale gold mining activity in Zimbabwe, Murwendo et al (2017). According to Fidelity Printers and Refiners (2017) statistics show that gold output was 24,8 tons of gold in the year 2017, with the bulk of it being produced by the small scale gold mining sector. Large scale miners delivered 11,6 tons to Fidelity while the small scale mining sector delivered 13,2 tons of gold between January and December in 2017. Figure 2.1 below shows the gold bought by Fidelity Refiners from both the small and large scale gold producers between the period January to August 2017.

The small scale gold mining sector produced 47% of the country’s total gold output in 2017 which shows an increase compared to the 40% produced in 2016. Small scale gold mining plays a significant role in improving livelihoods for many mining communities, and is primary source of income for most rural populations. According to Hoardley and Limpitlaw (2016), women are being more involved in small scale gold mining activities, as a source of livelihood. 15% of the estimated 50 000 small scale gold miners in Zimbabwe are women, and the roles that they play during gold mining is quite broad.

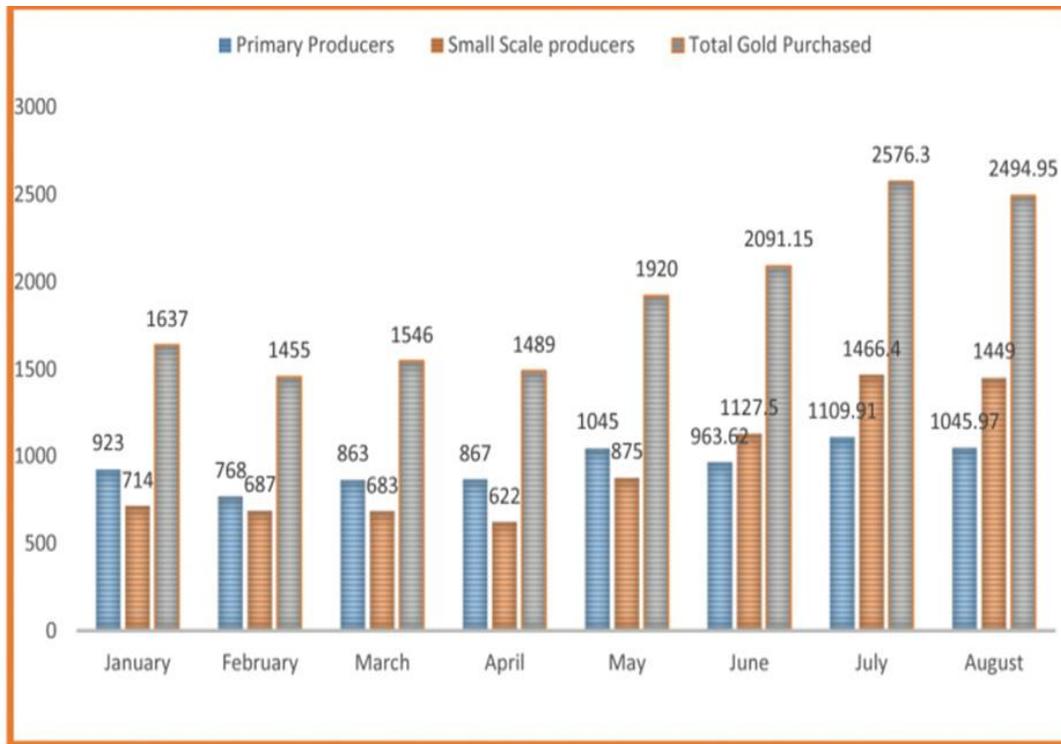


Figure 2.1: 2017 Gold purchases by Fidelity Refiners in Kgs

Source: Fidelity Printers and Refiners (2018)

2.2.3 Small scale gold mining in Kadoma

Kadoma mining District has several gold deposits. Gold in this area exists mostly in narrow, discontinuous quartz veins in the Archean core of the 100km Kadoma anticline (Mhlanga, 2002). Some of the large scale mines in the region like Dalny and Golden Valley which exploited deep gold deposits during the colonial era shut down and this resulted in many people being unemployed and hence the number of people engaging in small scale gold mining increased significantly since 1990. According to Shoko and Veiga (2004), primary gold ore in the Kadoma-Chakari region is extracted from narrow discontinuous quartz and is manually extracted. Mineral processing in Kadoma heavily relies on some technologies which were introduced over a century ago like stamp mills, cyanidation, and amalgamation. Shoko (2004) is of the view that these old methods are well established and are trusted by the small scale gold miners, and hence most of them are reluctant to adopt new technologies regardless of how damaging some of these old technologies are to human health and to the environment. Veiga (2004) concurs with the above view and notes that mercury amalgamation is an essential part of

ore processing for most of the small miners and the mercury that is used to recover the gold is burned without any means of recovery, while the amalgamations tailings are discarded locally, thereby creating some zones of elevated mercury concentration. In the Kadoma-Chakari region, the ore extraction process is heavily manual, involving the digging up of up to 50 metres deep tunnels, with some basic tools like shovels, hammers and picks. The ore, which is then crushed in ball or stump mills is then put on copper plates to increase gold recovery (Veiga 2006)

2.3 Mercury in Small scale gold mining

Small scale gold mining is one of the major causes of mercury emissions worldwide and the health impacts as well as environment are a cause for concern locally and globally. UNEP(2014) identified artisanal- small scale gold mining as the major mercury emitter from international use and that it contributes about 37% of the total global mercury emissions. Mercury is used during mining to extract gold from the ore and this is done through the formation of an amalgam. the amalgam comprises of mercury and gold. The amalgam is then heated to evaporate the mercury and isolate the gold. (UNEP 2013). The remaining mercury tailings after amalgamation are rich in mercury, at times containing more than 500 ppm of residual mercury which results in the creation of mercury hotspots. It is estimated by Veiga (2005) that an average of 1 to 2 grams of mercury are lost for every gram of gold that is produced in small scale gold mining. Considering this assertion, if artisanal gold miners produce an average of 500 to 800 kilograms of gold annually, therefore an estimated 800 to 1000 tons of mercury are emitted annually by small scale gold miners. According to Veiga (2005) highest emissions are from China which releases about 200 – 250 tons, followed by Indonesia 100 to 150 tons and then 10 -30 tons in each of Brazil, Bolivia, Colombia, Venezuela, Philippines and Zimbabwe.

2.3.1 Amalgamation process in gold mining

Small scale gold mining involves extraction of gold from primary ores. The ore that is extracted from the mines is crushed manually, often by hammers to loosen the ore before it is graded according to its various particle sizes. In Kadoma, ore extraction is highly manual involving digging of up to 50 meters deep with tools like shovels, picks, and hammers. According to Veiga (1999), the gold ore particles are then put in a Rod mill or a Ball mill for the grinding process. Water is added to the gold ore and then the grinding begins to take place, after a few hours the

mercury is mixed with the fine ore and the mill is turned on to make the mixing process of gold and mercury to take place.

The milled ore is put in a wide basin and the metal alloy or the amalgam is allowed to settle, water is added to the mixture, getting rid of the dirt within the mixture, thereby remaining with the amalgam of the mercury and gold. This separation process results in the production of mine tailings. Amalgam separated from the slurry is placed on a piece of cloth and the excess mercury is removed by squeezing. The amalgam produced is added with Borax which is used as a cleaning agent to refine it. The amalgam is then heated or burnt in order to separate the gold from the mercury. The mercury then evaporates leaving behind pure gold. The mercury vapor produced during this process of burning the amalgam is inhaled by the miners and this results in health problems including cardio-vascular complications and disruption of nervous system.(WHO 2003). The process of amalgamation during gold processing is illustrated in Figure 2.2 below.

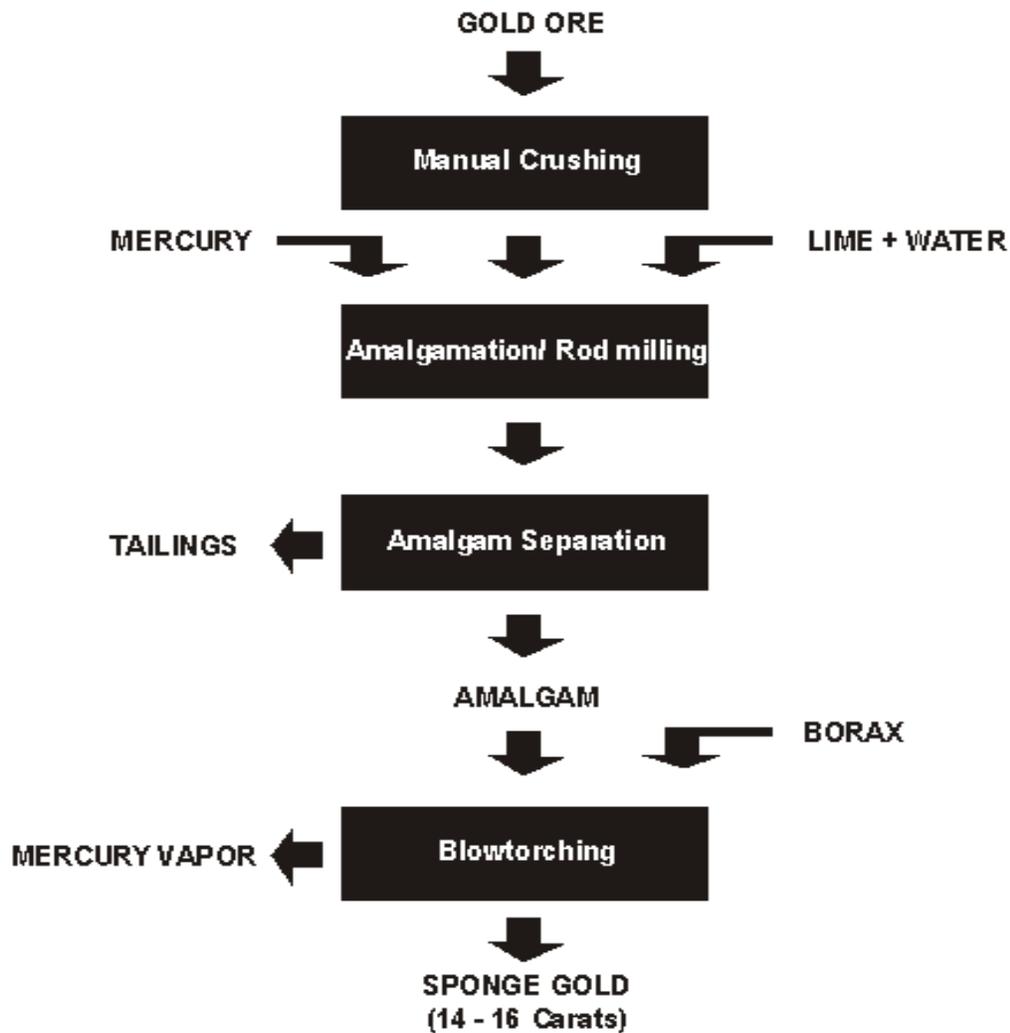


Figure 2.2: Amalgamation Process in small scale gold mining

Source: Mines and Geosciences Bureau fields report files(1996)

2.4 Participation of women in small scale gold mining

With the recognition of the socio-economic importance and contribution of small scale mining in sustainable livelihoods, there also has been realization of the importance of gender in order to strengthen small scale mining as a sustainable economic sector. Approximately 30% of the world's small scale miners are women, and they play a variety of roles ranging from digging, processing and the amalgamation of gold. Women's direct participation in small scale gold mining varies throughout the world .In Asia, less than 10% of the miners are women while in Latin America approximately 10-20% are women. The percentage of female small scale miners

is however highest in Africa, where it ranges between 40-50% (Onuh 2002). On the other hand, Wasserman (2000) is of the view that there are inconsistencies between the estimated and the actual number of women involved in small scale gold mining due to the fact that women often work on part-time basis. Women are often associated with transporting and processing during gold mining, as opposed to digging. Murao et al (2002) postulates that women who conducted amalgam burning in the pocket mines of Luzon Island in the Philippines had elevated levels of mercury accumulation in hair and breast milk.

According to Krisnayanti et al (2012), the women who are involved in small scale gold mining are not mainly involved in the highly manual activities like digging, they often perform the activities which require less strength like making amalgams, mixing the amalgams on panning, as well as burning of amalgams to recover gold. These activities, however are more toxic, and some of the women are usually with their children nearby, therefore they are both exposed to mercury during the processing of gold. Mercury that is inhaled by the women during mercury amalgamation is highly toxic to the developing fetuses, and is passed on before birth, as well as after birth through breast milk, if the mother is exposed to mercury, especially methylmercury. Mercury exposure for pregnant women can also lead to spontaneous abortions, and low birth weight babies Rodriguez – Villamizar et al (2015) also indicates that women who are exposed to elemental mercury in small scale gold mining are more likely to experience irregular menstrual cycles, as well as higher miscarriage rates than those who are not occupationally exposed to elemental mercury.

In Zimbabwe, approximately 1200 of the 20000 legal registered claims are registered by women (Murwendo et al 2017). In the formal small scale mining sector, 10% of the miners are women, while at least 50 % of more than 300 000 small scale miners in the informal sector are women. Women work part time in the mining sector more frequently than men, (UNIDO 2012). Since women are mainly involved in the processing aspect of mining, they are highly susceptible to inhaling mercury vapors or dermal contact of metallic mercury. The mercury vapor released during amalgamation poses a serious health threat to women, especially those of child bearing age.

2.5 Human exposure to mercury during gold mining

For the small scale gold miners, mercury can be absorbed through the skin during the amalgamation process as the miners make or burn the amalgams but the main route of exposure, however is through the inhalation of the mercury vapors during the burning of the mercury amalgams.

2.5.1 Exposure to Mercury Vapor

According to Keating et al (2005), the people mainly affected by elemental mercury vapor are the artisanal miners who undertake the amalgam making and burning process. This stage of the small scale gold mining process is arguably the most dangerous, because of the exposure to mercury vapor which is absorbed through the lungs and also results in neurological damage. Typically, there are no measures that are taken by small scale miners to prevent mercury inhalation or the loss of mercury into the environment. Amalgam normally consist of about 40% mercury and 60% gold and the miners purify the amalgam by evaporating the mercury on open flame (Veiga 2004).

Mercury vapor is oxidized in the lungs and it forms mercury parts which are soluble in body fluids, and while about 90% of the inhaled mercury is excreted in a few days through urine and feces, some of remaining mercury accumulates in the central nervous system (Hacon 1990, WHO 2008). Suzuki (1999) agrees with the same view and notes that mercury has the ability to permanently damage the nervous system, with the kidneys being the most affected in medium term exposure and the brain in the long term exposure.

Stopford (2001), however groups the effects of mercury according to the type of exposure. Short term exposure to excessive amounts of mercury vapor (1000 to 44 000 $\mu\text{g}/\text{m}$), is accompanied by symptoms like coughs, chest pains, hemoptysis and impaired pulmonary function, while chronic exposure includes symptoms like metallic taste in the mouth, ulcers, gum diseases like gingivitis and blue gums. Moreover, the long term with low level exposure results in less significant symptoms like fatigue, memory loss, irritability and depression. Long term exposure to high mercury levels have been associated with hallucinations, abnormal irritability, insomnia, muscular tremors, and suicidal tendencies.

EPA(2012), on the other hand is of the view that exposure to less amounts of mercury over a prolonged period results in several symptoms like finger and toe tremor, headaches, bleeding gums, slurred speech, poor coordination and movement of arms and legs, blurred vision, dizziness, hearing loss, and difficulty in writing among others. The psychological symptoms are identified as fatigue, irritability, lack of energy, exaggerated emotional response and depression. WHO (2000), however alludes that some of these effects and symptoms regress slowly after a few years of removal from mercury exposure.

During the making and the burning of amalgams, the small scale gold miners rarely take any precautionary measures, with most of them not wearing any protective clothing like dust masks to prevent inhaling the poisonous vapor. When inhaled, the mercury vapor is absorbed by the lungs and it is passed to the blood stream where it is transported to all organs of the body. The major health concerns of mercury vapor poisoning are brain, central nervous system and kidney damage and malfunction. The inhaled metallic mercury vapor results in some symptoms like breathing difficulties, coughing, chest pains, pneumonia and kidney failure, (WHO 2010).

According to Veiga (2011), the body keeps 80% of the mercury vapor which is inhaled, and the liver and the kidneys try to cleanse the body of mercury inhaled or absorbed. The liver attempts this through the digestive system and the kidneys through the urine. Nevertheless UNEP(2012) is of the view that mercury can build up in the body, especially the kidneys and cause severe damage and the elimination of the inhaled mercury might take several weeks to around 5 years, and the longer the period of exposure, the longer the time taken by the body to eliminate mercury.

The people most likely to face health problems due to mercury vapor are the amalgam burners, the people who have used mercury for a prolonged period, the children whose mothers were exposed to high concentrations of mercury during pregnancy and the children who are often present during amalgam burning.

2.6 Exposure to Methylmercury

When mercury is released during gold mining, some of it is disposed in the tailings. The tailings in small scale gold mining are a huge source of mercury pollution. After the amalgam is formed, the remaining crushed ore, unrecovered ore and water are either released into the environment or they are processed further. If this mercury that is released enters water bodies, it reacts with organic acids and hence is converted into methylmercury (Hinton 2002).

Methylmercury is an example of organic mercury and is the most dangerous of all the forms of mercury because of its ability to bio accumulate, or build up in an organism's body and bio magnify in the environment. It mainly damages the central nervous system with the kidneys being the most vulnerable organ (WHO 2002). Due to the methylmercury in the water bodies, fish are inevitably going to have the methylmercury, according to Hinton et al (2003), around 70 to 90% of the mercury that is in the fish is in the form of methylmercury, and the consumption by human beings may be fatal. Mercury can bio accumulate within the food chain and the predators at the top of the food chain are at more risk due to contaminated prey. In humans, the ingestion of methylmercury results in cardio vascular diseases, and in pregnant women, methylmercury affects the development of the embryo.

2.7 Health effects of mercury

Fetuses are most vulnerable if exposed to mercury because of their organs, nervous tissue and brains which are still developing. Transplacental exposure is the most dangerous because the fetal brain is very sensitive. Neurological symptoms include mental retardation, seizures, vision and hearing loss, delayed development, language disorders, and memory loss. In children, acrodynia, a syndrome characterized by red and painful extremities, has been reported to result from chronic Hg exposure (WHO 2007, 2008). Pregnant women who are exposed to mercury also ultimately expose their unborn children to mercury, thereby resulting in health problems. Breastfeeding women who are intoxicated with mercury will transmit the mercury to the baby via the breast milk. Mercury can cause mental impairments and learning disabilities, developmental disorders, birth defects, and eye and hearing damage in babies because of their mother's exposure during pregnancy. Mercury exposure for pregnant women can also lead to spontaneous abortions and low birth weight babies. During early child-hood, mercury exposure

can cause severe neuro-logic and systemic damage in children. Human bio-monitoring results from several ASGM countries have shown alarming concentrations of mercury in hair, urine and blood of children, women and men (Krisnayanti et al., 2012).

2.8 Knowledge gap

There are several studies which have focused on the impacts of mercury use in gold mining. Nevertheless, most of these studies mainly focus on the ecological and hydrological impacts of mercury use in small scale gold mining. Studies that have been carried out on the impact of mercury use have not been specific to any age group, but rather have been inclusive. Information on the impact of mercury use in small scale gold mining on women of reproductive age in Kadoma is restricted, hence the purpose of this study was to bring more clarity towards this subject matter.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research design

This study used a mixed research design whereby both the qualitative and quantitative research methods were applied. The qualitative research enabled a clear understanding of people`s views, opinions as well as a description of the activities which they carried out during small scale gold mining in the study area and why they undertook it in that manner. Qualitative data was obtained using open ended questions from the questionnaire, interview with key respondents and direct observations which were guided by an observation guide.

Quantitative research design was used to make measurements of the frequency of the mining activities carried out by the respondents. This was adopted for this study to analyse activities which could not be described or observed during the course of the research. Triangulation of the methods was therefore used and this assisted in attaining a detailed analysis of the research problem and hence make recommendations to improve the problem.

3.2 Target population

The target population for this study include female small-scale miners in the reproductive age (14-40 years), Environmental Management Agency Officer and Small-Scale Gold Miner`s Association representative. The women of reproductive age involved in small scale gold mining in Kadoma provided socio-demographic information like age, household size and marital status, as well as the gold mining and processing activities which they mainly undertake and the frequency of those activities. Environmental Management Agency was targeted to provide information on the strategies in place to reduce the exposure of the miners to mercury while the Small-Scale Gold Miner`s Association was chosen to solicit information on the participation of women in small scale gold mining activities, the use of mercury and the strategies in place to reduce the exposure of the miners.

3.3 Sampling procedures

A sample is defined by Frey et al (2000) as a sub-group of a population. The rule of the thumb was applied to determine the sample size, whereby 10% of the total population was taken from the total population sample. The total population sample was 8500 women involved in small scale gold mining in Kadoma, therefore the sample size for this study was 85 questionnaire respondents. Purposive sampling technique was used to come up with the sample. Purposive sampling was used whereby only a section within a population who suit a criterion and can give relevant information to the study are chosen as the respondents. For the study therefore, women involved in small scale gold mining who fitted in the reproductive age criteria were chosen from the mining communities as the questionnaire respondents for the study. This sampling method was used to reach the targeted sample because it is cost and time effective and is effective in coming up with a sample of relevant people who are directly affected or involved in a certain phenomenon.

3.4 Research instruments

3.4.1 Questionnaires

A questionnaire was designed and self-administered to 85 women of reproductive age involved in small scale gold mining in Kadoma. A questionnaire survey was chosen since substantial amounts of information can be collected from a large sample in a short space of time and was self-administered to give clarifications where needed. The questionnaires consisted of both open ended and closed ended questions and had 3 sections which were determined by the objectives of the study.

Closed ended questions were used to avoid long answers and they captured information on the socio- demographic characteristics of the respondents like age, marital status, and household size. Open ended questions gave respondents freedom to express themselves freely in their own words concerning the mining activities they carried out as well as the methods which they used to reduce exposure to mercury during gold mining. The questionnaire was structured in English and was translated to Shona which is the local language in Kadoma in cases where the respondents could not understand the former language for better communication and therefor avoiding errors.

3.4.2 Key Informant Interviews

Interviews with key informants were conducted to supplement the information that was obtained from the questionnaire survey. Structured interviews were conducted face to face with Environmental Education officer from the Environmental Management Agency and the Small-Scale Miner`s Association of Kadoma representative and these interviews captured information on the mining activities undertaken by the women of reproductive ages, awareness campaigns done as well as strategies to reduce exposure of the women to mercury.

Appointments were made with the interviewees prior to the interview to give them enough time to prepare for the interview and thereby promoting fruitful interviews. An audio device was used to record the interview after been given permission by the informants, in order to capture all the information given to the researcher. Open ended questions were formulated based on the objectives and they were ideal for giving an explanatory account as well as views and perceptions of the issues under study, they guided the interview and the responses given by the key informants were written down on paper.

3.4.3 Field Observations

Apart from conducting interviews with key informants and administering questionnaires, direct observations were also made to collect more information. Direct observations were used to identify the specific mining activities that were carried out by the women during gold processing, the type of personal protective equipment that they used and the number of miners using the personal protective equipment during gold mining as well as the precautionary measures taken to reduce exposure to mercury during gold mining. An observation guide prepared prior to the field work was used (Appendix 2), and the observations made were written down for analysis. Field observations gave firsthand information of what was happening and helped in describing the existing situations, and therefore bridge the gap between data obtained from questionnaires and that from interviews with key informants.

3.5 Data analysis and presentation

For this research descriptive statistics and qualitative content analysis were used in order to analyse the research findings gathered from the questionnaire survey and from the interview response data. Descriptive statistics was used whereby the qualitative data was converted into frequencies, arithmetic means, and percentages, and this was achieved using numerical data coding in the Statistical Product Service Solution (SPSS) version 20. Age, household size and education level were some of the variables coded for analysis. Graphs and tables were created using this package and were used for clear presentation of findings. Qualitative data from interviews observations and open-ended questions were converted into descriptive information using the qualitative content analysis approach whereby the behavioral and descriptive data was categorised according to its meaning and given a numeric value. SPSS was then applied to come up with frequencies and percentages and therefore analysis was made.

3.6 Ethical considerations

Ethical considerations are important in research because they promote truth and avoidance of error, misrepresenting of research data, they also promote accountability and helps in taking human rights into consideration. Ethical considerations were made throughout the entire project. The interviewees were informed prior to the interview to get approval, and before the interview the researcher stressed out the purpose of the research. Data was collected, reported, and presented without any alterations and the researcher there was no fabrication of data and the public was not deceived in any way. Confidentiality was a priority and all communications, records and information collected during the study were confidential and the names of the participants did not appear in the questionnaire. Risk assessment was done during interviews to avoid stress or political clashes or any social harms, and the answers given were recorded accurately with no alterations. Purpose of research was stressed out before the interviews and scientific honesty was observed when recording and entering and manipulating the data.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Demographic characteristics of miners

Table 4.1 Demographic characteristics of the miners

Variable	Frequency	Percent%
Sex		
➤ Female	85	100
Age		
➤ 15-19	7	8
➤ 20-24	12	14
➤ 25-29	25	29
➤ 30-35	28	34
➤ 36-40	13	15
Level of education		
➤ None	13	15
➤ Primary	25	29
➤ Secondary	45	53
➤ Tertiary	2	3
Household size		
➤ ≤3	7	8
➤ 4-9	16	19
➤ 7-9	58	68
➤ 10 and above	4	5
Marital Status		

➤ Married	48	56
➤ Single	12	14
➤ Divorced	25	30

Fig 4.1 indicates that the women practicing small scale gold mining in Kadoma are dominantly in the 25-29 and 30-35-year age groups. In Zimbabwe this age group is the most economically active age group. The dominance of the women in this age group in small scale gold mining therefore can be attributed of lack of employment in the formal sector due to lack of educational qualifications. The participation of miners in the 15-19 year age group is minimal and this is attributed to the fact that they are in the teenage and will be attending secondary school in schools near the mining communities like Mayflower School.

A substantial proportion of the respondents (53%) reached secondary level therefore the miners are literate. Their increased participation in small scale gold mining is therefore a result of inadequate educational achievements reducing their competitiveness in the formal employment sector. A smaller proportion of the respondents reached tertiary level and their participation in small scale gold mining as compared to other jobs befitting their educational qualifications is an indicator of lack of formal employment for some people in Kadoma.

68% of the miners have households of between 7 to 9 people. Shoko(2004) asserts that small scale gold mining is a source of livelihood for three quarters of the miners in Kadoma, and it also sustains the families of the miners. Results in Table 4.1 indicate that the participation of miners who have households of 7-9 people is relatively higher than of those with households of less than 3 people because miners with bigger households rely more on mining as a means of sustenance for their families. Small scale gold mining is therefore a source of livelihood for the miners in Kadoma.

Figure 4.1 indicates that the larger proportion of the miners are married (56%), while a relatively low proportion of the respondents are single. Married women who have families participate in small scale gold mining as a means to fend for their families. Figure 4.1 also indicates that those

who are divorced (30%) are also participating in small scale gold mining more than the single women and this is influenced by the responsibility and the roles of women as providers and their contribution towards household food security through venturing in small scale gold mining which earns them and their children a living.

4.2 Gold mining activities exposing women to mercury

The main gold mining activities carried out by the respondents which exposed them to mercury include amalgam making which exposes the miners to inorganic mercury, amalgam burning which exposes miners to mercury vapor during the roasting of amalgams as well as purification of mercury and proximity to amalgam burning points which exposes the miners to both organic mercury.

4.2.1 Amalgam making

Small scale gold miners in Kadoma are exposed to mercury through the amalgam making process whereby the gold ore dispersed in water is washed over copper plates which are loaded with mercury. Observations made showed that 95% of the miners do not use gloves during this process of making the gold- mercury amalgams. The miners are therefore exposed to the inorganic or metallic mercury through dermal contact during this process and the amalgams usually contain 40% mercury and 60% gold.

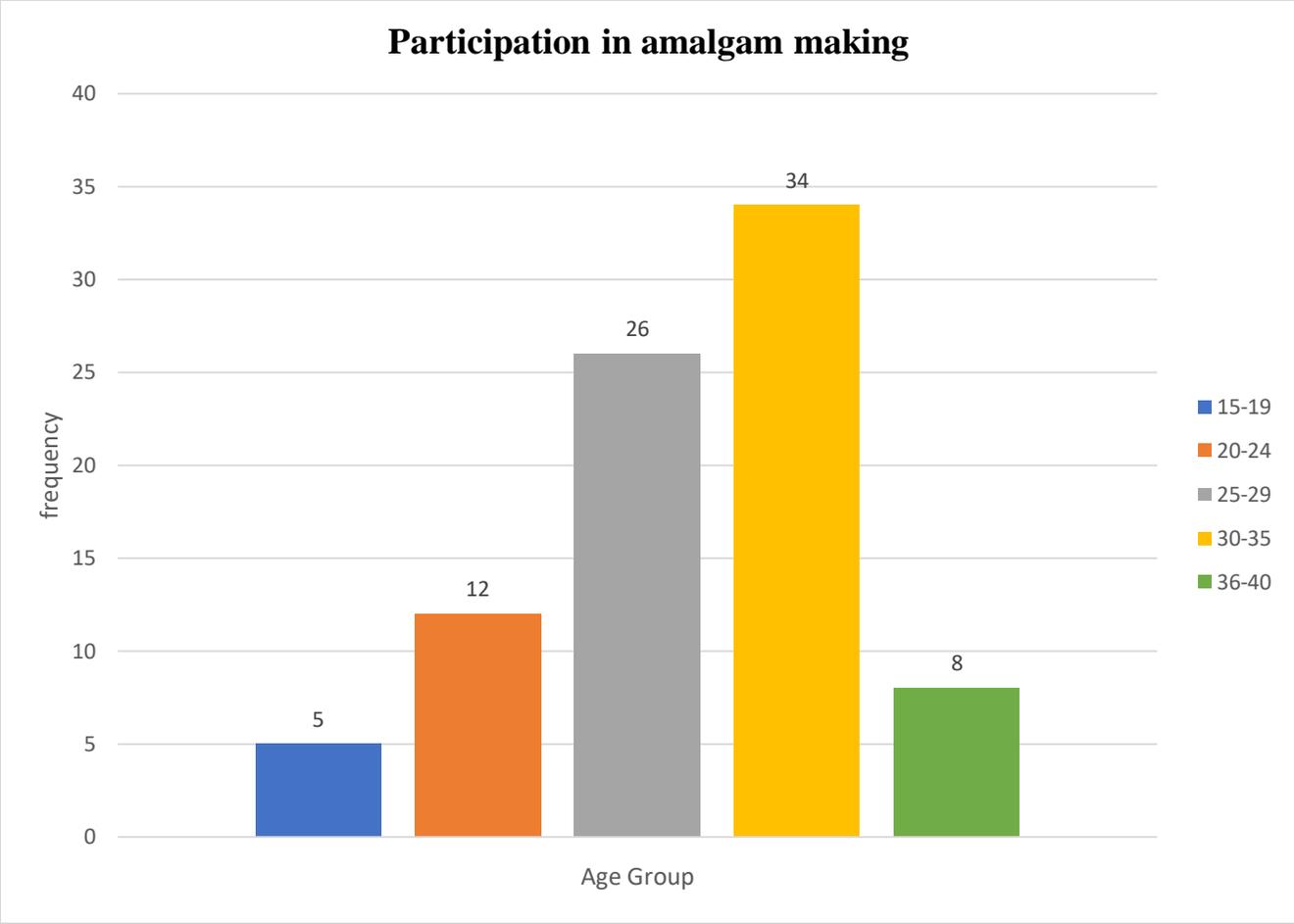


Figure 4.1 Participation of women in amalgam making according to their age groups

Figure 4.1 indicates that the women mainly executing amalgam burning are in between the ages 30 and 35 and therefore this is the age group which is more exposed to inorganic mercury through the amalgam making process. This process is undertaken by the miners who are experienced with this process so as to reduce losses, therefore this explains why the 15-19 year age group has the least number of miners participating in this activity, since they are not yet fully equipped with the process. This age group basically has the least miners participating in small scale gold mining therefore their participation in amalgam burning is resultantly reduced.

4.2.2 Amalgam burning

In the study area, amalgam burning is mostly done at the mining sites. During this process the miners in Kadoma are exposed to mercury vapour as the mercury evaporates from the amalgam

during the burning process. 90.28 % of the women reported they never use protective masks during this process and 82.19 % do not use gloves, and 77.46 % generally wear clothes that do not cover their arms, legs and feet when they perform the amalgam burning process. Miners are therefore more exposed to mercury during this process.

Table 4.2 Women exposed to mercury through amalgam burning

Age group	Frequency	Percentage of total miners executing amalgam burning
15-19	4	57%
20-24	10	83%
25-29	22	88%
30-35	27	96%
36-40	11	85%
TOTAL	74	

Table 4.2 indicates that a sizeable proportion of the women who are exposed to mercury vapour during amalgam burning are mainly in the 30- 35 age group whereby 96% of the women in that age group carry out amalgam burning and these are the miners with the most experience in amalgamation. The age group with the least proportion was the 15-19 age group and their participation in amalgam burning is restricted because their participation in small scale gold mining is minimal. 87% (73) of the total respondents practice amalgam burning and they are therefore exposed to mercury vapour which is released during this process.

Places of amalgam burning

Burning of amalgams is mainly done at mill sites using the copper plate system. 81% of the respondents indicated that amalgam burning is carried out in a room at the mines. Burning that is done in a room increases the inhalation of the mercury vapors especially if there is not enough ventilation in the room, thereby increasing exposure to the female miners. The miners use fires to burn the amalgams and they use their mouths to blow the fires, thereby increasing the mercury vapor inhalation during this process. 19% of the miners practice open- space amalgam burning

Proximity to amalgam burning points

Table 4.3 Distance of miners from the amalgam burning sites

Distance from amalgam burning point	Percentage of miners
≥ 5 meters	45%
6-10 meters	15%
≤ 10 meters	30%

Direct observations made showed that the miners who were not performing either amalgam making or amalgam burning were exposed to mercury vapor which evaporates from the amalgam during amalgam burning. 95% of the miners in the study area do not wear masks during the gold mining process therefore those in close vicinity to the amalgam burning points at the mines inhale the mercury vapours released during amalgam burning. The body retains 80% of all the inhaled mercury vapour (WHO 2009), and therefore results in respiratory infections. The miners in Kadoma are therefore susceptible to facing health consequences due to their exposure to and excessive inhalation mercury vapour

4.2.3 Purification of mercury

Interviews made with key respondents highlighted that the miners use nitric acid to purify the mercury which would have been used to form an amalgam in order to make it suitable for use again. Figure 4. Indicates that Women in the 36-40 age group are the ones who mainly carry out purification of mercury process, and during this process are exposed to mercury vapour as well as inorganic mercury through the handling of mercury during the purification process.

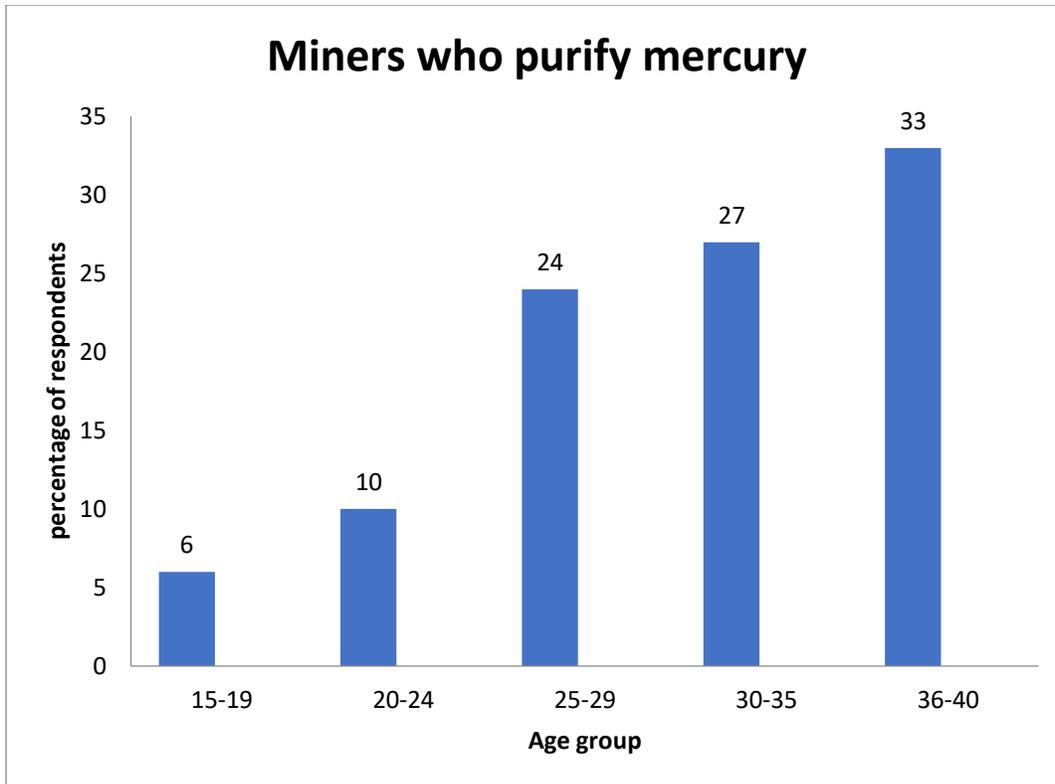


Figure 4.2 Percentage of miners who purify mercury

Frequency of mining activities

Table 4.4 Frequency of mining activities

	Frequency	Cumulative frequency
Daily basis	44	44
Weekly basis	34	78
Monthly basis	7	85

Table 4.4 indicates that the women undertake small scale gold mining in Kadoma mainly on a daily basis. EPA (2012) indicates that occupational exposure to mercury over a short period of time on frequent intervals results in more complicated health problems as compared to exposure to mercury in a long period of time but on less frequent intervals. Therefore, the daily occupational exposure to inorganic mercury and mercury vapour of the miners is more likely to cause more health complications compared to the women who only undertake gold mining activities on a monthly basis. The miners in the study area participate in gold mining on a daily basis because it is a major source of their livelihood for most of the miners and a form of sustenance for both themselves and their families.

4.3 Evaluation of strategies to reduce exposure

Table 4.5 below indicates the questionnaire responses given in relation to effectiveness of strategies used to reduce exposure to mercury during mining. Rotating of miners was the regarded as the most effective strategy to reduce exposure to mercury because it was the most feasible strategy which being exercised at the mining sites as compared to the other strategies. Rotations are carried out in such a manner that those more occupationally exposed to mercury like the amalgam burners, rotate with those less occupationally exposed to mercury like the ore extractors on a weekly basis, thereby reducing exposure based on mining activities.

Use of retorts is the least effective strategy of reducing exposure to mercury in the study area. Retorts help in the conversion of mercury vapor back to its original liquid state without much exposure to mercury fumes. amalgamation process, but however their application in small scale gold mining in Kadoma is minimal due to the lack of financial requirements needed to implement their use. Lack of knowledge and awareness on the contribution of retorts in small scale gold mining to reduce exposure to mercury also affects the success of the implementation of this method in the small scale gold mining sector of Kadoma.

Table 4.5 Effectiveness of strategies employed to reduce mercury exposure

Strategy	Effectiveness				Total
	Poor	Fairly good	Very good	Excellent	
Rotating miners	10	32	28	15	85
Use of personal protective clothing	6	39	30	10	85
Use of retorts	45	25	10	5	85

Environmental education

Questionnaire findings in Table 4.6 below indicate that educational awareness campaigns on the impact of mercury use in small scale gold mining in Kadoma are mainly carried out on annual basis. The miners in Kadoma are therefore not aware of some of the health impacts that mercury use and exposure has on them since educational campaigns are not regularly conducted.

Table 4.6 Frequency of educational campaigns in Kadoma

Frequency of educational awareness	Percentage of respondents
Weekly	8%
Monthly	5%
Bi-annual	11%
Annually	51%
Rare	25%

An interview with Environmental Management Agency indicated that awareness campaigns that have been carried out in some of the mining communities in Kadoma include distribution of fliers amongst the miners. The main message in the fliers is the reduction of mercury use in small scale gold mining activities to extract gold, thereby improving health as illustrated in Figure 4.4 below:

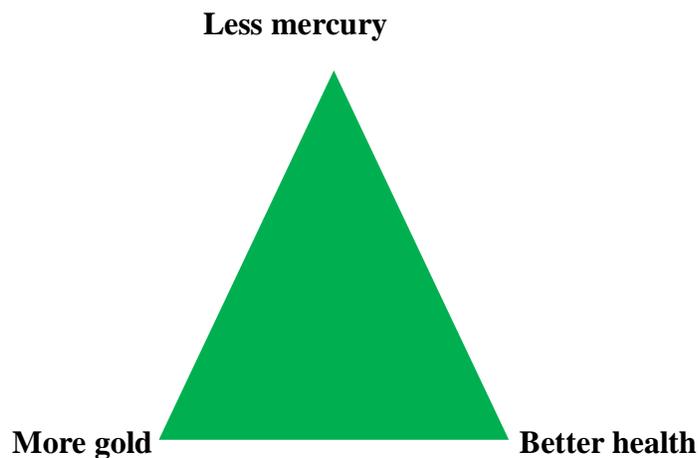


Figure 4.3 Illustration of message conveyed in fliers distributed among miners

Source: Environmental Education Department, EMA Kadoma (2018)

Mercury Storage

An interviewee from EMA indicated during an interview that mercury should be stored at least 100 meters from where people reside. The results gathered from the respondents contrastingly indicate that 67% of the miners store mercury in their homes, while 33% store mercury at store rooms at the mills/ mines. The exposure level to inorganic mercury is therefore increased at the homes, and since most of the respondents have big households, the number of people exposed to mercury increases. The findings also additionally revealed that 80% of the women keep the mercury in plastic bottles containers, while around 20% keep mercury in polythene bags.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The research findings indicate that the women of reproductive ages practicing small scale gold mining in Kadoma are mainly between the ages 25 and 35, and this age group is also the economically active age group. Their participation in small scale gold mining is driven by the lack of employment in the formal sector due to their levels of education as well as lack of employment opportunities in the country. A substantial proportion of the women attained secondary education, with tertiary education being the least reached level of education due to financial problems. Most of the women are married and with relatively large households of between 7 -9 people. Small scale gold mining is therefore a source of livelihood and sustenance for these married women as well as for those with big households.

The gold mining activities that mainly expose women of reproductive ages to mercury during gold mining are inhaling mercury vapors during the burning of amalgams, as well as through poor handling of the metallic or inorganic mercury. The activities mainly done by the women during mining are mostly the low labor activities which include processing of gold through making and burning amalgams as well as cleaning of mercury using nitric acid, which produces toxic fumes containing mercury.

Findings from the research indicate that some of the measures used to reduce exposure to mercury during gold mining include use of Personal protective equipment, rotating of miners from the various mining activities as well as use of retorts to reduce the release of mercury vapor. The method found to be most effective was the rotating of miners because it was the easiest method, while retorts are not being used because they are assumed to be expensive.

5.2 Recommendations

- The Government of Zimbabwe should enforce legislation which is binding regarding the use and illegal buying and selling of mercury in the small-scale gold mining sector to

reduce easy accessibility to mercury and therefore ultimately reducing mercury contamination into the environment.

- The government should also fund some pilot programs on Mercury and its impact on the natural environment and on human health especially for women to increase research and therefore educate the people of mercury.
- EMA Kadoma should embark on more frequent awareness campaigns on the alternatives of mercury in gold mining which are cleaner, as well as educational campaigns on the health impacts of mercury to women of reproductive ages.
- Small scale gold miners in Kadoma should introduce the use of other of methods like Retorts especially the “Kitchen Bowl Retort” method which is a relatively cheap method yet more effective and cleaner.

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Appendices

Appendix 1: Questionnaire for women involved in small scale gold mining

My name is R144471M, a student at Midlands State University studying for a Bsc Hons. Degree in Geography and Environmental Studies. In partial fulfillment of this degree programme, I am undertaking a research entitled **The Impact of mercury use in small scale gold mining on women of reproductive age: A case study of Kadoma.** I would appreciate if you kindly answer the following questions. This information is highly confidential and will be used purely for academic purposes.

Date..... Questionnaire No.....

INSTRUCTION: *Please tick the appropriate box and fill in the blanks*

SECTION A: Demographic/ personal information

1. Age(years) : 15-19 years 20-24 25-29 30-35 36-40

2. Level of education:

None Primary Secondary Tertiary

3. Marital Status: Single Married Divorced

4. What is your household size? 3 and below 4- 6 7-9

10 and above

SECTION B: Worker exposure to mercury

5. How long have you been engaging in gold mining?

Less than a year 2-5 years 6-9 10 and above

5. How often do you come for gold panning?

Daily Weekly Monthly Others (specify).....

6. Which activity do you mainly carry out?

Digging Making amalgams Amalgam burning Purifying Mercury

Others (specify).....

7. How frequently do you carry out the mining activities named above?

.....

8. Where do you burn amalgams?

9. Do you take home the clothes you wear during amalgamation? YES NO

10. Do your wear Personal protective clothing during gold mining YES NO

SECTION C: Strategies used to reduce exposure to mercury

11. What are the strategies employed to reduce exposure to mercury?

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

12. How effective are the strategies named above in reduction of exposure to mercury during gold mining?

Poor	
Good	
Fairly good	
Excellent	

11b). Explain your answer

.....

13. How often are educational campaigns on mercury carried out? (*Tick where appropriate*)

Weekly	
Monthly	
Bi- annually	
Annually	
Rare	

14. What are your reasons for using mercury in gold mining?

.....

THANK YOU FOR YOUR CO-OPERATION

Appendix 2: Interview guide for Environmental Education Officer, EMA Kadoma

- 1.** What do you attribute the persistent use of mercury in small scale gold mining in Kadoma to?
- 2.** What are the main activities exposing miners to mercury during gold mining in Kadoma
- 3.** How often do you carry out educational awareness campaigns on the impacts of mercury on women of reproductive ages in Kadoma
- 4.** What are some of the strategies employed to reduce occupational exposure to mercury during small scale gold mining
- 5.** What are your recommendations on reducing the impacts of mercury use on women of reproductive age in Kadoma

Appendix 3: Interview guide for the Kadoma President of Small Scale Mines Association

1. What is the rate of women participation in small scale gold mining in Kadoma
2. What do you attribute the increase in the use of mercury to?
3. What are some of the alternatives of mercury in small scale gold mining
4. What are some of the mitigation strategies employed to reduce the exposure to mercury during small scale gold mining
5. What are your recommendations in reducing mercury exposure

Appendix 4: Field observation Guide

1. Type of personal protective equipment used during operations
2. Number of miners wearing protective clothing
3. Distance of the miners from the amalgam burning sites
4. Precautionary measures taken by the miners when handling mercury
5. Place where the amalgam is burnt

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