



# Global Mercury Project

Project EG/GLO/01/G34:  
Removal of Barriers to Introduction of Cleaner Artisanal Gold Mining and Extraction Technologies



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## **A SOCIOLOGICAL SURVEY OF SMALL-SCALE ARTISANAL GOLD MINING IN THE KADOMA-CHAKARI AREA.**

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## Executive Summary

Small-scale artisanal gold mining is a growing sector in Zimbabwe whose effects cannot be ignored. In the Kadoma-Chakari area this sector has significantly increased since the 1990's. This can be linked with the downscaling of mining operations of the main mine in the area, Dalny Mine owned by Falcon Gold. This left the greater community in the area unemployed and as a means of survival most are engaged in small-scale gold mining as a self-employment drive to sustain their livelihoods.

The impacts of small-scale mining are either positive and/or negative on the social, economical, physical and biological environment. Key observations of the survey were as follows.

- The main occupation in the area is small-scale gold mining (78% of the respondents are engaged in mining). As a result mining provides the main income for livelihood sustenance in the area.
- Extraction of the ore by small-scale miners is highly labour intensive and, as a result, the labour force is predominantly male (88%).
- Amongst the workers, the age range is mainly 20-40 years.
- The academic level in the sample population is good. Most people (52%) have attained secondary (Form 1-4 or high school) education, 31% have primary (Grade 1-7) education, while 17% are illiterate.
- Miners are of a diverse ethnicity and the main languages are Shona (spoken by 53% of the respondents) and Chewa (37%).
- Problems associated with small-scale mining activities include drug (alcohol) abuse, promiscuity and sexually transmitted infections.
- Education is seriously affected as students of school-going (late primary and secondary school level) age engage in mining.
- Most miners grow their own maize or purchase it from surrounding farming communities. However most food is purchased from either Kadoma, Chakari, or brought in by vendors.
- The main water source for both mining and domestic purposes in the area is borehole water.
- Health facilities are an issue of concern as the nearest health centre in Chakari, located less than 10km from most mine and mill sites, is not accessible other than to current workers at Falcon Gold's Dalny mine, even for emergency cases. Most have to travel to Kadoma for treatment.
- Tools used in ore extraction are very basic, i.e. picks, shovels, hammers and chisels.

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- All mills use the copperplate system to amalgamate the ore and are mainly white owned.
  - All mill sites have cyanidation tanks/ponds. These are used to recover gold remaining in the ore after mercury amalgamation.
  - Gold extraction is by mercury amalgamation. Nitric acid is also used in conjunction with mercury to burn away impurities in the gold. Among the miners and millers knowledge of the health and environmental dangers of improper mercury use is high. However most do not consider these risks seriously and knowledge is not in-depth. Few use protective clothing (gloves and masks).
  - Burning of the amalgam to recover gold is mainly done at the mill sites.
  - Gold output from small-scale mining is roughly 5-15 grams per tonne depending on the grade of the ore.
  - Most of the gold obtained by small-scale miners is sold to private buyers or millers.
  - While the sample population might look smaller than requested target of 250 volunteers for the health study, the average household size is 4 people. If each household is considered as having 4 potential volunteers, this exceeds the 250 participants required for the health study. These are also potential volunteers for the health survey. It should be noted that most mills are closed for business on Saturday afternoon and on Sundays. It is therefore advisable to carry out any studies during the working days (Monday to Friday).

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## **Introduction**

The small-scale mining sector has grown phenomenally since independence and is an increasingly significant feature in the mining sector. Its strongest showing has been in the 1990's and it is continually playing an important role in economic growth and development. In Zimbabwe gold mining dominates this sector. The increase in small-scale gold mining activities can be attributed to their lucrative income generating potential, which provides a ready means of survival to local communities, more-so with the country's erratic rain patterns which makes reliance on agriculture uncertain. Kadoma and Chakari fall within a gold mining area, hence the prevalence of small-scale gold mining activities.

Small-scale artisanal gold mining has both negative and positive aspects to it. The positive aspects include its economic contribution and social benefits to the mining community (i.e. income generation, employment and support of family livelihood). On the negative side are environmental degradation, pollution, health problems and other negative social and economic impacts.

## **Public Consultation And Sociological Impact Assessment**

The strategy adopted for the public involvement process is compliant with the Terms of Reference for the National Women In Development (WID) Expert/Sociologist. It features a range of methods of information sharing with Interested and Affected Parties (IAPs).

Public consultation is an integral component in sociological surveys as it provides opportunities for individuals, communities, and other IAPs to provide input into the study.

## **Scope of Work**

The social impact assessment and stakeholder consultation involved the following:

- Social scan to identify and classify important stakeholders and their potential major concerns and interests.
- Identifying interview areas.
- Arranging interviews with individual stakeholders and stakeholder groups

Objectives of the social scan, public consultation and sociological impact assessments were:

- To collect data on the structure and demography of the population living in the Kadoma-Chakari small-scale mining communities.
- To identify types of occupations in the area.
- To gather information on dietary uptake in the study area

- To provide a detailed description of the gold mining process, in particular mercury usage.
- To look into the availability and accessibility of social amenities (health facilities, schools, water and sanitation).
- To identify agricultural practices in the area.
- To look into the status and situation of women engaged in gold mining.

In this study an analysis was done on the mining community, the mining process and its impacts. The survey looked at mines and mills situated along the old and new Kadoma-Chakari roads and their communities, the Chakari town community and social infrastructure/amenities in the area.

### **Social Scan**

Following the social scan, stakeholders were divided into the following groups:

#### *i) Millers*

These are predominantly Zimbabwean whites, operating either as individuals or small syndicates comprising at most of three people. None are engaged in the actual digging of the ore. Rather they mill the ore brought in by the small-scale miners for a fee. They all process the resultant sludge from the milling in cyanidation plants which are said to be capable of recovering about 85% of the remaining gold. Mills are all of the stamp mill type with the traditional amalgamating copper plate. Most mills have very few fixed staff compliments, with the majority of workers hired on a contract basis. The mills operate through out the year.

#### *ii) Falcon Gold Permit Miners*

Falcon Gold Mine permit miners are individual miners who are contracted to mine on Falcon Gold Mine claim sites and sell their gold through Falcon Gold Mine Company mills. These comprise the bulk of individual small-scale miners from Chakari town. Mining is unsophisticated using basic tools such as picks, shovels and hammers and is poorly capitalised. Production is around 5 tonnes of mined ore per household per month and rarely exceeds 10 tonnes.

#### *iii) Cooperative Mines*

These are miners who form teams and work as a cooperative in their mining activities. In the area only one cooperative mine was identified (DRC Mine in Golden Valley). Work here is done in shifts and outputs can be considerably high. Besides having manually operated windlass lifts over their shafts, mining is quite unsophisticated.

*iv) Individual Claim Owners*

Local individual upcoming mining entrepreneurs (indigenous business people) dominate this category. Mining undertaken by these is still unsophisticated as most lack capital to purchase equipment and put in place infrastructure.

*vi) Individual Non-Claim Miners*

These work on unregistered claims (illegally) or are contracted by registered claim owners. They are highly migratory, moving from one dig to the other depending on the quality of the ore.

*vii) Farmers*

These are found in the resettled farms within the study area. Amongst them some members were also engaged in mining.

*viii) Other Occupations.*

In this group are people who earn a living as vendors, radio repairers, mechanics, etc.

*ix) Government Departments*

Government institutions included: Police, Ministry of Health, Ministry of Mines, and the Central Statistical Office.

**Area Surveyed**

The following mills, mines and communities were visited during the study. They are placed in order of their proximity to Kadoma Town along the two roads to Chakari, i.e. the Old Kadoma-Chakari Road and New Kadoma-Chakari Road.

*New Kadoma-Chakari Road*

Ordoff (Halfway) Clinic  
 DRC Mine  
 Halfway Resettlement Community  
 Ryan Mine Mill  
 Coetzee (Delcia) Mill  
 Delcia Mine and Mill  
 Maldon Mine  
 MPAGRA Mill  
 Golden Valley Farm Resettlement Community

*Old Kadoma-Chakari Road.*

Glasgow Mill  
 Alabama Resettlement Community  
 De Lang Mill  
 Chakari Town Community  
 Blackmore Valley Community

## Sample size

Respondents to our interviews are as follows:

Men	Women
<b>90 (78%)</b>	<b>25 (22%)</b>

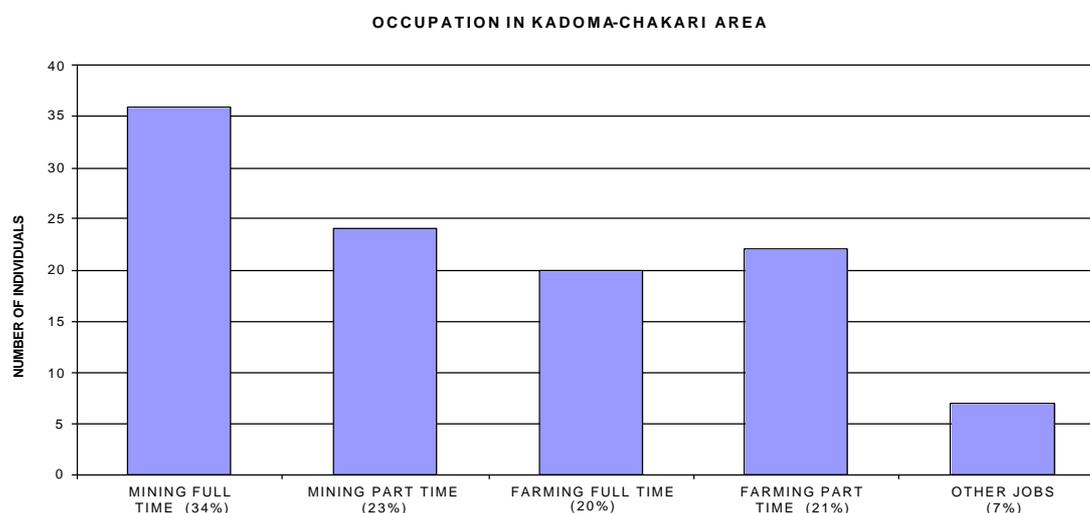
The survey mainly targeted the mining community in the area. Among all the respondents most were miners or mill workers, and 8 of them were mine or mill owners, (the majority being mill owners). In addition to targeting the mining community interviews were also carried out in surrounding communities (Chakari, Golden Valley, Alabama and Blackmore Valley).

## Community Structure in the Kadoma- Chakari area

The majority of people in the area are miners or employed at the mills. These stay either at the mine or mill sites or in mining compounds belonging to Falcon Gold Mine. There are a considerable proportion of resettled farmers who have occupied the surrounding farms in the area. In mining settlements there are no clear leadership structures. However in the resettled farms, while there are no traditional leadership structures, political leadership structures exist.

## Occupations/Sources of Income

The main income-generating activity besides mining in the Kadoma-Chakari area is farming. The distributions of respondents in terms of occupation are as represented below:

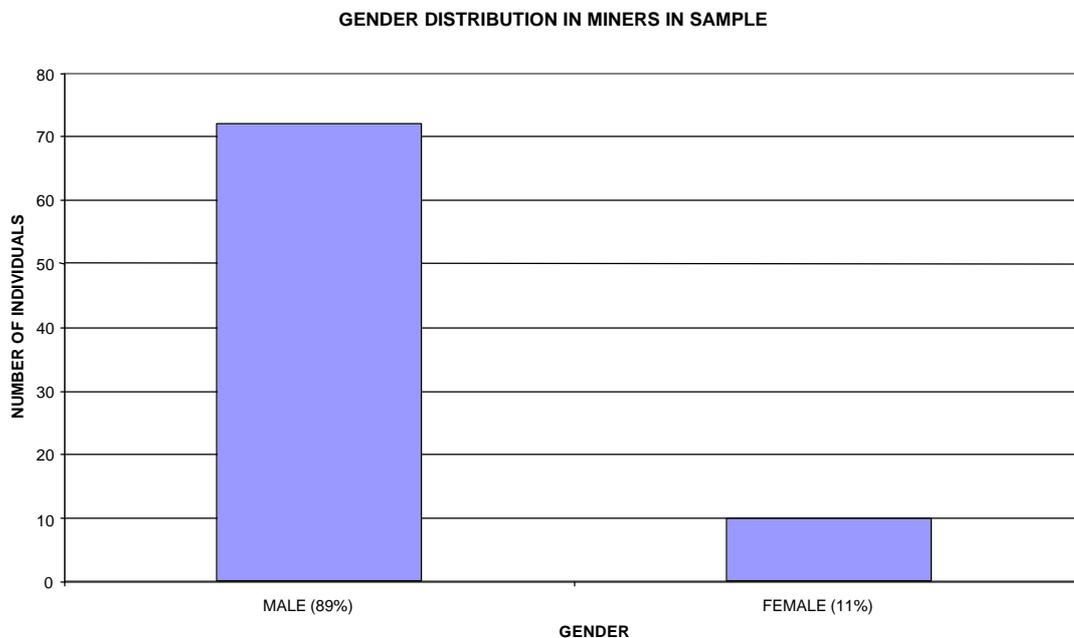


It can be noted from the above graph that the majority of the respondents are miners. Almost all the part-time farmers are engaged in mining (i.e. are part-time miners) and only engage in farming during the rainy season when it is not conducive to mine due to the filling up of shafts with water and related high incidences of shaft collapses due to wetness of the earth. Farming is therefore an alternative source of income and subsistence for miners. Of those engaged in full-time mining, the majority are mill workers since mill operations are done through out the year.

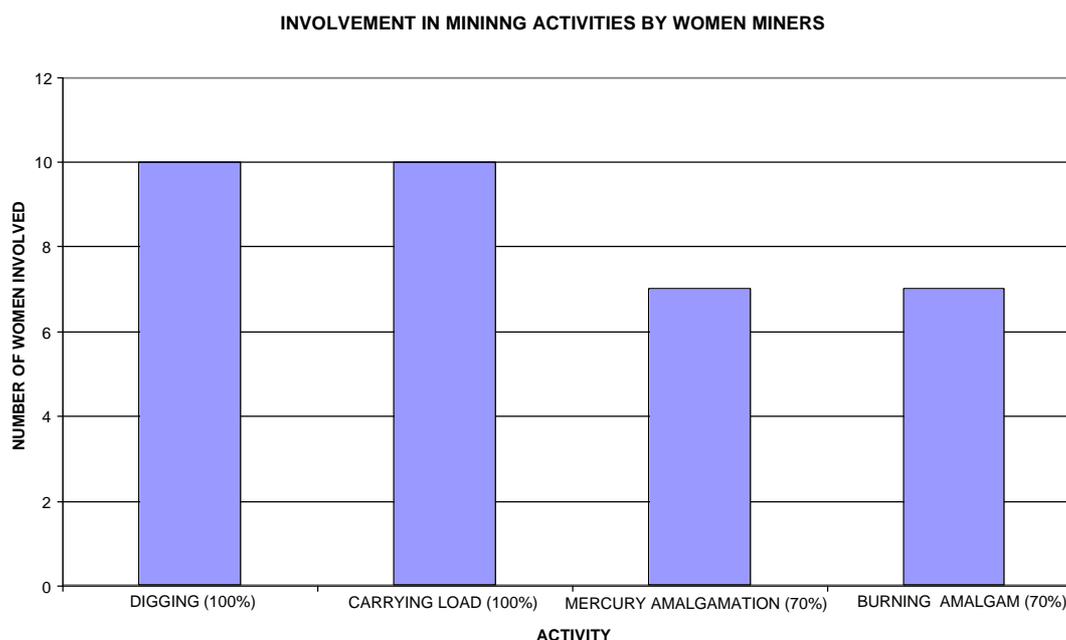
The average income in the area is Z\$40 000 (US\$14.8)/month. Most miners have families at their rural homes outside the mining area. However transport costs are prohibitive for them to commute to these rural homes. As a result they tend to resort to prostitution that is rampant in the mining areas. This can be linked to the high cases of sexually transmitted infections in the area. This also impacts on the livelihoods of their family as very little of the money earned filters into the rural homes.

### Gender Aspects: Women Involvement in Mining

Women make up only 11% of all the miners interviewed. Mining is predominantly manual and hence is it is the domain of men. In all the mills visited none of the mill workers were female and the millers explained this as being due to the manual nature of the work. Digging by women was however close to the surface (not exceeding 10m) while that done by men could go to depths beyond 30 metres. Gender distribution in mining activities within the sample is illustrated below:



In some mining households however women were fully involved in mining processes, including digging, carrying the load, mercury amalgamation and burning of the amalgam. In the case of the 10 mining women in the sample, most were involved in all stages of mining and process of gold as shown in the graph below:



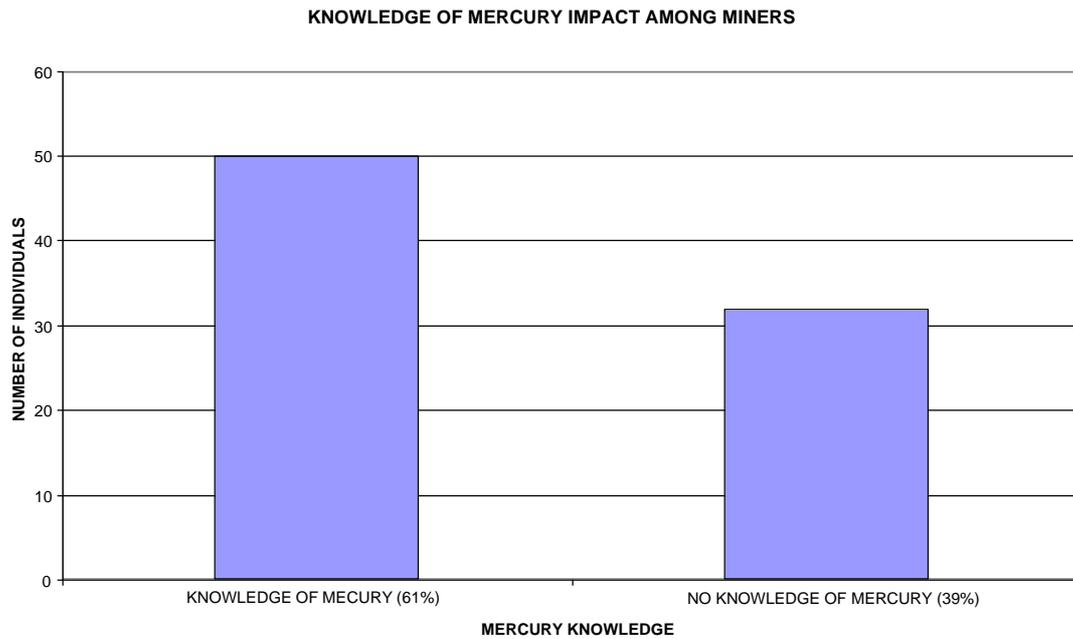
Though fewer in comparison to men, women engaged in mining play a significant role in contributing to household income. Since most households are male-headed, it is doubtful that women have much control over their mining incomes.

Other occupational activities women are engaged in include vending (selling vegetables, sugar, meat, cooking oil and other food stuffs as well cigarettes at some mining sites) and carrying out general household chores.

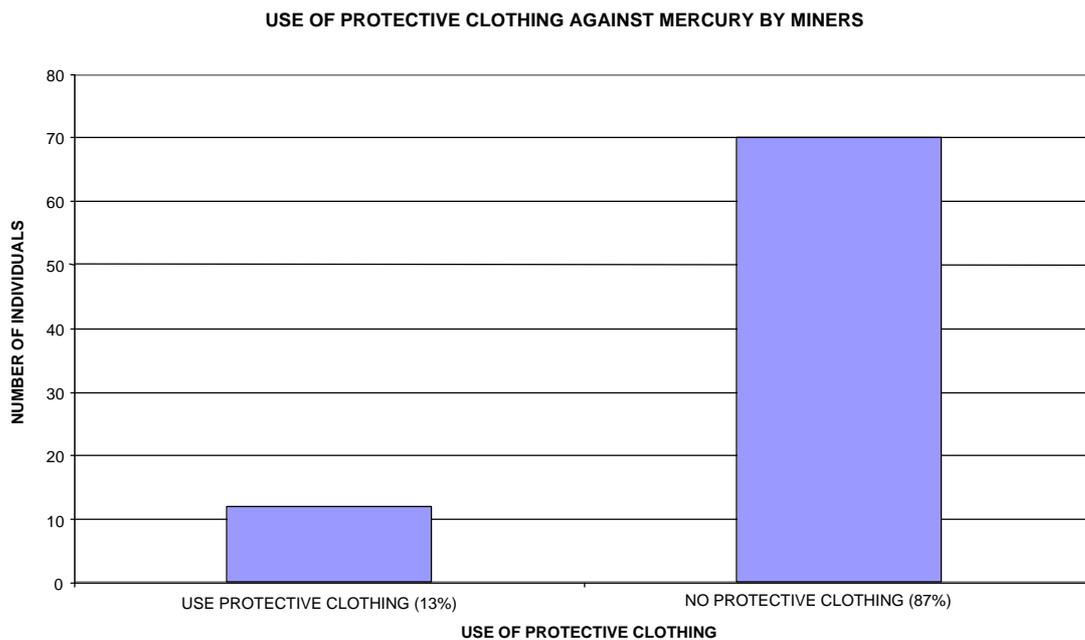
### **Use of Mercury in Gold Extraction: Mercury Amalgamation**

All the small-scale miners interviewed used mercury amalgamation to extract the gold from the ore. Mercury is purchased either from retailers in Chakari (22%), mill owners (39%) or from private gold buyers (39%). This activity is mainly done at the mill sites which all have a copper plate system. All respondents said burning of the amalgam is done at the mill sites with the exception of one woman who does it at her home. It was also learnt that nitric acid is used to remove impurities in conjunction with mercury amalgamation in gold extraction. Most of the miners had burns on their hands due to the use of this acid without protection. Burning of the amalgam was mainly done using wood fire.

While more than half the miners (61%) had some prior knowledge of the harmful effects of using mercury, few (only 15%) used any sort of protection against it and most handled it with bare hands. This could be linked to the fact that the impacts of mercury poisoning are long term. Another reason could be that gold mining is the main source of income and therefore benefits outweigh health concerns. Knowledge of mercury poisoning is illustrated below:



Use of protective clothing (gloves and masks) by miners is illustrated below:



Almost all the mill workers live with their families in the vicinity of the mill sites, with the greatest distance being 500m. Since most of the burning of the amalgam is done at the mill site, such households are vulnerable to fumes coming from the burning of the amalgam to extract the gold. Also highly vulnerable are the miners who do the actual burning of the amalgam. Since most miners travel 2- 15km to the mill sites, their households are not as vulnerable.

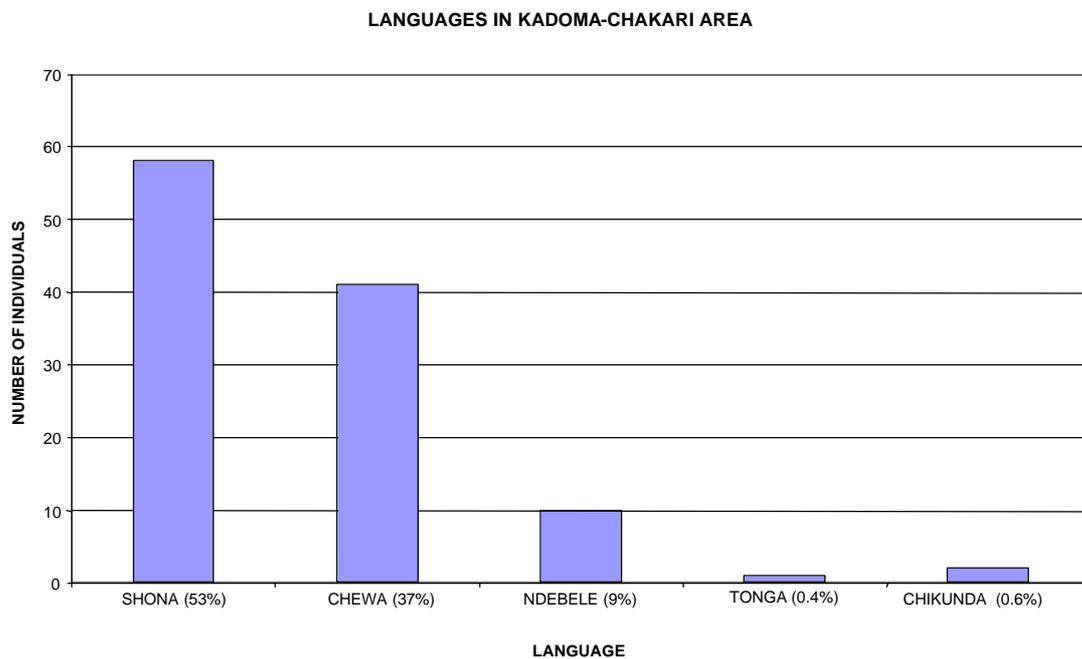
### Demographic Data

According to recent unpublished census data from the Central Statistical Office, the Kadoma-Chakari area has a total population of 6354 people. Of these 3227 (51 %) are

male and 3127 (49%) are female. The sample size of this study makes up 2% of the total population. The mining community is however predominantly male. This might be due to that most miners or mill workers are young unmarried males. Some male miners have families staying at their rural homes away from the vicinity of the mining area. The following demographic data is based on the sample population.

### *i) Ethnicity*

The community in the Kadoma-Chakari small-scale mining area is of mixed ethnicity. The dominant languages spoken in order of popularity within the sample are Shona (mother language of 53% of respondents), Chewa (37%) and Ndebele (9%). This is graphically illustrated below

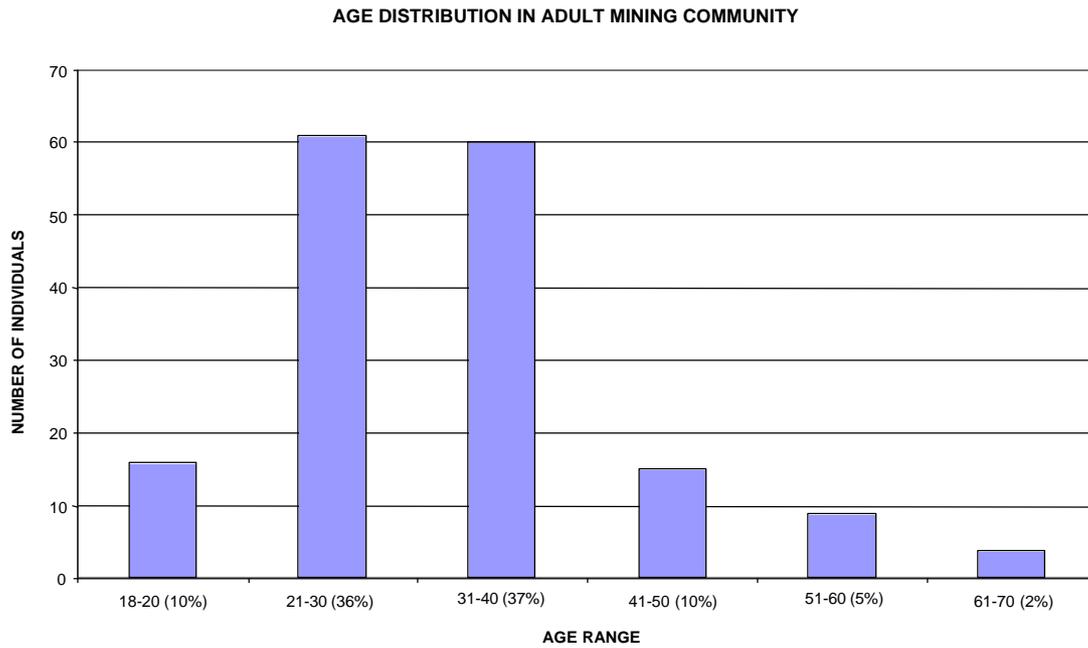


### *ii) Age Distribution*

#### 1) Adults

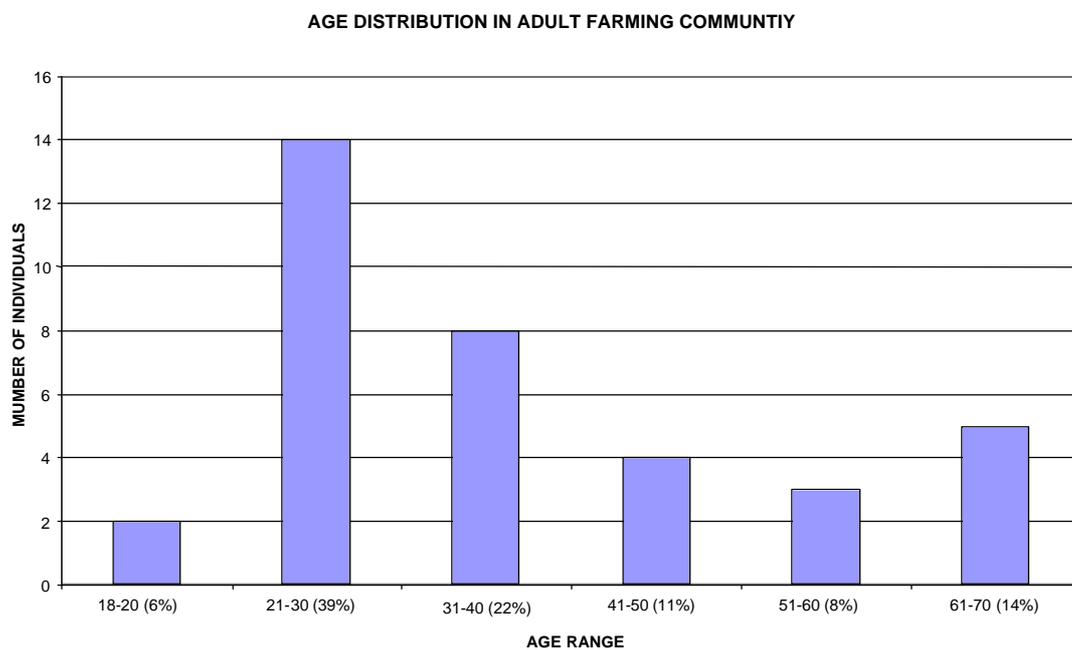
##### 1a) Mining Community

Most adults in mining community are concentrated in the 20-40 year age group as illustrated below.



### 1b) Farming Community

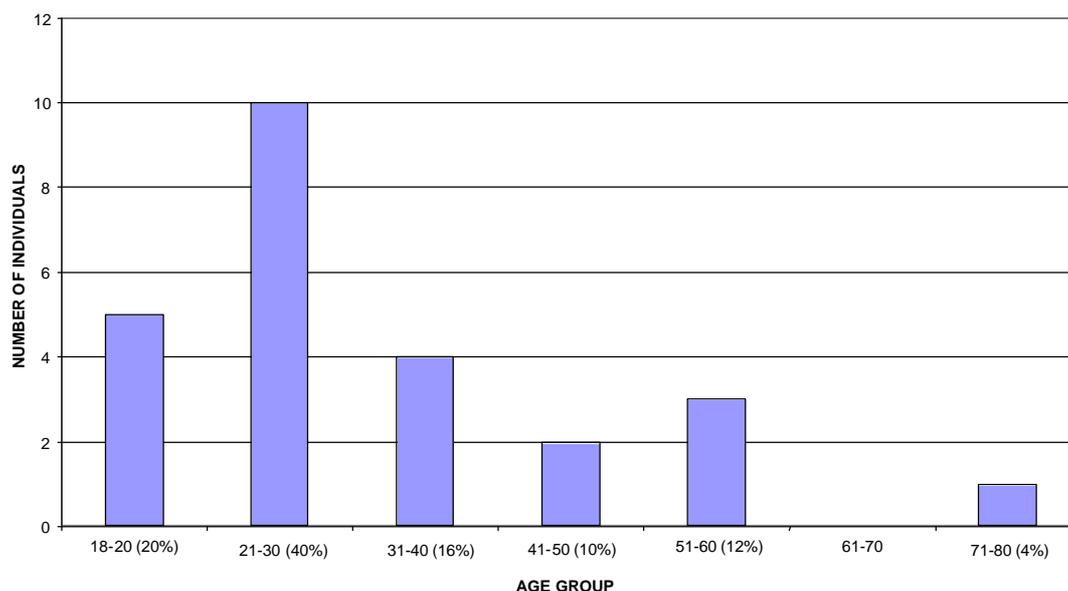
Amongst the farmers, the dominant age group is also 21-30 yrs as illustrated below.



### 1c) Non Mining and Non-farming Community

Here as in the farming community the dominant age group is 21-30 yrs as shown below. Their occupation is quite varied including vendors, radio repairers, mechanics, civil servants, etc.

AGE DISTRIBUTION IN ADULTS ENGAGED IN ACTIVITIES OTHER THAN MINING AND FARMING



The majority of people in the economically active age range (21-40 years) are miners. The number of adults tapers off considerably in above 50yrs amongst miners. Most people that are engaged in mining beyond 40 years are mill workers. The manual nature of the work might be a factor and also that maybe people retire from mining to do other work or possibly mortality might be high in this community. There are more people above 40 in the farming and non- mining and non-farming sectors of the community.

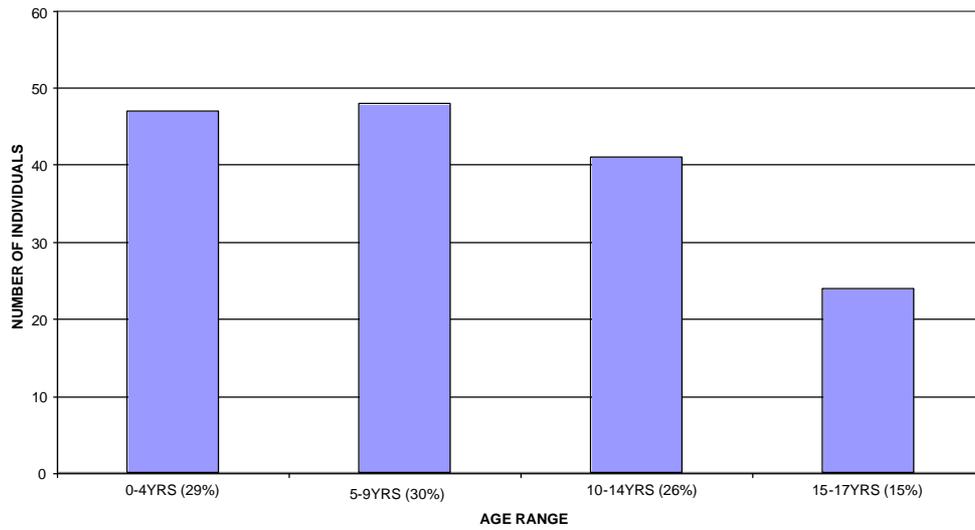
## 2) Children

The age distribution amongst children shows no distinct pattern in all occupations as illustrated in the graphs below. It is however concentrated in the age groups 14yrs and below.

### 2a) Children from Mining Community

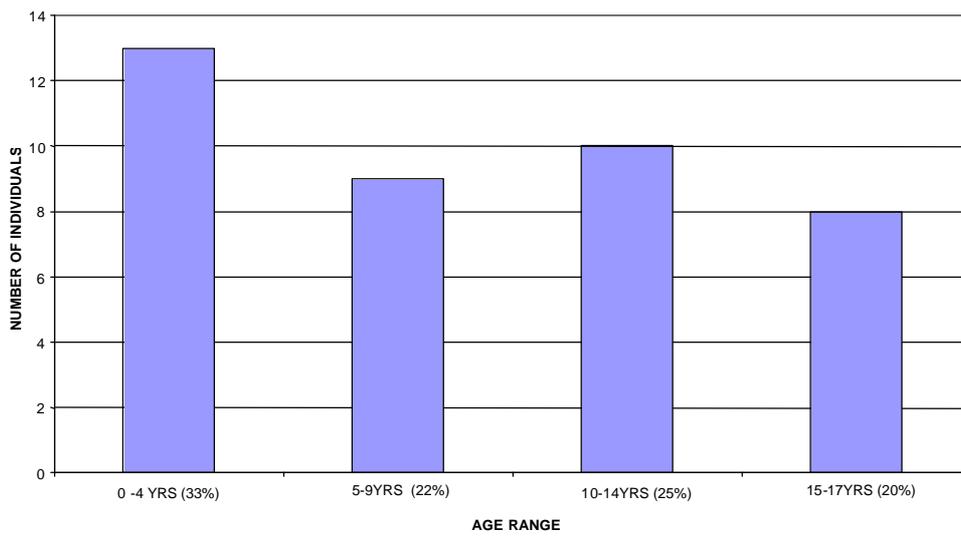
Besides children at mills who do not engage in mining, most boy-children in the mining community are at some stage in their lives engaged in mining with their fathers. The majority of the children are of primary school level (5-13 yrs) and stay with both their parents.

**AGE DISTRIBUTION AMONG CHILDREN IN MINING COMMUNITY**



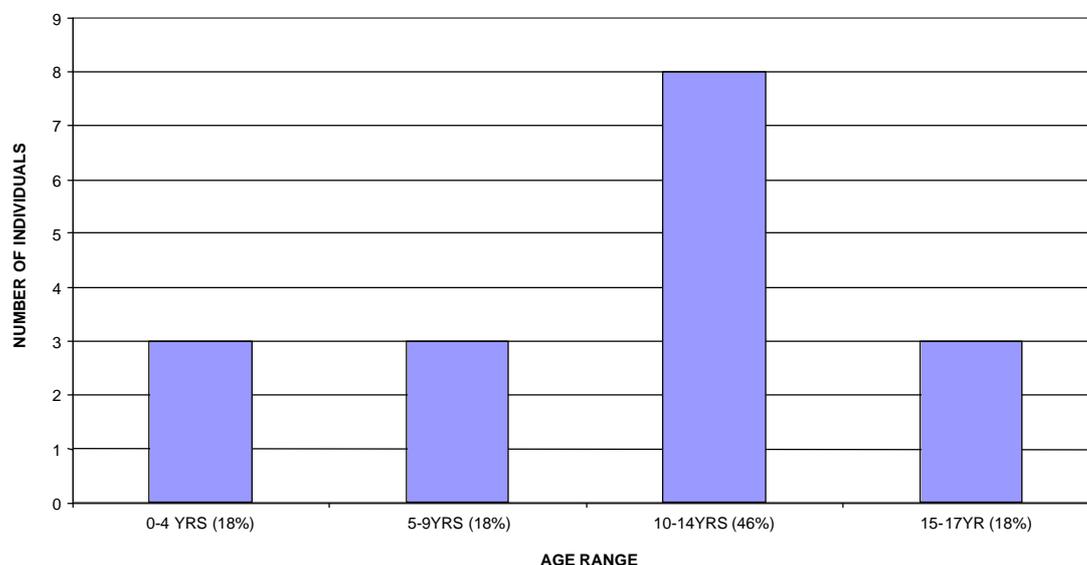
2b) Children from Farming Community

**AGE DISTRIBUTION AMONG FARMING COMMUNITY CHILDREN**



## 2c) Children from Non-mining and Non-farming Community

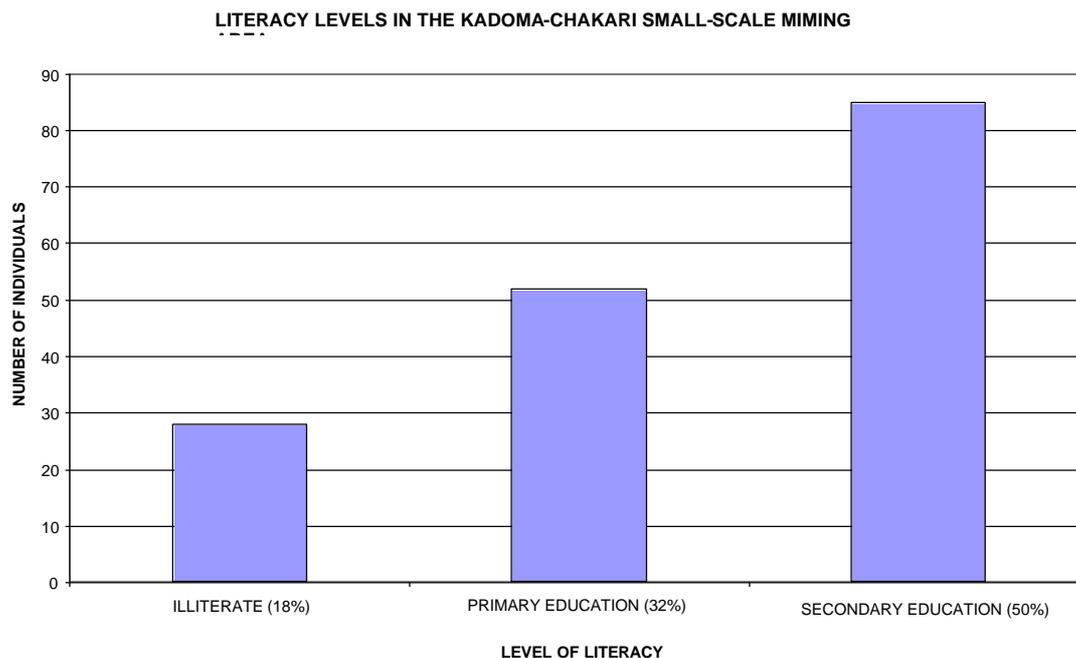
AGE DISTRIBUTION AMONGST CHILDREN IN HOUSEHOLDS ENGAGED IN ACTIVITIES OTHER THAN MINING AND FARMING



It is difficult to perceive levels of mortality within the community. Mining is mainly done by the active work group (between 20-40 years of age). It is not known as to what happens to the miners when they retire from active digging. Most likely they go back to their rural homes where they originally came from and die there (most people in the area have migrated into the area for employment reasons and have rural homes elsewhere in the country). Mortality rates within the sample population staying in the vicinity of the mine/mill site were said to be very low. Most people claimed that there were very few accidents that have happened at their sites.

*iii) Education Levels of Adult Community*

Literacy levels in the area are good, with the majority (52%) of the adult community members having attended secondary (Ordinary High School Level) education. Primary education level is from Grade 1-7 and is normally done at the age of 6-13 years. Secondary education is from Form 1-4 or Form 1-6 and is normally done at the ages 14-19 years. Education levels in the sample community are as indicated below:



Levels of illiteracy are however considerable (17%) as shown above. 31% of the community has primary level education.

### **Social Infrastructure/Amenities**

#### *i) Housing*

Workers' houses at the mill sites visited (with the exception of Glasgow Mill and the Falcon Gold compounds which have brick and asbestos and corrugated iron sheet roofs) are deplorable. They comprise thatch, pole and dagga structures that are hardly suitable for human habitation. At one site the workers are asked to construct their own housing structures. Resettled farming villagers either had the opportunity of occupying farmhouses and farm compounds or have built temporary housing structures. Those miners staying in Falcon Gold compounds pay a rental of Z\$500-Z\$1000 (US\$ 0.19-0.37) per month.

#### *ii) Occupational hygiene/Sanitation*

On all the mine and mill sites visited, lack of sanitary facilities is quite glaring. With the exception of two mills (Glasgow and Coetzee) that provide basic toilets in the form of pit latrines and Blair toilets respectively, there are no toilet facilities on all other mill or mine sites visited. Bathrooms are in the form of grass-thatch surrounded structures constructed by the workers themselves. Only miners staying in Falcon Gold Mine Company compounds have the privilege of flush toilets and shower facilities. They however say that the toilet systems are usually blocked/plugged.

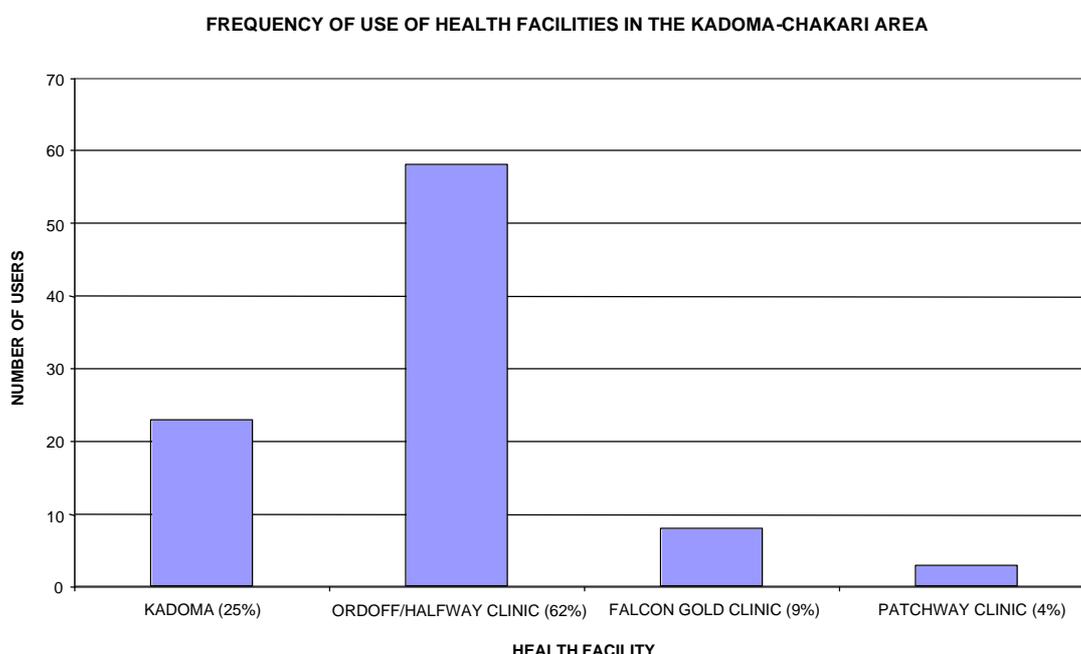
#### *iii) Water*

Most of the water used for domestic purposes in the area is borehole derived or pumped from disused mine shafts, with the exception of Falcon Gold compounds in Chakari which a fed from dam water. Water is said to be of good quality, however the

possibility of contamination cannot be ruled out. Workers at mill sites and people staying on Falcon Gold compounds have easy access to water, which is usually close to their houses. However for most of the resettled villagers away from farmhouses and compounds and mine claim sites, water sources can be up to 5 kilometres away. Fetching of water is primarily done by women who either carry it on their heads or using wheelbarrows. Exceptions are mine sites predominantly occupied by men where they have to fetch their own water.

#### iv) Health Facilities

Health facilities are an area of concern to the community. Despite having a clinic in their vicinity, most of the small-scale mining community cannot access it as it is reserved only for current workers of Falcon Gold's Dalny Mine. They therefore have to travel distances of 20 to 40km to access health facilities in or near Kadoma. Ordoff Clinic near Kadoma is the most frequently visited, followed by facilities in Kadoma itself as illustrated below:



The community strongly feels that Falcon Gold Company has neglected its social obligation by neglecting its former workers who were retrenched after the mine scaled down its operations. Most of the retrenchees are now self-employed as small-scale miners. They feel the mine owners should play a role by providing access to health facilities, particularly for emergency cases. Transport costs to other health facilities are very expensive and of concern to the community. The cost of a trip to and from Kadoma, irrespective of distance is Z\$2000 (US\$0.74).

The majority of cases brought to the Ordoff Clinic are sexually transmitted infections. There are very rare cases of mine accident casualties. Also common are cases of malaria. It can however not be established whether the latter are real cases of malaria or mercury poisoning since symptoms of mercury poisoning are similar to those of malaria. According to a report from the Small Scale Miners Association of Zimbabwe (1994, p8) symptoms of mercury poisoning include tremors. These can be likened to

the fever typical of malaria. This is further substantiated by an article in Horizon magazine (April 1992, p12) titled "Hidden Death in a Tiny Lump of Mercury" which sites a New Scientist magazine article. The article states that mercury poisoning can go unnoticed because the illness is so like malaria.

#### v) Education

Education facilities include those in Kadoma and Chakari as well those within the mining sites. Most schools are in the range of 2-7 km away from most of the mining sites.

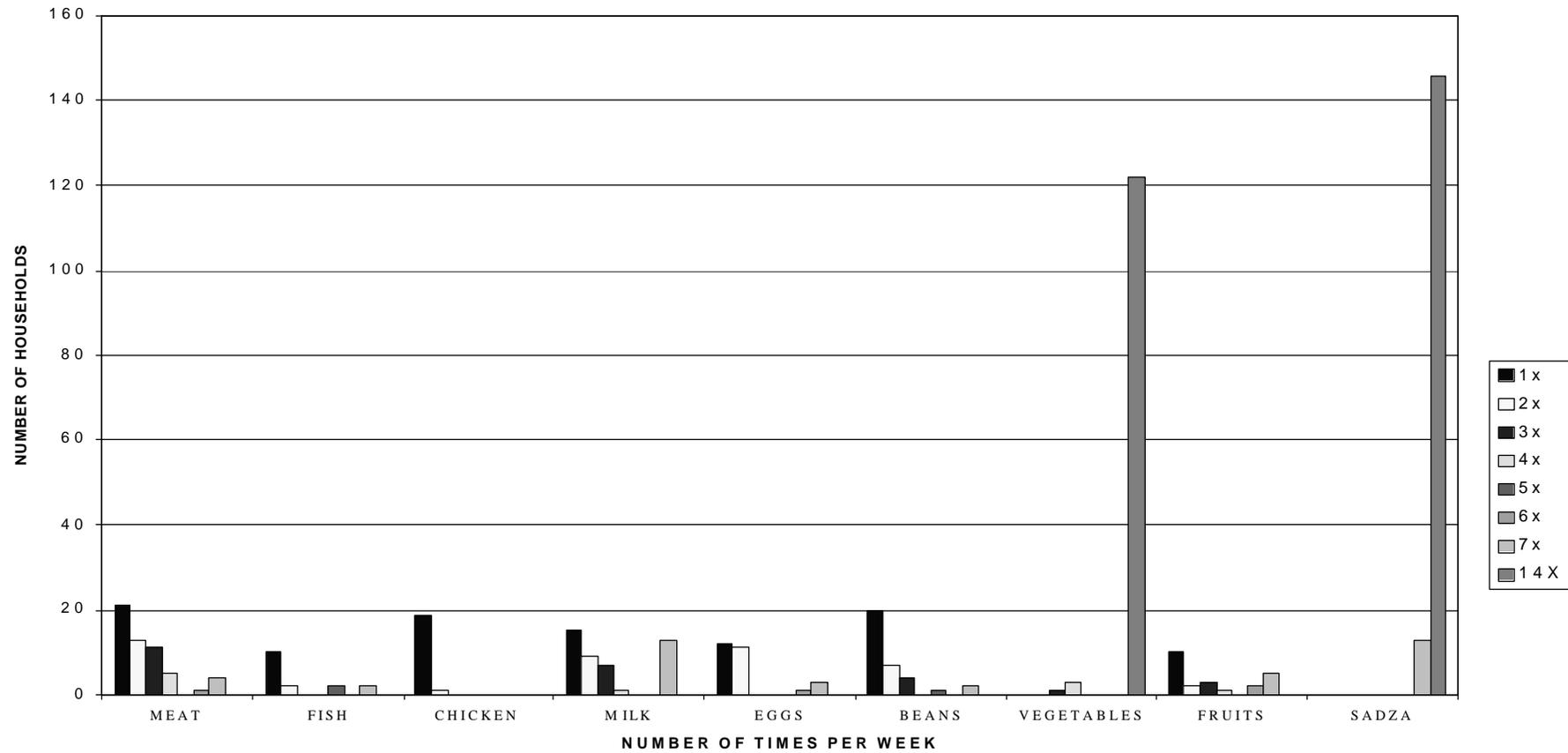
Attendance at the schools has been adversely affected by small-scale mining activities at both primary and secondary level. Absenteeism is quite rife as students help out in gold digging activities in small-scale mining dependent households, particularly so in the dry season. This affects both sexes at the schools. This however does not affect communities living at the mills as there is no case there of child labour involvement in milling activities. Dropouts are also a common aspect. Promiscuity and pregnancy feature amongst girls in the community affecting even primary school girls who fail complete their primary education. Also rampant is drug abuse, especially alcoholism.

Most of the children from small-scale mining households are said to be malnourished and have poor hygiene. Payment of fees is also poor as most of the money from gold digging is spent on food. These aspects impact significantly on school performance by children from the mining community.

#### vi) Diet

In the sample population, sadza (thick cornmeal porridge) is the most frequently eaten food, being eaten quite regularly during the week. Most people eat sadza twice a day. This is understandable as it is the country's staple carbohydrate source. This is mainly accompanied by vegetables, which are also eaten two times a day by most people. Meat follows, though eaten with less frequency (1-2 times a week), then milk and beans. Beans are mainly consumed when in season. Fish are eaten when in season (usually in summer) and are usually brought in by vendors from outside the area since there are very few rivers in the area and those rivers that are there contain no fish. However Kapenta, (*Limnothrissa moidon*, a small non-carnivorous fish caught in lake Kariba that is usually caught and sold dried in packets in shops, is eaten whenever families can afford it. The choice of relish is largely influenced by cost rather than preference. While most people would prefer to have meat twice daily they cannot afford it and therefore consume vegetables more frequently because they are cheaper. Meat is either bought from surrounding butcherries or brought in by vendors. The consumption rates of various foods per week are illustrated in the table below.

FREQUENCY OF CONSUMPTION OF DIFFERENT FOOD TYPES



It should be noted that since the main foods consumed are the starchy carbohydrate source and vegetables, it is most likely that the population might be lacking essential nutrients, in particular protein. This was evidenced in the sample community where most people appeared visually undernourished (i.e. skinny).

Mercury poisoning through the diet cannot be ruled out. While most mill workers do not grow their own crops, almost all the other small-scale miners grow their own maize and vegetables. Some of them in addition keep livestock and poultry. Most mill workers buy their maize and vegetables from surrounding farming communities. If there is mercury contamination in the soil, this will accumulate in the cultivated food and animals and will in turn be passed on to humans that feed on them.

## **The Gold Mining Process**

### *i) Extraction*

Extraction of the ore from the gold reefs is manual and involves digging it out with basic tools, i.e. picks, shovels, hammers and chisels. In most instances steps are made as the people dig deeper (up to 30m) to enable the ore to be moved up by shovel to the top. However in a few cases vertical shafts are dug, with miners being sent down using a bucket and rope from a hand operated winch. In such cases digging can go to a depth of 30m or more below ground level. Due to the manual nature of the work and the hardness of the parent rock, digging is primarily a man's task. There were a few incidences where women were involved in the digging of the ore, this usually to shallow depths (2-5m). Protective clothing (gloves, coveralls, safety boots, helmets) was not worn at any of the mine sites visited.

One claim owner said he could improve his output if provided with funding to purchase requisite technology (mechanical equipment) for mining. This included such things as compressors, explosives, mechanical mine heads and a mill.

It was observed that in some of the claims buyers/middleman came in as 'sponsors' providing tools, food, transportation, mercury and paying for the milling process. In the end they would deduct all these costs from the miners when they bought the gold from them. This means that in the long run the miners derive minimum benefit from the mining process as their profits are heavily eroded.

The resultant ore obtained is sent to nearby stamp mills for crushing. With the exception of one indigenous black claim owner, all mills are operated by Zimbabwean white people and the small-scale miners are charged a fee of Z\$2500 (US\$ 0.93) per hour for the milling process.

At the mined claim sites most of the disused shafts are left uncovered and mixed soil heaps left above the ground. New shafts are dug next to the old ones (which are said to provide ventilation into the new shafts). This leaves behind a very degraded environment on worked mine sites. The disused shafts are a hazard to both humans and their livestock. Though there is a new regulating policy on this in the Environmental Management Act, its implementation at small-scale mining sites is yet to be seen.

It should be noted that in the Kadoma-Chakari area we saw no evidence of gold panning activities.

### *ii) Milling*

Most mills are primarily devoted to milling the ore brought in by small-scale miners with no mining done by the mill owners themselves. Their clients are usually from the surrounding areas, but some bring their ore from as far as Sanyati (70km away). The mills are electrically powered and all of them have a copper plate system on which the gold is amalgamated with mercury.

Miners expressed interest in obtaining mills, as the price of milling is said to be expensive. However they cited the cost of erecting one and lack of capital as the chief impediments.

The average load brought to the mill by a miner is roughly 5 tonnes of ore per month. This yields between 5-15 g of gold depending on the quality and source of the ore. Most mills will serve any client. However, mills belonging to or contracted under Falcon Gold only serve clientele that has been given permits by Falcon Gold. The charge for milling was said to be about Z\$2500 (US\$0.93) per hour.

### *iii) Gold Extraction by Mercury Amalgamation*

After milling the refined end product is mixed with mercury on the copper plate. Mercury readily bonds with base metals such as gold, a process known as amalgamation. The amalgam is scrapped off the copper plate and squeezed in a cloth to remove unused mercury, which is then collected in a container for re-use. The gold is then recovered by burning away the bonded mercury. This is usually done at the mill sites, with hazardous consequences to the miner and mill workers. Retort mercury recovery had been introduced at one of the mills. However this was met with a lot of scepticism from the miners who felt they were being cheated by the miller of some of their gold.

Sources of mercury to miners are wide-ranged. They include suppliers such as retailers in Kadoma, the millers or the buyers/dealers. It is therefore difficult to ascertain how much mercury is used in the gold extraction process. The amount of mercury used also varied depending on the ore obtained. The level of mercury use however should have risen significantly with the upsurge in small-scale artisanal gold mining. The price of mercury was Z\$2000 per 50g, which was said to be adequate for the extraction of about 100 grams of gold.

Handling of mercury at the mills is usually by the miners (bringers of the ore) as these are usually suspicious of the millers cheating them of their gold. Handling of the mercury is very careless, and is usually done with bare hands. Whilst most acknowledge the possible dangers of mercury, this danger is not taken very seriously. This might be due to the fact that the impacts are long term and the symptoms not easy to identify.

Vaporised elementary mercury is said to be highly poisonous. Approximately 80% of inhaled mercury is retained. This is retained in the lungs, particularly the alveoli.

Concentration in the blood is said to indicate recent poisoning, while concentration in urine is said to indicate long-term exposure. Exposure to vapours of mercury results in chronic poisoning. Symptoms include gingivitis, tremors and personality changes, kidney injury, and increase in blood and urine above normal levels. The overall poisoning effect is like malaria and therefore hard to detect.

General interest was expressed in methods that would increase mercury recycling as it is said to be expensive and also on increasing efficiency of the gold extraction method.

#### *iv) Gold Extraction by Cyanidation at Mills*

Concern was raised by a few of the claim holders/miners that while they did the digging and paid for the milling, all they got in the long run was gold from the amalgamation process and not the remaining coarser sand-like sediments which also contained gold, sometimes even more than that obtained from mercury amalgamation. They claimed that they were being short-changed by millers who did not do any digging of the gold but obtained the pounded crude ore on which they then used cyanidation to extract the remaining gold. Indeed every mill visited had cyanide treatment (vat-leaching) ponds, tanks or plants.

An analysis of cyanide use in gold mining in the area and related impacts on the environment and health is recommended.

Some small-scale miners would like to operate cyanidation plants, funding permitting. However they lack the resources and financial support/backing.

#### *iv) Gold Marketing/Sale*

Small-scale miners obtain roughly 5-15g of gold per tonne of gold. The marketing of gold is through three means: selling the gold to Fidelity Printers (11%), an arm of the Reserve Bank; to legal and illegal dealers/middleman/private buyers (50%); or legal millers (39%). Fidelity Printers, a government arm of the Reserve Bank of Zimbabwe, buys gold at a price of close to Z\$20 000 (US\$7.4) per gram. The private buyers buy the gold at a price range of Z\$8000 – Z\$15000 (US\$ 3 –5.5) per gram. However private buyers go to the source of the gold, i.e. the miners.

### **Recommendations**

The following recommendations are suggested for the study area:

- Resettled farming communities are politically sensitive. There is therefore need to obtain permission from ZANU PF party hierarchy in the area in order to access them. This applies to communities at Alabama, Golden Valley (Enfield Farm), as well as the Chakari town community. Mill site communities are easily accessible through the mill owners.
- Most small-scale miners lack financial support to purchase requisite capital equipment to increase efficiency and output. It is recommended that this aspect be addressed.

- 
- Environmental degradation at disused mine sites remains unchecked. Miners should be made aware of the negative environmental impacts, the relevant environmental legislature, and prompted to take action to rehabilitate disused mine sites.
  - Most miners and millers have some knowledge of the health and environmental dangers of improper mercury use. However there is a complacent attitude regarding its use. This might be due to the long-term effects of these dangers and also the monetary benefits outweighing health concerns. Awareness education on these long-term effects should therefore be provided.
  - Malaria is said to be prevalent in the area. However, since symptoms of mercury poisoning are said to be similar to those of malaria it is difficult to tell whether these cases are malaria or mercury related. Investigations on these two possibilities should be undertaken.
  - While it is difficult to access most mining sites to test human mercury poisoning levels, respondents can be accessed at mill sites, schools and shopping centres in the area. Whole households should be considered in the health study to assess the impact of mercury on food, water sources and the surrounding environment in the Kadoma-Chakari community and its effect on human health.
  - While there are not many surface water systems such as rivers in the mining area, the possibility of underground water mercury contamination cannot be ruled out. Mercury can also accumulate in the ecosystem as well be absorbed by humans. Tests should therefore be undertaken to assess this possibilities.
  - All miners, millers and mill workers are willing to accept cleaner methods of gold extraction. Relevant training and necessary technology should therefore be provided.
  - Cyanide is used for gold extraction at the mills. Its impact on health and the environment should be investigated. Also of concern is that millers derive benefits from the cyanidation process at the expense of the small-scale miners. The possibility of profit sharing or reduced milling cost negotiated with the millers should be looked into.
  - Nitric acid is used to remove impurities in conjunction with mercury in the gold extraction process by most miners at the mill sites (and not in the cyaniding tanks/vats). Its impacts on health should be investigated.
  - Women miners have the disadvantage that unlike man they do not operate in groups or associations. It is therefore difficult to address their concerns individually. It is recommended that they be encouraged to form groupings in order for them to have a collective voice in their undertakings. Organisations and institutions that will work in the area are urged to be gender sensitive and incorporate the needs of the underprivileged women miners. Technology

should also be designed to make the work for women lighter, in particular manual activities.

### **References**

- Small Scale Miners Association of Zimbabwe (1994). Pilot Project Proposal. A study of mercury vapour poisoning amongst alluvial gold panners and a solution: Environmental Protection Through Appropriate Technology. December 1994, Harare.
- Unknown Author (1992). Hidden Death in a Lump of Mercury. Horizon Magazine. April 1992, p 21.

## Appendix 1: Structured Questionnaire For Community Groups

### STRUCTURED QUESTIONNAIRE FOR COMMUNITY MEMBERS ON REMOVAL OF BARRIERS TO THE INTRODUCTION OF CLEANER ATRISANAL GOLD MINING AND EXTRACTION TECHNOLOGIES ON THE KADOMA-CHAKARI SMALL-SCALE MINING AREA

#### INSTRUCTIONS TO THE ENUMERATOR

1. Explain that all the personal information respondents provide remains confidential and will not be disclosed to third parties.
2. Explain that it is important that the head of the household or the spouse should be the one to take part in the interview.
3. Do not read out to your respondent the alternative answers designed, but give them the opportunity to come up with their own ideas.

#### *Personal Details*

Interview Date -----/-----/03 (Interview done after prior informed consent by respondent)

Name of Mine/Mill-----, Location-----

Name of Contact-----, Sex; Male/Female Age: ---yrs

Phone/ Address of Contact-----

Name of Enumerator-----

#### *Demographic Information*

Q1 What is Marital Status of respondent:

- (a) Single
- (b) Married
- (c) Widow
- (d) Widower
- (e) Separated

Q2 What is the Head of the Household?

- (a) Male
- (b) Female

Q3 What is the number and ages of Household members?

	SEX		AGES
	MALE	FEMALE	
LIVING			
DECEASED			

Q4 What is the Household Total:

Q5 What is the highest level of education achieved by:

	ILLITERATE	PRIMARY	SECONDARY	COLLEGE	UNIVERSITY
Mother					
Father					
Children					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
Relatives staying With you					
1					
2					
3					
4					
5					

Q6. Where do you originally come from? -----  
-----

Q7. What language do you speak at home? -----  
-----

Q8 What other languages are spoken in the area? -----  
-----

Q9. How long have you been here? -----yrs

Q10. How long have you been engaged in mining/milling activities? -----yrs

**Habitat Information (Household Location & Structure)**

Q11. How far is your homestead from mine/mill? -----

Q12. Do you stay here permanently? ----- YES/NO

If not where is your permanent Homestead? -----

Q13. How many people stay in the homestead?

Men-----, Women-----, Children-----

Q14. What do you use for toilet facilities?

- a) Toilet
- b) Pit latrine
- c) Blair Toilet
- d) The Bush

Q15. What do you use for bathing?

- Shower/bathroom
- River
- Other structures (Specify)-----

*Occupational activities\*

Q16. a) Do you mine throughout the year? ----- YES/NO

b) If not when is gold mining prevalent? -----

c) If yes what do you do when not mining? -----

Q17. Do you raise income from activities other than mining? -----YES/NO

If not what other activities are you engaged in-----

-----

Q18. What is your main source of income? -----

-----

Q19. On average what is your monthly income/-----

-----

Q20. a) How many people in your household are engaged in mining? Men-----  
-----Women-----, Children-----

Q20. b) Is their engagement in mining Seasonal / Permanent? -----

Q21. What economic activities are those not doing mining engaged in? -----  
-----

Q22. How much do you spend a month on average on the following?

a) Food	Z\$
b) Water	Z\$
c) Rent	Z\$
d) Health	Z\$
e) School fees	Z\$
f) Clothing	Z\$
g) Transport	Z\$
h) Energy (firewood/electricity)	Z\$
i) Others (specify)	Z\$

What can you not afford? -----

Q23. How much ore do you mine per month on average as a household? -----tonnes

Q24. Do you use mercury in extracting you gold from the ore? -----YES/NO

Q25. a) If yes for Q24 above where do you get your mercury? -----

b) How much mercury do you use per tonne of ore/? -----

Q26. Where do you process/mill your ore? -----

Q27. On average how much gold do you get per tonne? -----g

Q28. Where do you burn your amalgam? -----

Q29. What do you use to process your amalgam? -----

fire/welding torch

Q30. a) Who buys your gold? -----

Fidelity Printers/Private dealers or buyers.

b) What are the difficulties you encounter while selling your gold? -----  
-----

Q31. On average what is the buying price for a gram of gold? Z\$-----

Q32. Are you aware of the dangers of handling/using mercury? -----  
-----

Q33. Do you use protective clothing when dealing with mercury? -----

Q34. How do you feel about your current working conditions? -----

Bad-----, Satisfactory but could be improved -----, Good-----

Q35. How can your working and living conditions be improved-----  
-----

Q36. a) Would you like to benefit from improved methods of gold extracting  
technology? -----YES/NO

b) Would you accept training for Q36a above? -----

### **Social Amenities**

Q37. What is your Source of domestic water?

- a) Rain water
- b) Dams
- c) River
- d) Boreholes
- e) Shallow wells
- f) Tap water

Q38. How is the quality of the water?

- a) Good
- b) Muddy
- c) Unsafe

Q39. Who fetches water?

- a) Women
- b) Man
- c) Boys
- d) Girls

What is the distance from the water source? -----km, or-----hrs

Q40. What do you use for energy?

- a) Fuel wood
- b) Electricity
- c) Generator
- d) Paraffin

Q41) How regularly per week do you consume the following foods?

- a) Mealie meal/sadza ----- times
- b) Meat ----- times
- c) Fish ----- times
- d) Chicken ----- times
- e) Milk ----- times
- f) Eggs ----- times
- g) Beans ----- times
- h) Vegetables ----- times
- i) Fruits ----- times

What are the reasons why you prefer certain food over others?-----

Q42. a) Do you grow your own crops and keep your own domestic animals? -----

YES/NO

b) If yes which ones do you grow-----

-----  
and which ones do you keep? -----

c) If not where do you source your food? -----

-----  
Q43. Are there vendors who sell food in your area?-----YES/NO

If yes what food do they sell?-----

Q44. a) Do you practise agriculture? -----YES/NO

b) If yes what type of agriculture? Commercial-----/Subsistence? -----

Q45. Are your food sources easily accessible? YES/NO-----

-. How many kilometres away? -----

b) Is food affordable? -----

Q46. Where are schools located?

i) Primary School -----km

ii) Secondary School-----km

b) Are School fees affordable? -----

Q47.a) Where is the nearest clinic located?-----

b) How far is it from your place -----km

c) Are health fees affordable? -----

**Appendix 2: Structured Questionnaire for Women/Women Groups****STRUCTURED QUESTIONNAIRE FOR WOMEN/WOMEN GROUPS ON  
REMOVAL OF BARRIERS TO THE INTRODUCTION OF CLEANER  
ARTISANAL GOLD MINING AND EXTRACRION TECHNOLOGIES IN  
THE KADOMA CHAKARI SMALL SCALE MINING AREA****INSTRUCTIONS TO THE ENUMERATOR**

4. Explain that all the personal information respondents provide remains confidential and will not be disclosed to third parties.
5. Explain that it is important that the head of the household or the spouse should be the one to take part in the interview.
6. Do not read out to your respondent the alternative answers designed, but give them the opportunity to come up with their own ideas.

*Personal Details*

Interview Date -----/-----/03 (Interview done after prior informed consent by respondent)

Name of Mine/Mill----- Location-----

Name of Contact-----, Sex; Male/Female Age: -----yrs

Phone/ Address of Contact-----

Name of Enumerator-----

Q1.a) Are you engaged in mining? YES/NO

b) If yes describe what activities you do.

- a) Digging
- b) Carrying Load
- c) Mercury amalgamation
- d) Burning of amalgams

c) Are you aware of the dangers of mercury use? YES/NO

d) Do you wear protective clothing when using mercury?-----

Q2.a) Are you engaged in any other chores besides the above? YES/NO

b) If yes state what other chores you do -----

-----

c) Do you derive economic benefit from the other chores? YES/NO

If yes state how much on average you make per month Z\$-----

Q3.a) How much do you receive from mining? Z\$-----

b) Do you decide how this income is used? YES/NO

c) If no to the above who decides? -----

Q4.a) How do you feel about your current working conditions? -----

-----

b) How can these conditions be improved? -----

-----

Q5.a) Do you feel you could be more engaged in mining activities? YES/NO

b) If yes how and where? -----

-----

-----

Q6. How many women in your area/site are engaged in gold mining activities? -----

-----

**Appendix 3: Structured Questionnaire for Mine/Mill Owners**

**STRUCTURED QUESTIONNAIRE FOR MINE/MILL OWNER ON  
REMOVAL OF BARRIERS TO THE INTRODUCTION OF CLEANER  
ARTISANAL GOLD MINING AND EXTRACTION TECHNOLOGIES IN  
THE KADOMA – CHAKARI SMALL-SCALE MINING AREAS**

**INSTRUCTIONS TO THE ENUMERATOR**

7. Explain that all the personal information respondents provide remains confidential and will not be disclosed to third parties.
8. Explain that it is important that the head of the household or the spouse should be the one to take part in the interview.
9. Do not read out to your respondent the alternative answers designed, but give them the opportunity to come up with their own ideas.

*Personal Details*

Interview Date -----/-----/03 (Interview done after prior informed consent by respondent)

Name of Mine/Mill-----, Location-----

Name of Contact-----, Sex; Male/Female Age: -----yrs

Phone/ Address of Contact-----

Name of Enumerator-----

Q1. When did you commence operation? -----

Q2. How many staff do you employ? Permanently -----, temporarily-----

Q3.a) How many among staff are married? -----

b) How big their families? -----

Q4.a) Have you had any deaths among your staff? YES/NO-----

b) If yes how many? -----

c) Are the deaths related to mining activities? -----

-----

Q5. What is the age range of your staff? ----- to ----- yrs

Q6.a) What is the turnover amongst your staff? High/Low-----

b) What is the frequency? ----- months.

Q7.a) Where do your staff stay? On site/away from site-----

b) How far are their homesteads from the mine/mill site? -----m

Q8. What is the source of your water supply?

- a) River
- b) Dam
- c) Borehole water
- d) Wells

Q9. Does your staff have toilet/sanitation facilities? YES/NO

If yes what type

- a) Pit latrine
- b) Blair toilet
- c) Flush toilets

Q10. Do you engage female workers? YES/NO

If yes how many? -----

If no why? -----

How do you feel about engaging female workers in future? -----

-----

-----

Q11. In what ways could your current milling/mining conditions be improved? -----

-----

-----

-----

Q12.a) How many mines do you own?-----

b) Where are these located? -----

-----

c) How much gold do you get per tonne? -----g/tonne

Q13. Which mining equipment do you possess? Tick where appropriate.

- a) Shovels----- b) Picks ----- c) Wheelbarrows-----
- e) Hammers----- e) Chisels----- f) Compressors-----
- g) Beam balances----- h) others (specify) -----

Q14. Which mining infrastructure do you have? Tick where appropriate.

- a) Shafts      b) mill      c) Cyanidation ponds/tanks

Q15. As the owner of the mill what role do you play? -----

-----  
-----

Are you the director, manager or a miner? -----

**Appendix 4: Information on Respondents**

NAME OF RESPONDENT	CONTACT DETAILS	SEX (M/F)	AGE	HOUSEHOLD SIZE
1. A. Banda	Golden Valley Mine Compound	F	39	-
2. Precious Karima	Maldon Mine, Box 73, Chakari	F	17	-
3. Constance Ncube	Box 387 Kadoma	F	-	-
4. Ivert Nkomo	Don Brilliant Mill (DeLang) Chakari	M	39	-
5. A. Matanga	Enfield Farm, Chakari	F	31	-
6. R. Tapfumaneyi	-	F	19	-
7. J. Nyamadzawo	Delcia Mine, Box 11, Chakari	F	41	-
8. D. Tare	Enfield Farm	F	56	-
9. Trymore Nyamadzawo	Delcia Mine, Box 11, Chakari	M	41	-
10. S. Makawa	Delcia Mine, Box 11, Chakari	F	51	-
11. S. Ngwenya	Chakari 10, Box 98, Chakari	F	28	-
12. Estiwe Meriseni	Golden Valley Mine, Box 704, Kadoma	F	45	-
13. Vera Schroeder	Ryan Mine, Chakari	F	25	1
14. Joseph Karima	Maldon Mine, Box 73, Kadoma	M	28	-
15. J. Ndou	Box 148, Chakari	M	28	4
16. Mrs. Phiri	Falcon Compound, Chakari	F	38	4
17. Lucias William	Maldon Mine, Box 73, Chakari	M	70	5
18. R. Chinzungu	Anfield Village, Chakari	M	32	6
19. Eneresi Sikonde	Maldon Mine, Box 73, Chakari	F	35	2
20. L. Taruvinga	Tagarika School, Box 1074, Kadoma	F	31	4
21. J. Moyo	Barkeley Chase	M	27	6
22. Lazarus Tare	Golden Valley Primary, P. Bag 1074, Kadoma	M	69	14
23. Mr Mudoni	Barcaly Chase 1020	M	25	3
24. G. Mateisangwa	Tagarika School, Box 1074, Kadoma	M	26	1
25. Adamson Dzamukova	Dalny Mine, Chakari	M	47	5
26. G. Chigwenene	Tagarika School	M	38	4
27. Mr. Tare	16 Barclay Chase	M	70	4
28. R. Chimutora	Ryan Mine	M	52	-
29. Lucia Mwanza	Maldon Mine	F	18	8
30. Christopher Antoinio	Turkois 9, Box 16, Chakari	M	33	7
31. Smart Matevera	Maldon Mine	M	58	7
32. N.Kanomaji	ZRP, Box 100, Chakari	M	27	1
33. P. Ngundu	Delcia Mine, Box 98, Chakari	F	21	4
34. M. Musiiwa	Delica Mine	F	19	3
35. C. Shumba	Chakari	F	24	2
36. Dona Nyirenda	Ryan Mine	F	57	2
37. A. Banda	H16, Golden Valley	F	39	9
38. Diana Mwanza	Alanza Compound, Chakari	F	22	4
39. Lilian Menyani	Maldon Mine	F	26	6
40. S. Tamanikwa	Anfield Farm	F	22	3
41. F. Muchaenda	Maldon Mine	M	32	5
42. Richard Mutandimange	(Hood Mine) 1096 Waverly, Kadoma	M	25	3
43. Kenneth Kachisa	(Hood Mine) 1784 Waverly, Kadoma	M	27	3
44. Munyaradzi Dlamini	(Right Five) 1784 Waverly, Kadoma	M	39	1

45. Mr Kabwe	Falcon 2, Box 04, Chakari	M	34	5
46. C. Chimutove	Milton 23	M	31	5
47. Tonderayi Shamuyarira	Coetzee Mill	M	34	4
48. Robert Hebert	Rm 35, Turkois, Chakari	M	42	3
49. R. Chimuto	Ryan Mine	M	52	6
50. Musitafa Milasi	House No. 2, M3, Chakari	M	35	6
52. Mensen Banda	541 Tafara, Chakari	M	26	3
53. John Phiri	81 E Street, Chakari	M	21	4
54. R. Mubaiwa	23A, Zengwe, Rimuka, Kadoma	M	22	3
55. M. Wadesango	(Right Five) Alabama, Tagarika	M	38	4
56. G. Tare	Golden valley Primary School, P. Bag 704, Kadoma	M	27	4
57. J. Banda	Downie mine, Chakari	M	60	5
58. Goremusandu Zaranyika	Golden Valley Primary School	M	55	9
59. J. Murombedzi	P. Bag 803, Chegutu	M	53	7
60. Socrats Maumbe	House No. T75, Chakari	M	21	6
61. E. Mundandanda	Alabama Primary School	M	31	4
62. I. Tare	Golden Valley Primary School	M	32	5
63. Tawanda Hungwe	Downie Mine, Chakari	M	24	3
64. I. Mazuru	DeLang Mill	M	28	2
65. C. Maphosa	Delica Mine	M	28	2
66. J. Mazarura	Ryan Mine	M	33	2
67. N. Geza	More Again Mine, Box 16, Chakari	M	37	4
68. N. Kachingwe	Mandarin 4., Chakari	M	42	6
69. Rastion Kaukaka	Dalny Mine Compound	M	49	7
70. N. Kuzvagwaoga	Milton 23, Chakari	M	35	4
71. T. Mhandu	House 98, Turkois 5, Chakari	M	26	5
72. I. Naison	Don Brilliant Mine	M	23	4
73. G. Chagwa	Falcon, Chakari	M	39	5
74. Trymore Nyamadzawo	Delcia Mine	M	38	6
75. S. Shonai	Delcia Mine	M	30	4
76. S. Chikoma	Coetzee Mine	M	23	4
77. Lovemore Masuti	Glasgow Mine, Box 50, Kadoma	M	38	2
78. J. Madzadza	Delcia Mine	M	32	4
79. Mathew Taruvinga	Galsgow Mine	M	18	5
80. L. Nyamadzawo	Delcia Mine	M	23	2
81. M. Matavire	(Alanza Mine) 19, 7 <sup>th</sup> Day, Chakari	M	32	5
82. Samuel Dickson	Delcia Mine	M	23	2
83. C. Phiri	Maldon Mine	M	40	5
84. C. Garawatu	Maldon Mine	F	51	14
85. Pateince	Maldon Mine	F	17	6
86. E. Phiri	Delcia Mine	M	43	5
87. A. Phiri	Maldon Mine	M	51	6
88. Gabriel Nkoma	Maldon Mine	M	21	5
89. Bright Mandala	Turkois 33, Chakari	M	17	6
90. J. Phiri	M 236, Chakari	M	36	4
91. Peter Kamanga	Delcia Mine	M	33	5
92. Simbarashe Phiri	Excelsa Estates, Box 73, Chakari	M	29	3
93. J. Karima	Maldon Mine 8H, Box 73, Chakari	M	28	4
94. Alexandra Binali	Maldon Mine	M	23	1

95. S. Phiri	More Again Mine, Chakari	M	26	1
96. P. Banda	Maldon Mine	M	41	4
97. Timothy Musomali	Blanket Mine, Box 109, Chakari	M	35	5
98. Wilson Banda	Ryan Mine	M	63	4
99. G. Phiri	More Again Mine, Chakari	M	38	6
100. Kyfer Mwanza	Maldon Mine	M	30	5
101. Tobias Zakeyo Phiri	Maldon Mine	M	58	9
102. M. Cephas	Maldon Mine	M	34	5
103. Clemence Kamba	Glasgow Mine/A555 Ingezi Kadoma	M	22	8
104. D. Julius	Galsgow Mine	M	62	4
105. Evson Sihlahla	Ryan Mine	M	53	5
106. A. Mafu	Zebra 32 Mine, 82 Chakari	M	27	1
107. Melusi Mpande	(Heywood Mine) Alabama Primary School	M	28	1
108. Madollar Phiri	Glasgow Mill	M	28	4
109. M. Phiri	Delcia Mill	M	39	6
110. Danisa Mbiba	Delcia mill	M	36	8
111. M Mpande	Heywood Mine	M	28	4
112. F. Mlotshwa	Doyami primary school, Box 748, Chakari	M	28	4
113. Lovemore Masuku	Delica Mine	M	40	8
114. Erita Chinyama	Maldon Mine	F	18	7
115. Mr Coetzee	Coetzee Mill	M	52 (?)	3