Title: Environmental damage caused by gold panning in Gwanda district {Zimbabwe}.

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Dedication

To my parents Mr and Mrs R Nhlanganiso Bhebhe, who are my inspiration and have always encouraged me in all my endeavours and even when I am low they are always there for me. To my two grand mothers who did not see me finish this course as they all passed away during the mid of my studies, may God bless them.

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My studying at this institute was a pleasure to me, and all this I owe to my supervisor and lecturer Mr Andries Jordaan, who guided me through this research and always gave positive comments and encouragement. A special thanks goes to Mr G Shava a lecturer with the Zimbabwe Open University for his positive critiquing of my work, and also to Dr Ntando Thebele for her critiquing and proof reading my work. Not forgetting my wife Nomsa and children Nonceba and Vuyani,for the support and encouragement and to my class mates for all the support they rendered me during the research period

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Abstract

The major thrust of the current study was to establish the major environmental damages caused by gold panning in Gwanda district in Matabeleland South Province of Zimbabwe. In this study the qualitative with a combination of minor aspects of the quantitative research paradigms were used with a sample drawn from panners, non panners and stakeholders. The stakeholders comprised local government officials, Environmental Management Authorities and officials drawn from local mining organisations while non panners included those people living with panners along the river banks and nearby communal settlers.

Given the in depth nature of the study, purposive sampling techniques were used with maximum variations in selecting panners and non panners, while at the same time maintaining a balance among the respondents. The use of purposive sampling was appropriate in the sense that the researcher could select unique cases that were especially informative.
Both qualitative and quantitative data was collected through the use of face-to-face interviews and a combination of questionnaires and observations managed to provide an in built triangulation for the study. A total sample of 92 respondents was used to respond to the questionnaires.

The study established that gold panning activities, which are poverty driven, have immensely contributed to environmental damages such as deforestation, river siltation, soil erosion, and water pollution and the destruction of aquatic based food chains as a result of disposing waste materials and the use of chemicals such as mercury and cyanide. Gold panning has been seen as having resulted in a serious health hazards associated with the lack of proper hygiene standards in the squatter camps.

Data from the study was presented through tables, figures and charts for easy analysis and evaluation. Besides being a disaster to the physical environment and the ecosystem gold panning was found to have negative socio – environmental effects on the land and to other aspects of human life like the spread of infectious diseases and HIV AIDS. In light of these findings the study recommends that a coordinated approach should be provided to panners to

provide them with some basic training in environmental management and the disaster risk reduction management skills. This will assist in reducing the environmental damages and other related disasters emanating from gold panning.

Chapter 1
Introduction

1.0 Background to the Study

Gold panning has been the worst enemy of the environment for a long time in Zimbabwe and now it has been worsened by the persistent droughts that saw a lot of people going into panning as a source of employment (Geology Survey 2000). The panning activities are mainly concentrated in rivers, disused mines and dams and this has threatened the water availability not for domestic use alone but for livestock and irrigation purposes. Siltation is a big problem and open cast mines are also a big threat to animals and people with mugging in some places and panners at times being trapped in disused mines with some dying and others injured in the process of gold panning. Diseases are a big threat as a lot of settlements are mushrooming in these places with no sanitation posing a health hazard to panners and communities at large while epidemics like the HIV/AIDS are into play in such areas. The district of Gwanda is one of the six districts in Matebeleland South Province and located in the agro ecological zones IV and V, which are characterized by low rainfall area and high annual evaporation (Sunga and Marinda 1998). Agriculture and mining are the main economic activities at the moment with the later gaining momentum, particularly in the small-scale gold mining (Marinda 1998)

1.1 Introduction

Environmental disasters have been on the increase in the country in the past two decades and a lot of other disasters that the country has experienced have been directly or indirectly linked to the environmental problems. It is for this reason that the researcher has thought it important to study one of the environmental challenges we face in our times and raise awareness of the urgent need to address it. Zimbabwe has an agricultural and mineral backed economy. Over half of the population lives in the countryside and practises some form of agriculture. When disasters like droughts strikes these people are left entirely dependent on donations or food handouts. In recent years this pattern has repeated itself a lot more often without adequate planning being put in place for them. This has left the rural population trying what ever means

to exist with gold panning being one of the survival options for the rural folk especially for the people that live along major rivers of the country. This dangerous activity has been done without any professional supervision leading to other problems such as death of people trapped underground and use of dangerous metals like mercury in the rivers and other related serious health disasters associated with unprofessional operations. Leakage of respiratory poisons into the rivers creates other potential disasters such as death of animals in the rivers. One other problem which gold panning has created is the siltation of rivers and shortages of water for animals and people in many areas. The general physical geographical outlook has been seriously deformed due to the illegal operations in the areas.

Whilst this is a local problem, it is one with very clear regional links as some of our rivers are also taking water to our neighbours. Many would ask if the strategies being employed to combat this problem are working since evidence still points to the increase in the problem not a decline. In the current study, the researcher seeks to find out the limitations of the current strategies and also find out what else needs to be done to alleviate this situation. The researcher would also draw comparisons on how other disasters have been managed in the past; perhaps some of these experiences could inform practice in this situation, which is threatening human lives. The researcher has one particular example in mind, which is that of wild life management where a lot of positive results were obtained from giving the locals autonomy in managing wild life in their areas. It was through education and ownership of the scheme that made all people in the affected areas feel the need to look after the wild life. Could this kind of resource management work for the minerals that so many people want to lay their hands on?

1.2 Statement of the problem

Gold panning is a wide spread problem that is found throughout the Zimbabwe. This problem is mostly due to the need for income, food, employment, asset ownership and decent living conditions. River siltation and water pollution and land degradation are some of the major problems that are associated with the illegal gold panning activities. The problem has brought about high costs in dam rehabilitations and water shortages after siltation and a good example is water shortages in the city of Bulawayo where the catchments have a lot of open casts and

there is no meaningful flow of water to the dams. Many tried and tested methods have been used to try and extract the precious mineral and all the methods are not safe for the public and miners. The paradox the current study seeks to unlock reads, “What are environmental damaged caused by illegal gold panning activities in Gwanda district”. The key variables under investigation are; the effects of gold panning on the general ecological system. The impact on people’s lives and the extent it has contributed to the decline in the water levels in the major dams and the disasters that it causes.

The environmental conditions facing many firms have changed rapidly. Today’s global competitive environment is complex, dynamic and largely unpredictable. (Acur & Englyst 2006:70). To deal with this unprecedented level of change, a lot of thinking has gone into the issue of how strategies are best formulated. It is worth noting that the management of change is best achieved when those affected by the change are involved in the processes that help them to better manage the change (Robbins & Coulter 2002:342). There is a great deal of literature and evidence confirming the beneficial effects of employee involvement practices. Lawler (1988a: 6) in his findings suggests that employee involvement is not just a fad but also an important and increasingly popular approach to management, which is producing positive results for a number of corporations. It is therefore the focus of the current study to establish the environmental damages and disasters associated with illegal gold panning in Gwanda district of Zimbabwe. In the process key variables like gold panning environmental damage, ecological effects and its associated effects are examined.

1.2 Research Questions

The current study on the environmental disasters caused by gold panning in Gwanda district has some sub research questions, which are driven from the main research topic, and these are:

- Why are most people into gold panning in Gwanda district?
- What methods are used to extract gold-by-gold panners?
- Where gold panning is carried, in the river or on open land?
- What happens to the pits that are opened after extracting the mineral?
- What chemicals are used for extracting gold and what are the related disasters to communities and physical environment?

- Is there any environmental assessment done before carrying out some gold panning?
- Are gold panners aware of legislations that govern such activities?
- Have they attended any training in the type of business they are involved in?
- What effects does gold panning have to the environment and the country at large?

1.5 Aims and objectives of the study

In any epical qualitative or quantitative study there is need to identify and state the main research objectives and aims, which provide the focus of the study. The current study on environmental disasters caused by gold panning has the following aims and objectives:

- To establish the environmental damages caused by gold panning activities in Gwanda
- To assess the effectiveness of measures being taken to address the problem associated with gold panning.
- To assess the environmental impact of gold panning disasters on the lives of the people in and around the affected area.
- To find out what else needs to be done to address this problem.
- To establish some of the mitigation strategies to reduce gold panning activities in Gwanda district.

1.6 Significance of Study

Deforestation, erosion, overgrazing, over cultivation and incorrect agricultural practices and the degradation of natural buffers amplify the effects of natural hazards. Recognizing the significance of such events for the entire world's people, the United Nations General Assembly, in December 1987, declared the 1990s as the International Decade for Natural Disaster Reduction (IDNDR). The primary objective of the Decade is to reduce, through concerted international action, and especially in developing countries, the loss of life, property damage and social and economic disruption caused by natural disasters. Such events are a potential disaster and developing countries have not met the declaration and the economic problems have also affected them. This study will then try to bring to light some of the problems that are a potential hazard and bring about solutions and recommendations.

The study on environmental degradation provides a fundamental basis for decision making for organisations involved in the management of the environment in general. Land is a fixed economic asset, which every citizen should take care of in terms of reclamation, soil conservation, management and protected physical environment from human and natural disasters. The current study provides crucial baseline information to the ministry of natural resources on the disasters and dangers to the natural environment caused by gold panning in Gwanda district.

Basically the findings from the current study will be important to the Gwanda development committees. They will realise the seriousness or the disasters to the physical environment caused by gold panning and the associated repacations on the surrounding dams, rivers, and other water sources. All things being equal the findings could be made available to Gwanda local authorities to identify the impact of gold panning on the physical environment. An environmental impact analysis carried out by the Natural Resources Board, has failed to come up with major recommendations on disaster reduction on gold panning in the area. The current study shall therefore be a cornerstone to the baseline carried out by the other stakeholders.

1.6 Methodology

Research methodology is seen by Miller (1979) as the planned sequence of the process involved in conducting research. The research methodology is unquestionably the most complex process in research given the enormous variability in their different paradigms, operations and the interactions that take place. Winter (2000) has it that the research methodology implements and anchor paradigms in specific empirical sites or in specific methodological practices. It specifies how the study addresses the critical issues of representation and legitimating. Stenbacka (2001) has it that the methodology situates the researchers in the empirical world and connects them to specific sites, persons, groups, institutions, physical places and bodies of relevant interpretive materials including documents and archives. It also seeks to address the general planning of the research process, strategies and data collection techniques.

Research is an important tool used to give bearings to a process that undergoes change or transformation. It helps people to evaluate the effectiveness of the tools used in a given process; progress made during the process and it also helps in shaping up future decisions about a process. Big and small organisations and organised systems would find it very difficult to improve their services without organised research methodologies pointing out on the weaknesses and the extent to which they present themselves in any given issue at any given time.

This chapter discusses and justifies the approach, methodology and methods used in this research.

1.7 The research design, a general perspective

"*The term research design refers to the basic plan or strategy of research, the logic behind it, which will make it possible and valid to draw more general conclusions from it*". In this study the researcher adopted a purely qualitative approach to the study which suites well a case study. Methods used will be those that would allow collecting as much information about the case study, which can be processed to make deductions and conclusions. Whilst a qualitative approach has been chose some quantitative aspects may be used to broaden the scope of data collected for the study. A qualitative research, broadly defined, means "any kind of research that produces findings not arrived at by means of statistical procedures or other means of qualifications (Strauss and Corbin, 1990: 17).

Hitchcock and Huges (1995, 12) note the strengths of a qualitative approach as:
"*Approaches that enable the researcher to learn at first hand, about the social world they are investigating by means of involvement and participation in that world through a focus upon what individual actors say and do*". Qualitative research therefore uses naturalistic approach that seeks to understand phenomenon in a context specific setting.
The researcher will make visits to the areas where gold panning is prevalent to experience first hand the social and economic hardships these people experience which are the key causes that push them to pan for gold. During these visits researcher will use the observation to get to

some of the issues that are linked to this problem, which may not be instantly seen at a glance. Documentary analysis and interviews will also be used to get to the depth of this problem.

Sometimes the terms method and methodology are used interchangeably whilst they actually refer to two different things. Kaplan, Cohen and Manion (1989, 41-42) methods are referred to as, "*techniques and procedures used in the process of gathering data while methodology means to describe and analyse the methods, throwing light on their limitations and resources, clarifying their presuppositions and their limitations and consequences, relating their potentialities to the twilight zone at the frontiers of knowledge*".

A lot of factors influence the type of research methods used in any research, for example when a lot of people are involved in a research it is best to use a survey. Surveys allow the researcher to gather information from many people who may be at different geographical locations at the same time. This method is best used to gather information that addresses the breadth not the depth of a problem since it can collect a lot of information or views from different people. The current qualitative study could therefore be a useful tool to gather the views of the various stakeholders in this problem since there are a number of rivers where gold panning takes place. The researcher would find out from the local authority for example, the district or regional body, the government bodies in charge of the environmental affairs and from the gold panners themselves. With little time available for the research it would be difficult to reach all these people and actually talk to them to get their valuable opinions.

To address the depth of a problem: interviews, literature search and those other methods that allow the researcher to cover a lot more detail on a given issue are used. It would be important to establish the amount of knowledge that the gold panners hold on the mineral deposits along the rivers they work on. Is it a guess game that they work on or do they has specific information on where to dig? There would be a lot more damage if they were just going digging in a trial and error fashion. Literature search will also be used to determine the mineral deposit location so that a comparison can be made with the areas where most panning is done.

1.8 The research design

The research design is the basic plan of the research and the logic behind it, which makes it valid to draw more general conclusions (Bogdan and Biklen 1982), The research design holds all parts and phases of the inquiry together. The research paradigm chosen for the current study is the qualitative research design. This is any kind of research that produces findings not arrived at by means of statistical procedures or other means of qualification (Strauss and Cobin ,1990).

The qualitative study has an interpretive character, arrived at discovering the meaning events have for the individuals who experience them and the interpretations of those meanings by the researcher. The qualitative study is a powerful approach provides intricate details of phenomenon that are difficult to convey qualitative methods.

It however be noted that qualitative analysis made in the process of analysing data where some statistical operations applied. However it was not necessary to pit the two paradigms against one another in a competing stance. The researcher felt that both the qualitative and the quantitative research was effectively combined in the same research project, the qualitative paradigm therefore dominated the study. Studies carried out by Russek and Weinberg (1993) claims that by using both qualitative and quantitative data, the study of science gives insight that neither type of analysis could provide alone. The use of multiple methods of data collection reflects an in built attempt to cater for triangulation and secure an in depth understanding of the phenomenon in question. The study on gold panning and environmental degradation enjoys detailed face to face interviews, questionnaire, focus group discussions and observations which are naturally dominant in the naturalistic interpretive paradigms and also to a certain extent supplementary to the positive paradigm.

1.9 Research instruments

In this, the researcher explored the issue of gold panning through interviews with the policy makers and local authority leaders, questionnaires for the residents in areas where gold

panning is taking place and the gold panners and a study of documents that show the trends for this issue past and present.

The researcher had to choose instruments, which will help me get the most information about the study within the limitations of time. For each group that the researcher will have to gather information from all stakeholders and will try to use the instrument that was the most practical to use for the case. For the policy makers and local authorise that implement these policies the researcher will use an interview to get as much information. The researcher probed these people about the failings in the policies in a way that a questionnaire may not collect as much evidence as is required. Depending on the number of people that were interviewed and the researcher chose to use a questionnaire to broaden the database. In this case the interview as the best tool because was able to present a case to the people in question and probe as much as was expected. This helped to raise research questions and discuss them fully with the individuals concerned. The researcher would have to cross check whatever information gathered would get from the interviews by talking to other groups of people involved in this issue. For every piece of research people aim top get the best quality of evidence, and to do this triangulation of data was very important. It is important as it presents evidence about the case from different viewpoints, the more this evidence matches the better the quality of the research. Triangulation also enriches the quality of the research as is noted by Cohen and Manion (1989, p. 269) who state that:

"…triangular techniques in the social sciences attempt to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint and, in so doing, by making use of both qualitative and quantitative data".

The study tried to involve as many gold panners and residents as possible so as to get as many views as possible about his case. The study was looking at a lot of people being involved, used a questionnaire to sample their views. This was because the questionnaire allows reaching out to a lot of people at the same time. The researcher used the local language (Isindebele) to communicate with some villages that may not have adequate working knowledge of this kind of work. This helped to get the most correct information on what the research is all about. The questionnaire has the advantage of being able to collect a lot of information on a snap shop,

which could cover a lot of areas. It was with this kind of view in mind that a questionnaire was considered an appropriate instrument to use for this group of people.

Czaja and Blair (1996, p. 106) describe this strength of the questionnaire this way: “The questionnaire was the indispensable means by which the opinions, behaviours and attitudes of respondents are converted to data”.
Questions in the questionnaire seek to identify the views or opinions as well as knowledge and understanding of the issue that the target group has. In so doing the researcher will be trying to establish how much of the panning activity is done with full understanding of the problems its causes and so how much planning for the future is drafted into the activity. The researchers was interested to gather information from those not involved in the panning but are equally affected by the results of gold panning as it is these people who are likely to push for environmental protection.

1.10 Issues of validity and reliability

The concept of validity and reliability are described by a wide range of terms in qualitative studies. In order to maximize the validity and reliability of the qualitative study the use of multiple sources of data that provided an in built attempt to provide triangulation and secure an in depth understanding of views from different sources was used. Triangulation is seen as an important methodological issue in naturalistic and qualitative approaches to evaluation to control bias and establish valid and reliable propositions because traditional quantitative techniques are incompatible with this alternative or epistemology. Patton (2000) advocates the use of triangulation by stating that, “triangulation strengthens a study by combining methods”. This implies in several kinds of methods or data including using both qualitative approaches. Therefore to acquire valid and reliable data, multiple and diverse realities in the current study, multiple methods of searching or gathering data were in order. Engaging multiple methods such as, questionnaires and observations, interviews led to more valuable and reliable diverse construction of realities. It should however be noted that triangulation include multiple methods of data collection and data analysis, but does not suggest a fixed method for all the researches. The methods chosen in triangulation to test for the validity and reliability of a

study depended on the criteria of the research. To ensure validity and reliability the researcher made an effort to visit different sites for information from legal mining organisation in Gwanda to gold panning in their operational areas.

Questionnaire Design

Design considerations included taking decisions on things related to designing a questionnaire that is discussed below.

Question content: Firstly the areas to be probed are determined by the research questions of the study. The questions are designed to get the most of information that can be collected from these groups about this problem

The wording of the questions: To ensure that the questions were clear, straightforward and easy to understand for the respondents the following points on question structure for the questionnaire drawn form (Cohen and Manion (1989), Borg and Gall (1983), Munn and Drever (1990), Bell (1993) and Wellington (1996)) were taken note of during the design stage:

1.11 Area of Study

Gwanda lies in Matebeleland South Province and it's the capital of the province with an estimated population of 18 000 people (Central Statistics 2004). The district is in region 4 & 5 with an annual rainfall of 450mm. A few wards of the district will be sampled mainly where the gold panning activities are high.

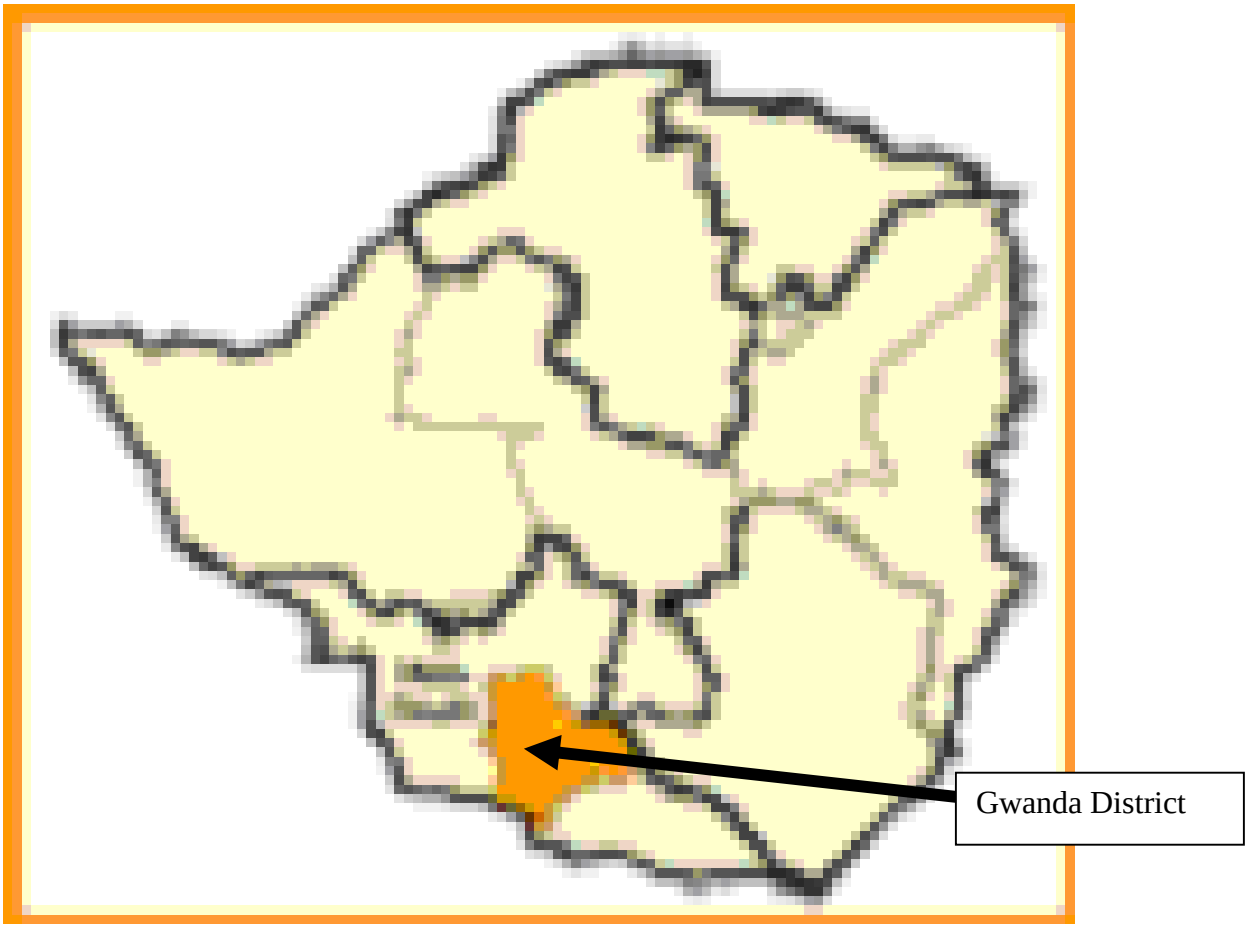


Figure 1.0 shows the geographical position of Gwanda and areas of gold panning concentration

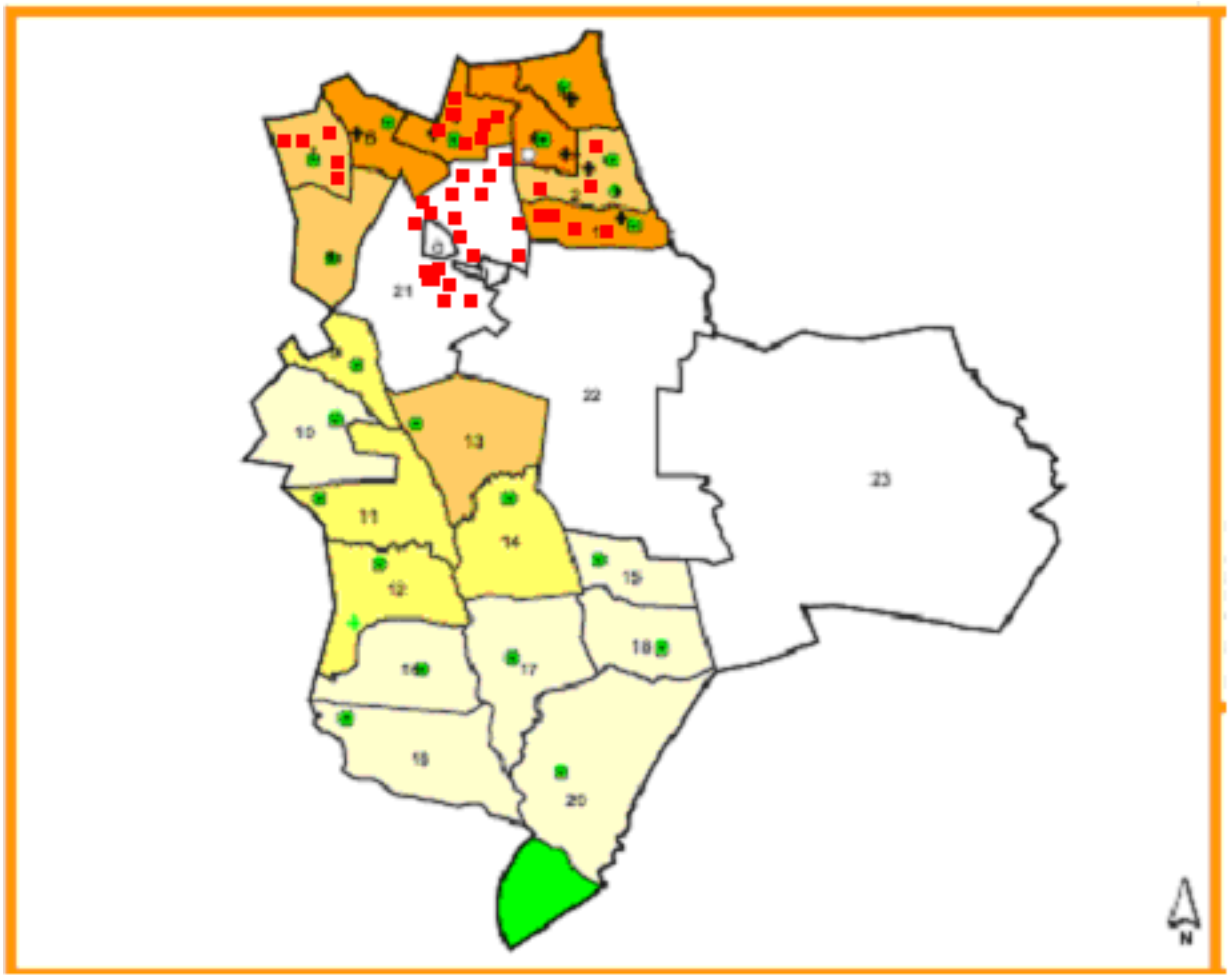


Figure 1.1

Key

- Potential mining areas
- Potential Cropping areas
- Nickel mines
- Gold Panning areas
- Gold Mining areas
- Horticultural Area

The gold panning activities are concentrated along Umzingwane and Mtshabezi rivers and around Gwanda towns. This has seen a spread to nearby communal areas of Matshetshe, Winhock and Maphane. The land degradation is now very pronounced in areas shaded red

around the district. The area of study covered areas along Umzingwane and Mtshabezi rivers and communal areas of Matshetshe, Winhock and Maphane areas.

Chapter 2

Literature Review

"All business proceeds on beliefs, on judgements of probabilities, and not on certainties"

Charles William Eliot.

2.1 Introduction

The Rio de Janeiro Earth Summit of 1998 stresses the need of good management of resources at all local areas for the benefit of all global citizens. For any nation to guarantee its future citizens of a good life sustainable, development should be at the core of its resource management. It is not surprising then that all world leaders have endorsed the development principles laid down at all the earth summits starting with the one at Tilibis. In recent years, several new and emerging risks have surfaced that require the attention and assessment of the safety professional including the areas of tourism, workplaces and mining (Thomas, 2000). Our changing workplaces, with new technologies and global economies, have opened a Pandora's box of new risks, which were virtually unheard of in the past years (Thomas, 2000).

2.3 Legislative Framework on mining activities in Zimbabwe

The same with gold panning, it was never there in Zimbabwe in the past and only surfaced due to economic hardships. The Mines and Minerals Act Chapter165, which is administered by the Ministry of Mines, Environment and Tourism, provides the main legislative framework for all mining activities in Zimbabwe. While the act did not inhibit the development of small-scale mining, it is not seen as promotional either. The act is complemented by 18 pieces of legislation administered by eight other ministries, which cover the usage and management of natural resources, a situation that sometimes lead to conflicts. For example, the Natural Resources Act sets the limit for cultivation on riverbanks at 30m while the Forest Act sets the limit at 100m. There is need to harmonise the pieces of legislation to make easy administration of mining operations. The effectiveness of the Ministry of Mines Environment and Tourism in administering the Act is constrained by lack of human and financial resources.

Act Chapter 165 has made it possible for all interested parties to extensively explore the mineral potential of the country. In its application it has eliminated the need for direct negotiations over the minerals rights between landowners and potential miners, as is the case with other countries for example South Africa (Sunga and Marinda 1998). However the Act is quite eloquent in the protection of the rights of the precedent activity e.g. farming activities and basic infrastructure, state assets and private property. The condition contributes largely to setting a base for dialogue between the owners of properties and the miners and creates the basis for mutual understanding and co-existence though this has presented some problems between the parties involved (Mines and Minerals Act).

The requirements of the Act involve the registration of a mining concession for the purposes of acquiring mining rights. In doing so the following have to be observed

- Acquisition of a prospectors licence at a nominal fee
- Appointment of an approved prospector who will perform the statutory pegging and registration of the area sought after.
- Notification of Government agencies of the area concerned.
- A sitting or works plan be produced for approval by the authorities in the Ministry of Mines and
- A comprehensive environmental impact assessment (EIA) of the proposed mining project be produced and approved.

To facilitate the administration of the Act, various advisory and regulatory boards including the Mining Commissioners, Geologists Metallurgy and Mining Engineering are integrated into the process. All these departments are accessible to all classes of miners; however lack of human and financial resources is a limiting factor to their effectiveness. There are other supporting regulations enacted to assist the Act and these are

- The mining (Health and Sanitation) Regulations, 1977, which regulate for the provision of adequate health and sanitation facilities on a mine;
- The Mining (Management and Safety) Regulations, 1990, which seek to control health and safety in and about a mine; and

- The mining (Alluvial gold) (Public Streams) Regulations, 1991 which seek to deal with small-scale gold panning activities in the country.

Besides the Mines Act there are other pieces of legislations, which governs the usage, and management of natural resources and these are

- The Natural Resources Act (1975);
- The Hazardous Substances and Articles Act (1971);
- The Forestry Act (1982)
- The Water Act (1976);
- The Atmospheric Pollution Prevention Act (1975);
- The Parks and Wildlife Act (1975);
- The National Museums and Monuments Act (1972)
- The Pneumoconiosis Act and
- The Interim EIA Policy (1995)

"*January 24, 1975 – New York City: bomb set off in the historical Fraunces Tavern killed 4 and injured more than 50 persons. Puerto Rican nationalist group (FALN) claimed responsibility and police tied 13 other bombings to it. Need to harmonise these legislations to avoid pointing fingers and guising*.

The pieces of legislation contribute towards the management of mining operations, but sometimes are found to be conflicting each other.

2.4 Mining Methods and the related disasters to the environment

The mining methods vary in the district with a combination of open pit, undergoing stopping and riverbank and bed panning. These operations are characterised by shallow diggings, which follow the reefs. Whilst open – cast mining practised by most miners is cheap initially; it is not sustainable and usually leads to the abandonment of the operation at an average depth not exceeding 20m because of hoisting problems and inability to de-water the mine workings.

In any case, most of these open cast workings end up with sharp or near vertical high walls or dangerous undercutting with the resultant high failure rate of the hanging wall (Sunga 1998).

Gold panning or small-scale mining has been propelled into the world limelight more in recognition of the environmental threat the sector poses, and less as an acknowledgement of its economic potential. Small-scale mining and gold panning in particular, has been viewed by many people world over as an environmental **disaster** in the making. The other contributing factor is the prevalence of a large female and child workforce (Sunga 1998) This is a post independence phenomenon, fuelled by amongst other factors the harsh economic` conditions, retrenchments and poor agricultural yields due to severe droughts (Sunga 1998).

In terms of processing panners are can be grouped into three broad categories according to the types of ore being treated:

- Alluvial
- Free mining or sulphidic
- Refractory ore

These methods are used inter changeable and miners are not concentrating in one method.

Panning activities need a lot of water for the extraction of gold and other minerals and this can have varying effects.

The water Act provides for the development and utilization of water resources, including the granting of permits to use water for mining purposes, protection of environment, control of water pollution and granting of permits to discharge the effluent and toxic work. The Act prohibits any person and industrialists and even mines to discharge any toxic or obstructing matter, radio active waste or other pollution or allow any person to dump or discharge such matter into the aquatic environment in contravention of water pollution control standards. However all these have been ignored by panners who are a threat to the ecosystem.

Positive aspects of panning/small scale mining are,

- Employment creation, foreign currency generation.
- Additional revenue to local authorities in form of levies.
- Possible donations and contributions for social and state functions

Negative aspects are

- Noise and air pollution from dust generation during the ore extraction, blasting and transportation.
- Clearing of vegetation, allowing loss of vegetation and exposing soil to erosion.
- Risk of lowering of ground water table as a result of draining water from the shafts.
- Risk of subsidence of ground due to evacuation of the soil.
- Potential safety hazards to humans, livestock from the surrounding areas falling into open workings, mercury and cyanide poisoning.
- Loss of general aesthetic value of the land.
- Risk of spread of diseases and HIV/AIDS arising from the influx of large numbers of worker immigrants into mining areas (Bulawayo Mining Commissioner Report 2007).

2.5 Soil Erosion and siltation of surface Water as a result of Gold Panning.

Erosion is likely to affect mining operation especially during construction phase and when land is cleared and soil is disturbed. Trenches and roads loosen the soil and this leads to erosion. Soil erosion has significant impact as it contaminates water bodies and modification of the soil profile as the topsoil is eroded (Bulawayo Mining Commissioner 2007).

2.6 Losses and Modification of Soil Profiles as a result of gold panning

Mining activities by nature are extractive that is, involve the removal of the soil from underground on to the surface (Pablo, 2006). The result is that the natural arrangement of the soil layers (profile) is altered. The soil Extracted from the deep down the earth's crust is not suitable for crop/plant growth. If not properly mitigated, the effect can have significant modification of the soil structure and effect of plant growth (Pablo, 2006).

2.7 Ground Subsidence as a result of gold panning

Mining leaves openings both on the surface and underground and as a result, fractures can develop leading to collapse of the ground. The impact can be catastrophic if the fractures or subsidence occurs where there are structures on the surface. Needles to say the impact are

disastrous if subsidence leads to trapping and subsequently loss of human life underground. The impact is high during the operation stage especially when blasting and during wet periods (Bulawayo Commissioner, 2007).

2.8 Ground water Abstraction and Pollution as a result of gold panning

Ground water abstractions for both domestic and industrial use can alter the level of the water table and this can lead to ground instability. Pollution of the underground water is likely to be through the wastewater finding its way to the ground mining usually goes beyond the water tables thereby altering the water table. (Bulawayo Commissioner 2007).

2.9 Surface Water Pollution, (Cyanide/Mercury)

Water from mining operation has the potential to contaminate surface water because of the cyanide and mercury used in gold extraction. Cyanide and mercury can cause harm to wildlife, aquatic and human beings (Bulawayo Commissioner, 2007).

Mining usually generate a lot of waste and these are in the form of,

- Waste during mining involving chemical and mineral waste
- Solid waste, including food staff from the camp.

Mining spoil piles should be placed outside the mining area and this should be in controlled erosion and sediment around all spoil piles to preclude sedimentation discharge to surface water. All food waste must be composted and properly disposed or used as fertilizer for vegetation during the closure of the mining activity. All plastic and glass material must be recycled and taken off site (Pablo, 2006).

2.10 Air quality, Dust and Noise control.

Water needs to be sprinkled on the roads and on loose soil to avoid dust and dust bonding materials like molasses must be used to control dust emission and use appropriate sound proof to reduce the noise and protect ear damage (Bulawayo Commission 2007).

2.11 Prevention of hazards and management

A detailed hazard management plan is comparison for any mining activity and this include

- Hazard identification and control
- Monitoring and reporting of industrial accidents
- Training and education of employees on first aid
- Industrial accident protocol
- Fire safety and prevention

There are a lot of hazards in the mining sector, be it a legal or illegal mining, the risk is very high, especially where explosives are used. Fire is also a big hazard that can cost people's lives (Mines Commissioner, 2007).

Development of respiratory diseases due to inhalation of respirable dust has been shown to be in direct proportion to the total load inhaled over a time period. This in turn is a function of:

- The dust particle size
- The concentration of particles in the atmosphere
- The duration of exposure

Notwithstanding the above mentioned the following should be implemented in order to decrease or eliminate respiratory dust inhalation and prevent adverse effects to workers and people staying adjacent to the mine.

- Provision or wearing of respirator with filter during mining or excavation and transportation of ore.
- Living quarters must be a distance way from the mining area.
- Minimum denudation of vegetation around the site
- Chest X- rays of all employees once/yearly in order to detect any incipient pulmonary disease such as persistent coughing and or shortness of breath.

Such measures will reduce the risk of lung-impregnated diseases to people working within the area (Occupational Health Act 1976).

2.12 The impact of mercury contaminants on environment

In most countries, miners use nitric acid (30%) to dissolve the mercury in the amalgam. This is dangerous and a disaster and an expensive procedure as it is difficult to precipitate all the mercury from the nitric solution. The process is usually done by introducing pieces of metal such as aluminium, copper, or zinc in the solution. In this way the remaining nitric solution

cannot be discarded because it is extremely corrosive and still contains residual mercury (Pablo Huidobro, 2006).

The most common process to separate mercury from gold is the decomposition (i.e., "roasting" or "burning") of the amalgam by heating above 360 degrees. Most mercury compounds evaporate at temperatures above 460 degrees, gold must reach almost 3000 degrees to evaporate. When heated, mercury becomes volatile leaving the gold in solid state. Unfortunately this process is done in the open pans using blowtorch or bonfires as a source of heating. Very often panners especially women burn their gold in the kitchens. Children are the main victims of this lack of understanding of mercury vapour inhalation causes intoxication mercury vapours are invisible. Most miners are not aware of these dangers of mercury vapours and use retorts to condense the mercury (Huidobro, 2006). The mercury vapour released during burning of amalgam in open pans is transported a short distance and it condenses and falls back to the ground. Ultimately this precipitated mercury can be transformed into methyl-mercury in aquatic environments, as such activities are very common in rivers, methyl-mercury easily bio-accumulates in the fish species people like to eat. These become a hazard to people and the environment. The main problem is the exposure of the workers and their families and the public to the mercury vapour. In Central Kalimantan, Indonesia, amalgam is burned in the open pans everywhere, including the kitchens and restaurants. A similar situation is observed in the Mekong River in Lao PDR, where a large audience of women and children observed the "fascinating" colour transformation when amalgam is burned and gold is obtained. In many African countries, amalgam becomes yellow. Usually the burning is too short and the temperatures too low to vaporize all the mercury, so gold *dore* usually contains as much as 20% mercury. This residual mercury is released to gold buyers and jewellery makers, poisoning the workers and their neighbours (Ibid).

A solution to these problems is to use blowtorches or "*mvuto* –a fire blow used by black smiths" bellows to increase heat and reduce residual mercury and vaporize all the mercury. Mercury vapour is toxic and cause disasters and need to use proper devices to recover mercury and eliminate vapour inhalation by miners and those not in such business.

It is also important to understand why the miners do not use the retorts. Engineers tend to look for efficiency of retorting process, but in many cases this is not most important concern of miners when considering changing to cleaner technologies. The arguments against retorts are site specifics and sometimes fraught with misconception. However, in some cases there are good reasons why retorts are not being used and these must be analysed carefully. The miners for not using retorts use some of the most common arguments is that; it takes time (and leave them vulnerable to bandits attacks, police and other acts that disadvantaged them when retorting). When using some of the methods recommended it needs practice to operate while losing on business, gold is lost during retorting, gold stick in the retort crucible, mercury loses coalescence after it is condensed from retorts and gold becomes brown (Gold Panner's Manual).

2.13 Home made retorts and their effect on the general ecosystem

There are many simple homemade retort that miners can make without need of a mechanical shop to manufacture. A very popular one is the RHYP retort advised by Dr Raphael Hypolito from the University of Sao Paulo, Brazil. It can be made with ordinary materials ranging from steel water plumbing connections. Black and un galvanized pipes are the best because mercury sticks to galvanized coating on water pipes, if necessary galvanized pipes can be burnt to remove the zinc (Panners' Manual, 2006).

When using galvanized pipes and water connections for the first time, miners should burn off the zinc layer before starting the retorting process, otherwise the evaporated mercury form a zinc amalgam and stick inside the retort, It is very important to be very careful when burning off the zinc layer of the galvanized pipes as zinc vapour is very toxic. One way to avoid the hazard is to burn the pipe away from people and connections burning in bonfire to increase oxidation and reducing toxicity risk (Panners' Manual, 2006)

2.14 Effects of mercury vapour exposure to the public

Metallic mercury is slightly volatile at room temperatures and its vapours are invisible. At higher temperatures more vapour is released and is more hazardous. The skin or the

alimentary tract does not absorb metallic mercury efficiently, but vapours are highly absorbed through the lungs. Cases of mercury poisoning are considered a serious occupational hazard and need a proper precaution measures.

Inhalation of mercury vapour is most significant for miners and gold shop workers who are directly involved in handling and processing of gold, but has a lot of effects to the surrounding communities directly and indirectly. Mercury vapour is absorbed through the alveolar membrane of the lungs, and the complexes in the blood and tissues, before reacting with biologically important sites. Kidneys are the most affected organs in exposures of moderate duration to considerate levels, while the brain is the dominant receptor in long-term exposure to moderate levels. Since mercury vapour poisoning affects liver and kidneys, high mercury in the urine can indicate the levels of exposure. Total elimination mercury in the blood and urine can take years and urine cannot be expected to correlate with neurology findings once exposure has stopped, it is a human tragedy (D itri, 1977).

Gold is a non – renewable natural resource with a fixed stock of ore deposits. Obviously, gold deposits will become exhausted at some point in future, depending on the area of extraction and technology. In most cases, the reserves that are economic to extract are lower than the total identified mineral reserves (Howe, 1979).

In 1993, Milne and Marongwe carried out a study on the economic costs and benefits of small-scale gold panning in the Mashonaland Central province in Zimbabwe. A statistical survey of panners and assessment of key environmental impact were carried out. A CBA was then done. This appendix shows a summary of the case study in 1993.

2.15 Cost Benefit Analysis of gold panning in Zimbabwe

The Costs and Benefits of Gold Panning in Zimbabwe (Milne, and Marongwe, 1993) says that, natural resource stocks are limited or in economic terms, exhibit scarcity. The concept of resource scarcity can be viewed both from a geophysical and an economic perspective. Gold is a non-renewable natural resource with a fixed stock of ore deposits. Obviously, gold deposits will become exhausted at some point in the future, depending on the rate of extraction and

technology. In most cases, the reserves that are economic to extract are lower than the total identified mineral reserves (Howe, 1979).

The general economic problem facing Zimbabwe is how to use these scarce, non-renewable resources to address long-term social, economic and environmental development goals. To help assess current government policy regarding gold panning and formulate more effective strategies, a socio economic analysis is usually required. In most cases, a comparison of costs and benefits (or a cost benefit analysis) is part of the evaluation. In short, Zimbabwe must maximize the net benefit to society from the extraction and marketing of economically accessible gold reserves.

The analysis should consider how the flow and distribution of costs and benefits might change over time. One problem, which always arises in environmental economics, is the difficulty on applying monetary values to many costs and benefits. These types of values should at least be listed and described gold reserves. This comparison of costs and benefits can take two forms. The first is a financial analysis where costs and benefits are measured from the perspective of the private sector mine owner. In this study, the analysis could be based on an individual gold panner or, a claim holder who uses panners to dig gold. We are addressing the following question: "*is the panner or claim holder earning a reasonable rate of return on his or her activity?"* This narrow approach ignores external costs such as erosion and pollution, which do not presently enter into the miner's or claim owner's individual accounting of production costs and revenues.

The second approach is an economic analysis, which compares a wider array of costs and benefits from the perspective of society as a whole. The area of analysis for this study could be at the provincial or even national level. Externalities such as erosion and pollution are included in the analysis. From public policy perspective, the broader economic cost benefit analysis is more useful.

This section will consider both approaches in evaluating the costs and benefits of gold mining in Zimbabwe.

2.16 Financial Analysis

The economic theory behind non-renewable resource extraction has been well developed over the past few decades, for example see (Pearce and Turner, 1990; Howe, 1979: Scott 1967). The theory suggests that mine owners (in this case, gold panners) will try to maximize net revenues. Decisions about the rate of extraction costs are influenced by the quantity, location and grade of ore, market demand and price for the mineral, marginal extraction costs, transportation costs and the discount (or interests) rate. Expectations of future changes in factors such as demand, market prices and discount rates are also important. Mine owners are assumed to have perfect knowledge of the deposit size, location and grades.

Changes in mining technology are also critical. Typically, as the higher grade and more accessible ores are mined, the marginal cost of extracting lower grade and deeper ores increased, relative to the market price. At some point, marginal costs of mining will exceed marginal revenues and it becomes uneconomic to continue operations using existing technology. Unless there is new technology developed to either reduce costs or extract more ore per tonne of material (thereby increasing economic reserves), the mining will cease.

The economic theory regarding non-renewable natural resources is usually associated with large-scale commercial mining. With gold panning in Zimbabwe however, we are not dealing with a single large mine operating in one area. Gold panners operate individually and tend to migrate along a river in search of better deposits. The distribution of gold deposits within river system will vary, depending upon the distance from and the geology of the resource (Rea, 1994). The distribution of deposits with a specific river is also extremely variable. The miners lack knowledge of deposit location and grades, gold prices, and technology. They do not use discount rates in their decisions about extraction rates. Other factors may also affect the number of panners and the rate of extraction such as general poverty, lack of alternative employment opportunities, land pressure in communal areas etc. Cleary the economic theory regarding non-renewable resource management can only partially help explain how gold panners operate and assist in policy formulation (Rea, 1994).

2.17 Financial Benefits of Gold Panning

The financial benefits of gold panning can be viewed from the perspective of the individual panner and is represented by gross average income. From the results presented earlier, the median income from gold panning in the week prior to the survey was $33 per panner for full time panner, estimated annual income was $1 680 based on finding the median yield every week. For part-time panners the estimated annual income over 27 weeks was $890
The income estimates are based on the prices actually received by the panners for their gold, which was roughly 65% of the official Reserve Bank price.

2.18 Financial Costs to the gold panning activities

The financial costs of any commercial mining activity are represented by the private marginal costs of extracting and marketing the ore. The costs should include all factors of production such as the cost of land (purchasing or leasing), labour and capital. The survey did not directly ask panners about production costs but these can be estimated.

The cost of land to an individual panner is either zero (where mining is done illegal or on behalf of a claim holder), or the cost of the permit (where the panner is following the Mining Alluvial Gold, Public Streams 1991 Regulations). The regulations rural councils charge individuals an annual fee of $20,000 in return for the right to pan along a 50-meter stretch of river. In this study, the costs associated with 1991 regulations are used as a proxy for land costs

On considering the costs for the individual panner, this could be measured by the opportunity cost of his or her time in the best alternative occupation. If for example, a panner earns $50 per day and the alternative is $75 per day, the opportunity cost to him is $25 per day. For the financial analysis, we assume no opportunity cost of labour to individual gold panners. It is very unlikely that panners count the cost of their time as a cost of production.
Shava, 1991 noted that, capital costs are small for gold panning and may range from buying material for sluice boxes, building a small hut, buying shovels and picks, etc. We estimate the

cost of these items to be more than $500 per annum on average, for the majority of clam holders, there is no capital cost since the panners are doing the work with their own tools and materials.

2.19 Net Financial Benefits of Gold Panning

From the perspective of the individual gold panner, the central question to be addressed is whether or not the activity earns a reasonable rate of return. The gross benefits as measured by median income for full-time panner of $1 680. The gross costs are only for land (permit etc) and capital equipment. The total costs might be just over $500 per year. Therefore, the average net disposable income for a gold panner is in the area of $1 180 per year. For part-time panners, the estimated net annual income is approximately $390.

The net income is comparable to low-income earnings in the formal and informal sector in urban centre. The income range is also comparable to rural incomes. A study by Campbell and Mangono (1994) indicates that annual household incomes averaged $2 900 in-deforested communal areas to $1 900 in resettlement areas. Clearly, full time gold panning does not yield median net returns, which are significantly higher than subsistence farming. For part-time panners, low annual panning incomes are augmented by other income usually subsistence farming.

This analysis must be compared with the majority (probably 70%) of gold panners earned a gross income less than the average of $52/week. Most would earn an income best represented by the median value of $33/week. Thus, while a few panners earn income that is significantly higher than for other occupations (assuming they could find a job), most full time panners net income might only be in the order of just over $1 000 per year.

The most important question is to ask is, “Do gold panners make a profit?” The answer is yes, but the net income levels are not particularly high for the bulk of participants. Also, we are assuming the individual panner does not place an opportunity cost on his or her labour.

The reason for staying in the sector ca be attributed largely to a lack of better paying alternative. Panners may also be staying in the sector due to the flexible hours of work, the relative independence they enjoy, the low costs of living, and the chance to make a big gold find.

2.20 Economic Analysis of gold panning

An economic analysis tried to capture all the major costs and benefits of an activity. This study used the province of Matebeleland South and Gwanda district in particular as the area of analysis or accounting stance. The main steps to consider in an economic analysis are

- Description of the benefits and costs.
- Quantification of a many benefits and costs as possible.
- Comparison of benefits and costs.
- Discussion of distribution of benefits and costs

2.21 Economic Benefits with specific reference to gold income

The main economic benefit in this sector is gross income through the sale of gold using the official Reserve bank price, which is equivalent to the world price less minor commissions. The fact that individual gold panners don't receive the full official price is irrelevant. The total value of gold is spilt between the panners who receive a price which is below the official price is irrelevant. The main concern is with the value of the gold on world prices. The total value of gold is spilt between the panners who receive a price, which is below the official rate, and the dealers or middlemen who sell the gold at the official rate (to either the Reserve bank agents or external buyers) and keep the difference. The total income generated is still the volume of gold ore multiplied by the world price. The income will still largely flow into Zimbabwe.

2.22 Foreign exchange of gold panning

Gold sales outside Zimbabwe can earn foreign currency as with any other export. If dealers legally through the Reserve Bank agents market the gold, foreign exchange will normally be brought into the country once the gold is eventually exported. The analysis can change when assumptions are made about income flows from gold smuggled illegally out of the country. Depending upon the situation, foreign exchange may or may not return to Zimbabwe. A survey of gold buyers would have to be made determined income flows in and out of Zimbabwe through illegal gold sales. For the purpose of this study, the study assumes all the income from gold sales eventually returns to Zimbabwe as foreign exchange. As of January 1, 2007 Zimbabweans were legally entitled to hold foreign exchange. Thus even illegal sales of gold outside Zimbabwe can now result in foreign exchange being held legally in the country. The panners now enjoy the same benefit and all sales of gold are quoted in foreign currency of the panners' choice or what is available at the time. This has also limited the gold flows to the Reserve Bank.

2.23 Employment creation from gold panning

Gold panning generates employment for people who have few alternatives to earn a similar level of income. The estimated 2 000 gold panners in Gwanda can be assumed to present "new jobs" in the economy of which 1 428 were full time and another 672 part time. Based on full time jobs therefore total person years of employment from gold panning were approximately 1770 in 2000. Using this assumption of twice the number of panners results in approximately 3 500-person years of employment.

The presence of individuals in the gold panning sector does not mean a loss of jobs in other sectors, or a transfer of benefits from region to another. The panners would largely otherwise be unemployed and subsisting on informal work in cities or in the rural areas.

2.24 Social Benefits from gold panning activities

The employment and income generated allows panners to support their families either in whole (for full time panners) or in part (for part time panners who have farm plots or other

seasonal jobs). This income support could mean having money to help pay for fees, buy food, and other necessities. The cost of living in panning areas appeared to be very low. Thus, panners who are successful in finding gold might have a small cash surplus after meeting normal living expenses.

2.25 Permit Fees for gold panning

The permit costs to a gold panner in a financial analysis become a benefit to the country under an economic analysis. Assuming every panning unit obtains an annual $20.00 permit under the 1991 mining regulations, the total benefit in the province would be approximately Z$18300 per year. This estimate must be viewed as a maximum since it assumes all panners are operating legally under the 1991 regulation. Experience has shown this not to be case. Doubling the number of panners results in permit revenues of Z$37 000.

2.26 Economic Costs

Many of the economic costs are the same as in the financial analysis. Land labour and capital must be accounted for. The actual costs of the gold panning activities are not known as the market speculation is very high and the costing of labour and other related costs are not done. In addition the number of individuals inside and outside gold panning has facilitated the negotiation of prices and most of the panners want the stock to be marketed as soon as they produce the ore. Donald Stocking, 1993, in such a case noted that *"You don't buy stock because it has real value. You buy it because you feel there is always a greater fool down the street ready to pay more than you paid"*. For gold panners it is sad that they don't even realize the market prices, and Donald says, *"The market will not go up unless it goes up, nor will it go down unless it goes down, and it will stay the same unless it does either"*.

2.27 Land

The land comprising of riverbanks and even the dry riverbed itself has no real alternative economic use. While small market gardens can be found alongside many riverbanks they are illegal under present legislation, which requires gardens to be at least 30 meters away. Most panning activity takes place well within this distance to the river.

2.28 Labour

In an economic analysis, the concept of opportunity cost of labour takes on greater importance than in a strict financial analysis. The literature provides a range of views on this subject. One approach is that in developing countries, labour in a sector like gold panning should be costed using average subsistence from incomes or potential incomes earned from informal employment in urban areas (Mishan 1988). The actual opportunity cost can be adjusted by the probability that a person might find alternative work within a certain time period.

A second approach considers opportunity cost in situations of extremely high unemployment, like in Zimbabwe presently. If a panner would otherwise be unemployed, the gold panning does not represent a transfer of labour from one sector of the economy and a consequent loss of output. This approach has even more merit of scarce land resource and population pressure preclude people from turning to subsistence farming as an alternative to remaining idle (ODA, 1988). In these cases the opportunity cost of labour can be zero.

Ray (1984) suggests the estimation of opportunity cost of labour in developing countries must be site specific and not rely on general rules of thumb, which might be inappropriate.

Evaluating the types of work a full time gold panner might find in a city or rural setting can help guide the decision about setting or ignoring opportunity cost labour. As indicated earlier, a study by Campbell and Mangono (1994) estimated annual household rural farm incomes in deforested and resettlement areas at Z$2 900 and Z$1 900 respectively. If we assume the household size is equal to that of a panning unit (four people), the average farm cash income per person is only between Z$750 toZ$475 per year.

In the city, a male gold panner with grade 7 education or less might find work as a gardener (with free accommodation) gold caddy, or security guard (both without free accommodation) among others. A female panner might find work as a domestic worker, which would include free accommodation. The average annual incomes for a gardener, domestic work or gold caddy in 1993 was in the order of Z$2000. The security guard's net income after accommodation (Z$1 00 per month) and transport (Z$100 per month) might only be around Z$2 000 per year.

An unskilled, full time gold panner earns a median income less than what might be earned in the city assuming a job was found. Using the median panning income of Z$1 680 for a full time panner and the figure of Z$2 000 for alternative work in the city, the opportunity cost of labour of gold panning is Z$320 per panner.

For a part time, the opportunity cost is less obvious because it is virtually impossible to assume a panner could find part time employment for only 27 weeks per year say during the dry season, A domestic worker, gardener, security guard or even a golf caddy would be unsuccessful to find a part-time job every year. From this reason, we assume the opportunity cost of labour for part time panners is zero.

2.30 Capital from gold panning

The cost of capital is similar to the financial analysis. For the estimated 2 100 panners in the province, the total capital cost of Z$500 per panner is aggregated to Z$1.1 million. For 4 200 panners the figure is Z$2.2 million.

Shava, 1991 noted that, there are a number of social costs associated with gold panning related to health and education. Clearly the lack of clean, safe water and inadequate sanitation facilities for a high proportion of panners can lead to increased incidence of disease. Ultimately these can lead to greater demands on the province's health clinics with corresponding higher health care costs to society as whole. One way of estimating this cost is

to use the preventative expenditure method and consider the cost of installing boreholes and blair toilets at panning sites.

The estimated cost of putting in a borehole is about Z$250 000. Assuming each borehole can service 100 households or about 400 people, the 1 365 panners without safe water would require the equivalent of four bore holes. The total cost would be Z$100 000. These costs also can be assumed to double if we double the number of panners in the province.

Another related social cost is the cost of treating panners who are involved in accidents. Although the rate of reported accidents seems low, the cost of treatment could be high where serious injuries require extensive hospitalization. These costs cannot be estimated with any accuracy but should be noted as an impact of gold panning.

Another social cost is the lack of education for many of the children and teenagers who are involved in gold panning. From a survey carried by Shava, only 9% of males and 28% of females were less than 16 years of age. While it is difficult to quantify the exact number so these young people who were not going to school the fact is that long-term employment and income opportunities would be more limited without proper education. Of particular concern is the higher proportion of young girls at the panning sites. There is solid evidence that progress in development and population planning is strongly related to education levels for women. Putting a value on the cost is very difficult.

One other social cost to consider is the money spent by officers in public agencies such as the Department of Natural Resources to monitor gold panning and the Zimbabwe Republic Police to arrest illegal panners. These costs cannot be estimated accurately, however, they would include transportation costs for vehicles (petrol and depreciation) and labour costs for the time spent on this activity.

2.31 Environmental Costs as a result of gold panning

Small scale alluvial and riverbed gold panning as presently practiced by many individuals creates a number of serious environmental impacts. The most significant concern is river

system siltation and resulting impacts on the quantity of water flowing downstream to domestic and agricultural users. These impacts are turned externalities where costs are imposed on people downstream who are not involved in gold panning and there is no compensation from the gold panners who are causing the problems.

Increased river siltation occurs during heavy rains in areas where improper gold panning is practiced. The reasons include soil compaction and deforestation along the river banks (which accelerates runoff), washing away off sifted material piled loosely on the river bank and the river beds, and collapsing river banks which have been undercut with tunnels. Siltation of rivers from gold panning can reduce the storage capacity and hence the operational life of small dams downstream from the panning sites. A 1992 report (ENDA and ZERO) suggested that half of the country's dams were already more than 50% silted and that for some rivers it was no longer economic to construct new dams due to the rapid siltation. A badly degraded riverbed can also slow down the rate, at which the river recharges and develops a surface flow after the rains come. This problem is sued to the myriad of excavated tunnels, trenches and holes, which must fill up first. The Matebeleland province is a major agricultural region, both for commercial and communal farmers. The long-term impact of siltation from gold panning in the sustainability of agriculture needs to be viewed seriously.

Alternate approaches to estimating Siltation from gold panning is required. The replacement cost approach could be used to provide rough estimates of the cost of putting the excavated material back into the riverbed, filling holes and tunnels.

Another approach would be to estimate the cost of moving the exacted material well away from the river to prevent deposition back into the river and resulting Siltation. This approach lends itself to increasing the flow capacity of rivers. Additional costs of terracing, protecting high risk river banks with rocks and planting vetiver grass for soil stability could be added as part of comprehensive programme to prevent siltation. This approach fits the preventative expenditure model (Wipenny, 1991) if it was carried out during mining by the panners, or the replacement cost model if carried out after mining by government.

Using the latter approach assumes manual labour is used to move the excavated pay gravel well away from the river. Rea, (1994) estimated the tonnage of river bed material that must be mined to produce average gold yields through several seismic surveys of gold yields through several seismic surveys of gold bearing rivers in the province.

One survey along parts of the Mazowe River, 15km east of Shamva showed that the average grade over the pay gravel zone was between 0.11 and 0.14 grams of gold per tone of residual material. Another survey along the Mukaradzi river east of Mt Darwin showed average grade of gold over the pay gravel zone was between 0.28 and 0.53 grams per ton. A third survey in the Mountain View River near Bindura found very low grades of less than 0.1 gram of gold per ton (Rea, 1994).

Using the estimate of 56kg of gold found by panners in the province in 1993, the residual river bed material dug and sifted could range from 106 000 tons (based on 0.53 grams/ton) to 560 000 tons (0.10 gram/ ton). These are rough estimates but they indicate the potential maximum volume of river material that having being excavated during gold panning, could be carried back into the river during heavy rains and move downstream, blocking dams, irrigation systems and urban water supply in takes (Rea, 1994).

Doubling the number of panner (and by implication the quantity of gold found) results in river siltation between 212 000 and1.12 million tones (Rea, 1994).

What might it cost to move this material away from the riverbed through a rehabilitation programme using manual labour? Rea (1994) estimated that a typical gold panner and tow to our assistants might process between 1 to 3 tons of pay gravel a day. Looking at this situation another way, we can assume that a crew of say, three people could also move 3 tons of pay gravel per day (without having to process it) out of the river per day. In other words, a panner can move on ton of material in one day.

For the estimated gold output of 56 kg in 1993 from 2.100 panners, it would require between 106 00 and 560 00 workers for one day, depending upon which yield/tonnes figures are used.

Working in the dry season (120 working days) this translates to between 883 and 4.667 full time labourers. At an average wage of Z$200 per month (or Z$ 1 200 for six months) these replacement costs range from Z$1.1 million to Z$560 million (Rea, 1994).

With twice the number of panners, the estimated cost of moving the material would double to between Z$2.2 million and $11.2 million for one year.

These costs only include labour for moving material out of the river and distributing it. Other costs for a more complete rehabilitation programme would be incurred for example, to rebuild riverbanks, protect high-risk banks with rocks, and terrace slopes and plant vetiver grass and trees. If carried out by social crew, this additional activity could cost an estimated $10 per meter of river length, with both sides of the river being treated at an average height of 2 meters. The cost is based on two men working at Z$10.00 per day/man, plus additional costs for vetiver grass, equipment such as wheelbarrows and shovels and general overheads. For every kilometer of river rehabilitated, the cost could be in the range of $10 000.

Given the significance of gold panning in the province and the large number of rivers being damaged, the cost of follow-up rehabilitation would be enormous, even with this simple, labour intensive method. For example, using the conservative figure of 500 km of rivers in the province, the cost of full restoration is $0.5 million. With a more realistic figure of 1 000km of rivers and tributaries in the province under siege at various times of the year, the cost could be $10.0 million. These costs are order of magnitude estimates only. To be consistent with assumptions about the number of panners, we can assign costs of $5.0 million for the estimate of 2.000 panners and $10.0 million for 4.000 panners.

Other estimation methods for siltation could be used if better data were available. For example, the lost income from lower crop yields due to reduced irrigation water supplies (effect on production approach) or the cost of dragging dams for building new dams (replacement cost) could be used (Belli, 1989).

2.32 Deforestation

The study collected baseline data on the state of the forest surrounding gold panning areas. What are the potential values being lost however, through deforestation caused by gold panners? Bojo (1993) listed the following benefits from woodlands.

Direct, local private benefits: fruit, fuel, wood, construction wood, wooden utensils, honey, wild foods, and medicinal herb;

Indirect, local private benefits: leaf litter as stock grazing feed, grazing grounds for cattle, termite mounds for fertility improvements.

Regional, semi-public benefits: soil retention, stream flow regulation, and recreation;

Global public benefit carob sequestration and preservation of biodiversity (genetic, species and ecosystem diversity).

Campbell et al (1991) undertook research in Zimbabwe to estimate values of woodlands in a various sites in high, medium and low potential agricultural zones. The study focused on values for direct and indirect local private benefits farm households. The range in value per household was between Z$84 and Z$336 per year. Bojo (1993) converted these values to an area basis of Z$1616 to Z$221 per hectare per year. While it cannot estimate the actual amount of woodland damaged due to gold panners, the potential values at risk are clearly significant.

The study found that most gold panners either did not use or know about others using chemicals such as mercury and acids to separate gold. Only 10% of the panners admitted to using these chemicals. There is no plausible way to estimate the amount of chemical actually used or to develop measures of this environmental cost to downstream water users. Doubling the number of panners might however, change a low impact activity into a moderate level of impact.

2.33 Water Pollution

The lack of clean sanitation facilities by most gold panners and their families means that the river itself is the ultimate source for some human waste. Many families would also do their washing and laundry directly in the river. These pollutants are another impact to downstream users, but again the quantity and cost cannot be directly derived. Given that the total population in the province from the 1992 census was 857 00 the estimated 2.000 panners and their families is a small proportion. Their contribution to total river pollution must also be viewed as quite low. If we double the number of estimated panners, the impact could increase from lot to moderate levels.

2.34 Comparison of economic benefits and costs

The gross income from gold sales (illegal and legal) is the main measure of benefit. Using assumptions about the number of panners and the medium value for gold production, the range in value was between $4.7 and $9.4 million in 1993.

The foreign exchange earned is a benefit to the Reserve Bank (from legal sales) and individuals (from illegal sales) but cannot be counted twice.

Employment was estimated at 1.770 person years and is viewed a new jobs rather than a transfer from other regions. This benefit obviously doubles if we assume twice the number of panners. The permit revenues are fairly minor benefits.

Summary of estimated costs and benefits from gold panning, Masholand Central Province, 1993.

Table 2.1 Summary of estimated costs and benefits from gold panning, Mashonaland Central Province, 1993

BENEFITS	**ESTIMATED VALUE 1993 2.100 PANNERS**	**ESTIMATED VALUE 1993 4.200 PANNERS**
1. Income from gold sales	4.7 million	$9.4 million
2. Foreign exchange	Neutral impact	Neutral impact
3. Employment	1.770 person years	3.5 person years
4. Panning permit fees	Zero-$18 500	Zero-$36 600
COST		
a) Economic Costs:		
- Labour (opportunity cost)	$460 000	$920 000
- Capital (Shovels, pans)	$1.1 million	$2.2 million
b) Social Costs		
- Water and sanitation	$258 000	$516 000
-Children not in school	Low impact	Low impact
- Monitoring/enforcement	Government officers	Government officers
c) Environmental Costs:		
- Siltation	$1.1 -$5.6 million	$2.2 - $11.2 million
- River Bank Rehabilitation	$5.0 million	$10.0 million
-Deforestation	Moderate losses	Moderate losses
-Chemical deposition	Low impact	Low impact
-Water pollution	Low impact	Moderate impact

Source, Marongwe, 1993, Environmental Management

The list of costs is much larger. The economic costs include the opportunity cost of labour for full time panners' only, and capital costs. The opportunity cost of labour was estimated has the difference between median income from full time panning and probable income earned in domestic/gardening work in a city. Capital costs for shovels, picks, pans, sluice boxes, etc are more substantial and assumes that this equipment must be replaced annually.

Social costs are captured mainly by the estimated cost of providing clean water (through boreholes) and better sanitation (through blair toilets) to panners who are without these facilities. This cost was derived using the replacement cost method. The estimated cost of providing safe water and improved sanitation facilities was Z$258 00. The social cost of children not in school felt to be low because of the low numbers of children actually working on the sites. The cost of monitoring gold panning and enforcing existing legislation could be estimated. With double the number of panners, these costs also are assumed to double.

The estimated environmental costs are quite high. The major cost is for the downstream siltation from gold panning activity. Using the preventive expenditure method and a range of gold yields per ton of pay gravel, the cost of removing the river bed material for one year ranged from Z$1.1 to Z$5.6 million (assuming 2.100 panners) or Z$2.2 to Z$11.2 million (assuming 4.200 panners)

Complete riverbank rehabilitation could require from Z$5.0 to Z$10.0 million per year using manual methods. The impact of gold panning on surrounding woodlands was difficult to measure and quantify dollar values. However, the level of woodland values at risk is quite significant. Gold panners no doubt are contributing to the loss of forest cover along river systems in the province.

The use of chemical and water pollution from sewage was felt to have a low impact overall in the context of the entire province. More investigation into these problems is required however, to better quantify these impacts throughout the country. As an example, Rea (1994) found heavy traces of mercury in a 1.2 km stretch of the Mtshabezi River near Gwanda in Matebelaland South.

A comparison of benefits and cost suggests the gold panning in Mashonaland central, as presently practiced, is no desirable from the perspective of Zimbabwean society as a whole. Using the gold yields per tone of pay material in the above table and the two estimates from number of panners, the range in estimated net benefits for the province of Mashonaland Central in 1993 shows that gold panning is uneconomic.

Table 2.2. A comparison of estimated net benefits by gold yield per tonne of pay material, and number of panners.

ESTIMATED NUMBER OF GOLD PANNERS IN THE PROVINCE	**ESTIMATED NET BENEFITS**	
	Low Gold yield of 0.10 gram/ton of pay material	High Gold Yield of 0.53 gram/ton of pay material
2.100 panners	7.7 million	-$3.2 million
4.200 panners	-$15.4 million	-$6.2 million

Source, Marongwe, 1993, Environmental Management

The net benefits are highly dependent on the gold yield in the riverbed per ton of pay material and are highly sensitive to changes in gold yield. The activity is uneconomic at the gold yields used in this study, however if gold yields per ton of pay material increased, the activity could become economic. One should reflect however, that as more panners continue to enter the sector, the higher yield gold deposits, which are easily accessible for panning technology, are being mined out. Panners will increasingly work older sites or those with lower grade ores.

For this reason: Alluvial and riverbed gold panning, as presently practices in the province of Mashonaland South, is not economic when a full range of economic, social and environmental costs are compared with the limited number of benefits.

The reader should be reminded that these figures only reflect the benefits and costs that were assigned a monetary value. The economic benefits are largely restricted to gold income. Panning permits represent a negligible benefit.

There are many more costs, which were not quantified. For example, the social costs of monitoring gold panning and enforcing legislation are not captured in the above table. Some environmental costs such as deforestation and chemical pollution could only be qualitatively assessed. If all costs were quantified, the economic analysis would look even bleaker.

The environmental costs for siltation were estimated using the preventative expenditure approach, that is, the labour costs associated with moving excavated material out of the riverbed. Capital equipment and overhead costs were not included. This cost, however, is a reasonable proxy value of the cost of avoiding downstream, siltation and having to rebuild or dredge dams, clear irrigation lines etc. The cost estimate high change if mechanized methods were to be used. Additional costs were also estimated for more complete riverbank rehabilitation (Marongwe, (1993).

The costs and benefits should be viewed as best estimated only. Should improved data become available, these values could be revised. Nonetheless, the ranger of values all suggests an uneconomic activity and provide a starting point to develop improved policy approached

In most cost-benefit analysis, the objective is to consider cash flows over time and discount this back to the present using a suitable discount rate. This approach is not possible with the data available. For example, estimating future income streams from gold sales would require data on the reserves in the province. The, estimates could be made about the number of years of panning activity possible for various sites. For costs, more information would be required on rates of siltation and deforestation over times as well as the actual areas of river being panned to estimate reclamation costs.

The analysis in this paper simply presents a range of estimates for benefits and cost, assumed to occur in 1993 only. These estimated are based on a number of assumptions, which can be debated and improved with better data. However, the analysis does present a good starting point from which other studies can build upon. The results of the analysis clearly indicate that

ongoing costs exceed benefits and should help guide policy-makers concerned with gold panning to seriously rethink current policy (Marongwe,1993).

2.35 Distribution of Benefits and Costs

The distribution of benefits and costs is an important aspect for policy markers to consider. Which groups in society are gaining because of this activity and which are the losers? With the losses, both actual and potential, some policy consideration might be given towards having the gainers compensate the losers for impacts.

2.36 Benefit Distribution

The income earned from gold sales is spilt mainly between the gold panners and gold buyers/dealers, the latter of which are the normal claim holders. Very few panners, if any, sell their gold directly through official channels. The panners received on average Z$54 per gram, which the official Reserve Bank price was Z$85 per gram. We assume that the buyers and claim holders received the official price. For the estimated 55kg of gold produced in the province in 1993, the 2 000 panners received almost Z$3 million, while the buyers/claim holders received Z$1.7 million.

The claim holders (if any) as land "owners" are earning a rent from the panners in return for providing the panners the right to pan for gold on the claim and providing a gold marketing service. This would be consistent with rent theory. In this case, the rental amounts to 36% of the total value.

With foreign exchange, little can be said about distribution of benefits in the absence of knowing what proportion of the gold is smuggled out of the country and income flows into and out of Zimbabwe.

The employment benefits are impact largely within the province. A proportion of the income earned by the panners would be spent in the province for the purchase of panning materials and suppliers (shovels and picks, lumber, etc food clothing and other expenses. Some income

would leak out of the province for purchases masse in other areas of the country or with remittances sent by panners to families living elsewhere. The panners pay the permit fees to the Local Councils but represent a very small level of benefit. In reality, most panners do not bother with a permit Marongwe, (1993)

2.37 Cost distribution

The economic costs of permit are incident in the panners. Capital costs for shovels and sluice boxes etc are borne by the panners as well.

Social costs of providing safe water and better sanitation to panners would, if implemented, fall on the government. The panners might be expected to provide some labour "in-kind". The cost of having children out of school would eventually fall on the government. As the children reach maturity, they would only qualify for low-income formal employment, subsistence agriculture, or informal employment and the dependent on the state to provide for all health care, possible subsidized housing etc. Cost of monitoring and enforcement are incident on government.

The environmental costs of siltation, if not addressed through a rehabilitation programme or by the panners themselves, fall on local farmers downstream of the panning, both communal and commercial and the government. The government would be responsible for dredging dams on communal land, or building new dams to replace those that had become choked with silt and were uneconomic to clear. For silted smaller dams on commercial land, the farmers would be responsible for clearing or replacement. Farm incomes would also decline if the siltation led to reduced water available for irrigation. If the gold panning siltation were addressed through a rehabilitation gram, the government would bear the cost. A more complete rehabilitation programme that encompassed terracing, planting grass and tree, etc, would be borne by government (Marongwe, 1993).

The more easily identified costs of deforestation caused by the gold panners are incident on all people living in the immediate areas, including the panners. The multiple benefits lost from

the depleted woodlands would measure the costs. Some of the direct and indirect benefits lost include fuel wood, building materials, fodder, fruit, nuts, shade from the sun, leaf mulch as organic fertilizer etc.

The costs of water pollution from chemicals and sewage are incident on people living downstream who may suffer direct health problems and the government, who would have to address the situation.

A striking feature of the synopsis distribution effects is that while the panners received the majority of the benefits; they do not pay for most of the costs, particularly the social and environmental costs. For the most part, these costs are incident on other groups in society. Where the government is responsible for paying, assumed costs such as water and sanitation, little if any of the expenditure would be traced back to the panner since few of them would be paying income tax (Marongwe, (1993).

Increased government expenditure is not castles to society. Impacts include either increased internal borrowing or upward pressure in domestic interest rates, increased external borrowing and pressure on balance of payments, or difficult trade-off by reducing spending in other programmers such as health or education. Where funds are borrowed, the question of debt servicing and the impact this has on current expenditure must be raised (Marongwe, 1993).

In summary, the gold panning situation represents a classic case of externalities caused by inappropriate natural resource extraction. The mining activity of gold panners generates a broad series of social and environmental impacts, the costs of which are borne by other groups in Zimbabwe who cannot be compensated by the panners

Chapter 3
Data collection procedures

"There is no disaster in the business that you can not avoid – if you see them coming and make the adjustments"

T.Boone Pickens, Jr.

3.1 Introduction

Since the current study is not a highly quantitative laboratory experimental research, the field research shall rely most heavily on the use of field notes which are running descriptions of settings, people, activities and observable physical features. Field notes shall include drawings or maps from the physical environment visited. Acknowledging the difficulties of writing extensive field notes during a scientific observation, Lofland and Lofland (1984) recommended jotting down notes that were to serve as a memory and then full field notes are constructed. In addition to field notes, the researcher shall have photographs, videotapes and audiotapes as measure of accurately capturing a setting.

The study visited the river bank to observe and discuss with gold panners after which a general survey was also carried out with local mining organisations like Blanket mine and Vumba mine to establish the impact of illegal gold mining in their surrounding areas. Visiting the mining organisations for data collection provided the multiple perspectives on the various aspects of the operations of gold panners thereby also providing the research with breath and depth of data to strengthen the research and also allow for addition of new information to a body of knowledge.

It should however be noted that qualitative data collection and analysis is no panic. It is difficult, given the fact that the researcher was dealing mainly with respondents who are involved in an illegal operation; however, the study made an effort to establish good relations with respondents to be able to collect valid and reliable data.

Research is an important tool used to give bearings to a process that undergoes change or transformation. It helps people to evaluate the effectiveness of the tools used in a given process; progress made during the process and it also helps in shaping up future decisions about a process.

Big and small organisations and organised systems would find it very difficult to improve their services without organised reach pointing out on the weaknesses and the extent to which they present themselves in any given issue at any given time.

This chapter discusses and justifies the approach, methodology and methods used in this research. By approach, it means the way the research is going to be done some researchers use 'traditions' to describe the approach (Bell, 1993) or 'design' (Oppenheim, 1992, p.6) who defines this term as follows:

"The term research design here refers to the basic plan or strategy of research, the logic behind it, which will make it possible and valid to draw more general conclusions from it". In this work, the study adopted a purely qualitative approach to the study which suites well a case study. Methods that were used for those that would allow collecting as much information about the case study, which was then, be processed to make deductions and conclusions. Whilst a qualitative approach has been chose some quantitative aspects may be used to broaden the scope of data collected from the study.
Hitchcock and Huges (1995,p12) note the strengths of a qualitative approach this way:

"Approaches that enable the researcher to learn at first hand, about the social world they are investigating by means of involvement and participation in that world through a focus upon what individual actors say and do".

The study made visits to the areas where gold panning is prevalent to experience first hand the social and economic hardships these people experienced, which are the key causes that push them to pan for gold. During these visits the study expected or used the tool of observation to get to some of the issues that are linked to this problem, which may not be instantly seen at a

glance. Documentary analysis and interviews were also used to get to the depth of this problem.

Sometimes the terms method and methodology are used interchangeably whilst they actually refer to two different things. Kaplan, Cohen and Manion (1989, p. 41-42) methods are referred to as techniques and procedures used in the process of gathering data while methodology means to describe and analyse the methods, throwing light on their limitations and resources, clarifying their presuppositions and their limitations and consequences, relating their potentialities to the twilight zone at the frontiers of knowledge.

A lot of factors influence the type of research methods used in any research, for example when a lot of people are involved in a research it is best to use a survey. Surveys allow the researcher to gather information from many people who may be at different geographical locations at the same time. This method was best used to gather information that addresses the breadth not the depth of a problem since it can collect a lot of information or views from different people. In this research a survey could there for be a useful tool to gather the views of the various stakeholders in this problem since there are a number of rivers where gold panning takes place. The researcher would have to find from the local authority for example, the district or regional body, the government bodies in charge of the environmental affairs and from the gold panners themselves. With little time available for the research it would be difficult to reach all these people and actually talk to them to get their valuable opinions.

To address the depth of a problem: interviews, literature search and those other methods that allow the researcher to cover a lot more detail on a given issue were used. It would be important to establish the amount of knowledge that the gold panners hold on the mineral deposits along the rivers they work on. Is it a guess game, that they work on or do they have specific information on where to dig? There would be a lot more damage if they were just going digging in a trial and error fashion. A literature search will be used to determine the mineral deposit location so that a comparison can be made with the areas where most panning is done.

3.2 The Interview.

Interviews were used as the primary major strategy for collecting data. However it was used in conjunction with questionnaires and observations made to get an in depth analysis of the impact of gold panning in the Gwanda district. The interview scripts were prepared to ensure that basically the same information is obtained from each person but there are no predetermined responses. In all cases the interviews were free to probe and explore within the areas.

3.3 Advantages of using interviews.

The interviewers are at liberty to probe respondents to obtain the major details relating to the study. Also interview guides used in the interviews ensured good use of limited interview time they make interviewing multiple subjects more systematic and comprehensive and they help to keep interactions focused between interviewer and the respondent. In keeping with the flexible nature of qualitative research design, interviews can be modified overtime to focus attention on areas of particular importance, or to exclude questions the researcher finds to be unproductive for the goals of the research Lofland and Lofand (1984).

3.4 Disadvantages of interviews in data collection

Recording interview data may present problems, for instance tape recorders may be indispensable, Lincon and Guba (1985). Note that tape recorders may provide elements of intrusiveness of recording devices and the possibilities of technical failure. While the interview has the advantage of interaction it is time consuming and very few respondents are covered.

3.5 Observations techniques in data collection

The classic type of data collection in naturalistic or field research is observation of participants or physical observation of the physical environment in the context of a natural scene. Observational data collection is used in the purpose of describing settings, activities, people and the physical environment and the meanings of what is observed from the

perspective of the participants. Observations can lead to deeper understanding than interviews alone, because they provide knowledge of the context in which events occur and may enable the researcher to see things that participants are not aware of. The study used several observations strategies such as watching from outside without being observed and in some cases maintaining a positive presence, being as un obtrusive as possible and not interacting with participants. In some cases the researcher engaged in limited interaction intervening only when further clarification of actions was needed. However the researcher exercised more active control over the observation as in the case of a formal interview to elicit the specific types of information.

3.6 Sampling strategies

Given the in depth nature of the study purposive sampling techniques were used to identify the sample. Also some maximum variations, stratified purposeful and snowball sampling were used while at the same time maintaining a balance among respondents. Patton (2000) supports the notion of maximum variation and the research by discussing that the real world is subject to change and therefore, a qualitative research was used to present change and record an event after and before the change occurred. However both the qualitative and quantitative research needs to test and demonstrate that the studies are credible.

Advantages and Disadvantages of using a questionnaire

The following advantages and limitations of using a questionnaire in small-scale research, discussed by Munn and Drever (1990, p.2-11), were taken into consideration in selecting a questionnaire as a data-gathering instrument:

Advantages

Efficient use of time by both the researcher and the respondent as either person works on the questionnaire at the most convenient time to them.

Anonymity for the respondent that increases the chance of getting accurate and authentic data as respondents would have no fear of their information being linked to them and maybe later

used against them. It is no secret to the gold panners for example that what they are doing was not a crime or offence, but when people find themselves in a helpless situation like the one of extreme poverty faced by many in the country they would be ready to commit a crime in order to survive. In this case it would be very important to assure the respondents of their anonymity for them to be able to give information being sort freely.

All the respondents are asked the same questions, which made it easier to generalise on the result obtained.

Use of standardised questions allowed for easier processing of the results once they were collected.

Disadvantages

Questionnaires provide descriptive data, which lacks in explanations as to why things happen the way they do. These descriptions are however very important to know if further studies are to be taken to get the explanations.

Questionnaires may offer very superficial information that could be very limiting for the researcher since there would be no one to probe the respondent further.

The instrument may be inadequate if its preparation is not properly done thus reducing its effectiveness in gathering data.

Limitations

The researcher assumed to be objective, neutral and capable of maintaining a significant degree of detachment form the documents. Subjectivity was sometimes difficult to eliminate as the researcher determined the categories of classification and in some cases these are chosen for the researcher's convenience, which may not reveal any significant meaning. In quantification of information it is assumed that frequency equals significance but as Hitchcock and Hughes (1995, p. 226) observed this is not necessarily true.

"The problem which faced the researcher was using content analysis that frequency does not, in fact, necessarily mean significance and that a striking word or phrase may turn out to be

more important in determining meaning". This could be interpreted to mean that whilst quantitative work can be done for documentary studies they are better studied qualitatively.

Chapter 4
Data presentation and analysis

4.1 Introduction

The presentation, management and analysis of qualitative data are unquestionably a complex process or operation, which involves highly technical language and systems of discourse. It involves the mystery of a special set of interpretive practices and narrative techniques. Bogdan and Biklen (1982) noted that data analysis in qualitative research involves working with data, organizing and breaking it into manageable units, synthesizing, searching for patterns and discovering what is important and what is to be learned and deciding what to tell others. In a qualitative data analysis, researchers tend to use inductive analysis where critical themes emerge out of the data.

The discussion of the result will focus on the description on the opinions of some respondents compared to the whole sample, which gives specific trends on the respondent and findings of respondent's opinions on panning. With the sample being a representative unit of the population these trends can be generalised for the whole population. Interpretation of the data focused at making sense out of it without trying to make any. The management, analysis and interpretation of qualitative data is unquestionable a complex process involving highly technical language and systems of discourse. It involves the mastery of a special set of interpretive practices and narrative techniques (Bogdan and Biklen 1982).

Data analysis in the study involved working data, organising it, and breaking it into manageable limits, synthesising, searching for patterns, discover what is important and what is to be presented. In quantitative data analysis researchers tend to use inductive analysis where critical themes emerge out of the data.

Patton (1990), Guba (1979) and Glaser 1967, have it that qualitative data analysis require some creativity, for its challenge is to make the raw data into meaningful logical categories to examine the holistic fashion and to find a way to communicate this interpretation to others.

Data analysis in the study began with the identification of the themes emerging from raw data, a process sometimes referred to as open coding. As the information was broken down into manageable chunks, it was derived to an audit trail that was a scheme for identification of chunks to their provider and context. The qualitative report will be characterised by the use of voice in the text, that that is participants' quotes that illustrate the themes being described. However it should be note that the use of traditional tables, graphs, charts and other qualitative figures are used in the presentation of data. The report is a rich, tightly woven account that closely appropriates the reality it presents. Some constant comparative analysis, phenomenological analysis was used in the analysis. The study on the impact of gold panning in Gwanda district applied different data analysis strategies to strengthen the research and improve on the validity and reliability of the research findings. It should be noted that contemporary qualitative studies are sometimes computer programmes such as SSPS, although the benefit of such software are mainly in storing and segregation of data, rather than in processing or analysing.

Although it is common in research to draw a distinction between qualitative and quantitative data analysis, it has emerged that the two may go hand in hand based on the analysis of large amounts of qualitative work that usually have a prerequisite to have a fruitful quantification in physical science. The study on the impact of gold panning on the physical, social and economic environment enjoyed both qualitative and quantitative data.

Patton (1990) Guba (1979) and Glaser (1967) have it that qualitative analysis requires some creativity, for the challenge is to place the raw data into a logical meaningful categories and to examine them in a holistic fashion and to find a way to communicate this interpretation of others. Data analysis in qualitative study begins with identification of the themes emerging from raw data, a process sometimes referred to as open coding (Strauss and Corbin 1990), As the information is broken down into manageable chunks, the researcher derives an audit trail which is a scheme for identifying data chunks according to their provider and context. The constant comparative analysis, which is well suited to, grounded theory used to study that phenomenon for which the researcher assumed that fundamental social process to explain something of human behavior and experiences on the environment. The study on

environmental impact caused by gold panning in Gwanda district applied different data analysis strategies to strengthen the research and improve on the validity and reliability of the research findings.

In order to explore the major issues raised by the literature review concerned with environmental damages, interviews, questionnaires and observations were conducted with a small number of panners, non-panners and stakeholders in Gwanda District. The findings of the study were based on the information provided by respondents comprising panners, non-panners and potential stakeholders in environmental management in Gwanda District

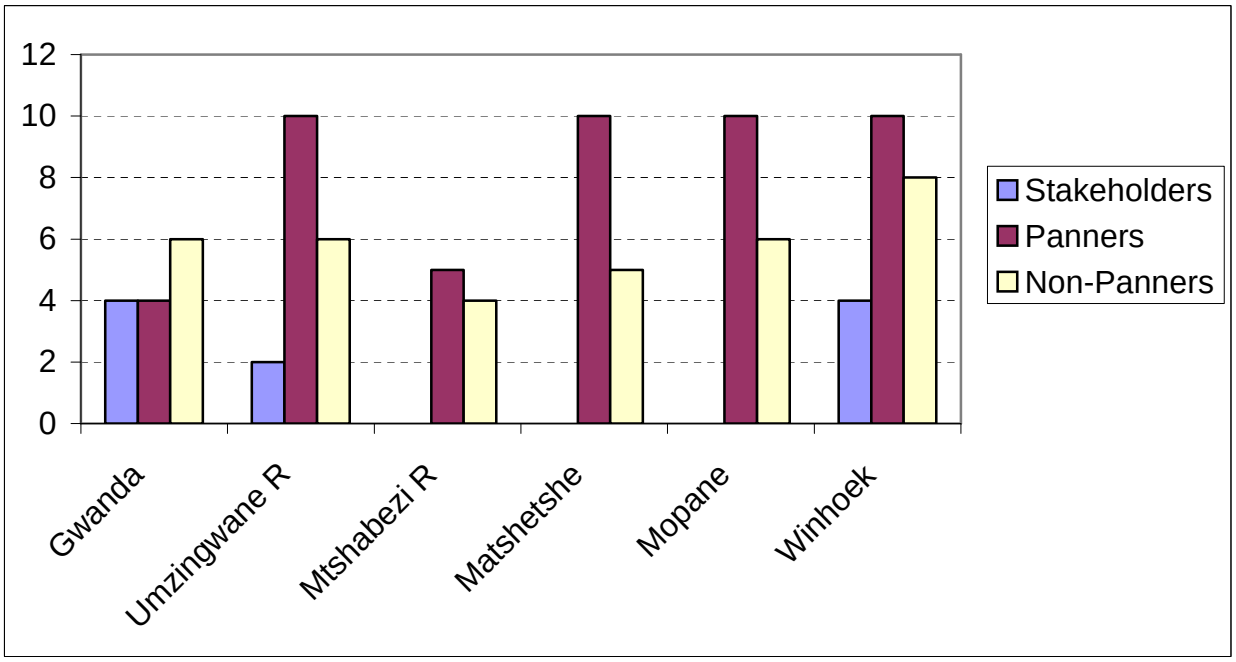


Table 4.0 Profile of respondents

The sample is the source of capturing the data and describing the central themes or the principal outcomes that cut across a great deal of participants or programme variations. In this case maximum variations of respondents yield detailed descriptions of each case in addition to identifying shared patterns that cut across cases.

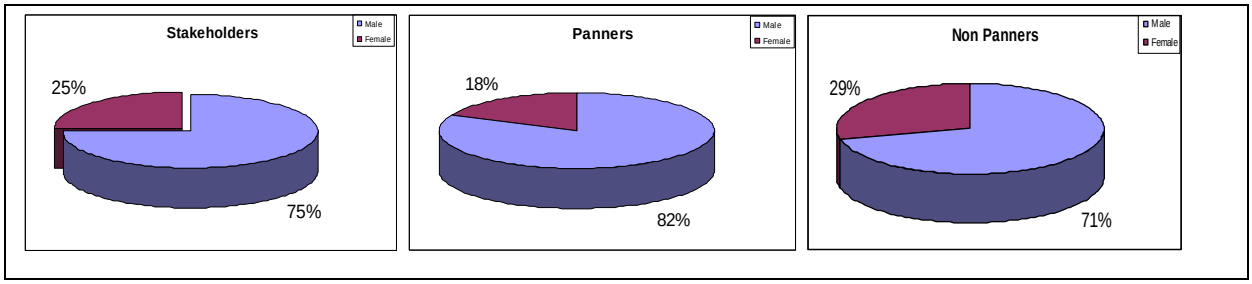
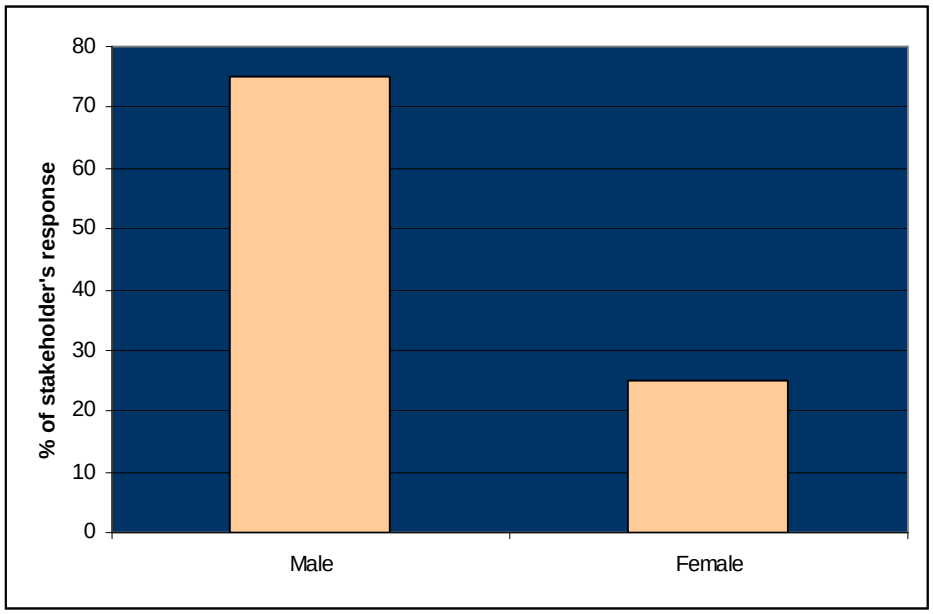
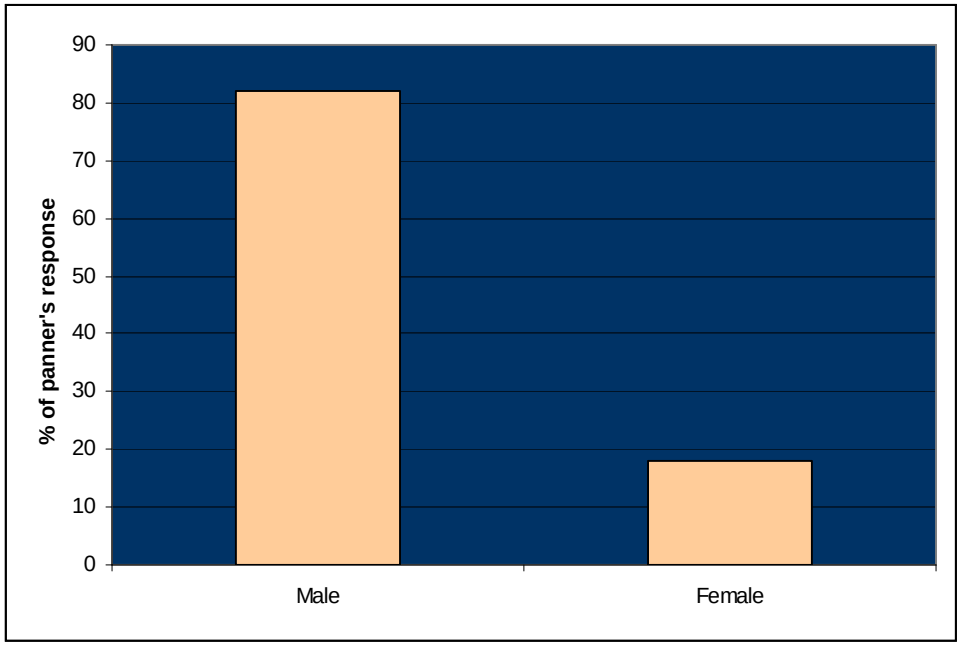


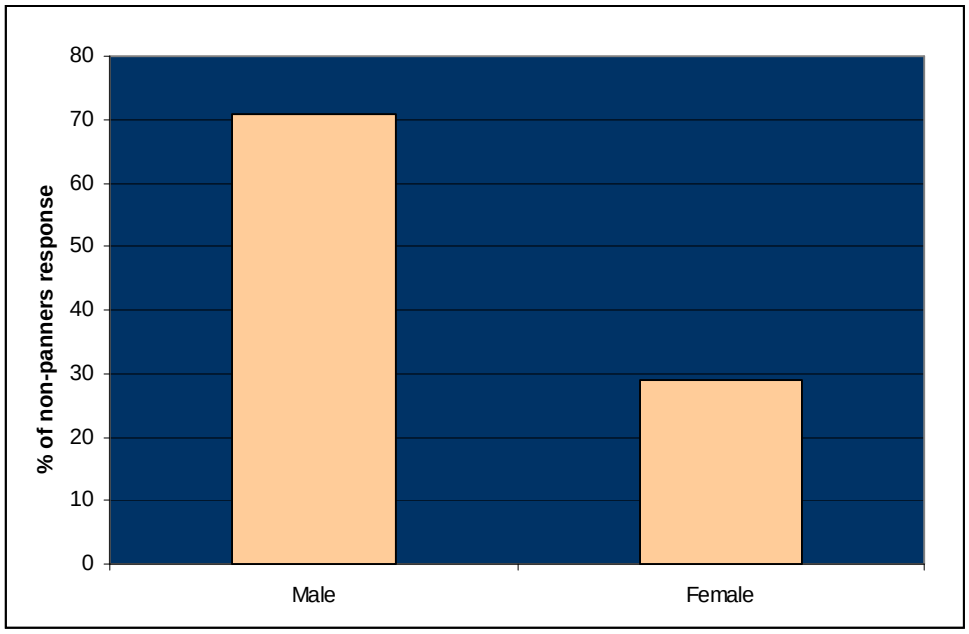
Chart 4.1Respondents by gender



Response by stakeholders



Response by Panners



Response by Non-P anners

From the look of things, the majority of the panners are male (that is 82%). This is probably because gold panning activities require maximum physical fitness, which most women may not match.

The study established that at most of the sites visited, men were mainly involved in the digging and sieving of the soil with women assisting in carrying some water. Basically, the study established that gold panning involves digging narrow tunnels following the belt of the gold mineral, an activity that most women may not seek to undertake. However, some women were involved in searching for the gold, through sieving the soil using some washing bowls. In most of their responses, the female panners indicated that the job of gold panning was not suitable for them, but they had no choice, as it was their only source of income, despite the fact that they were compromising their health.

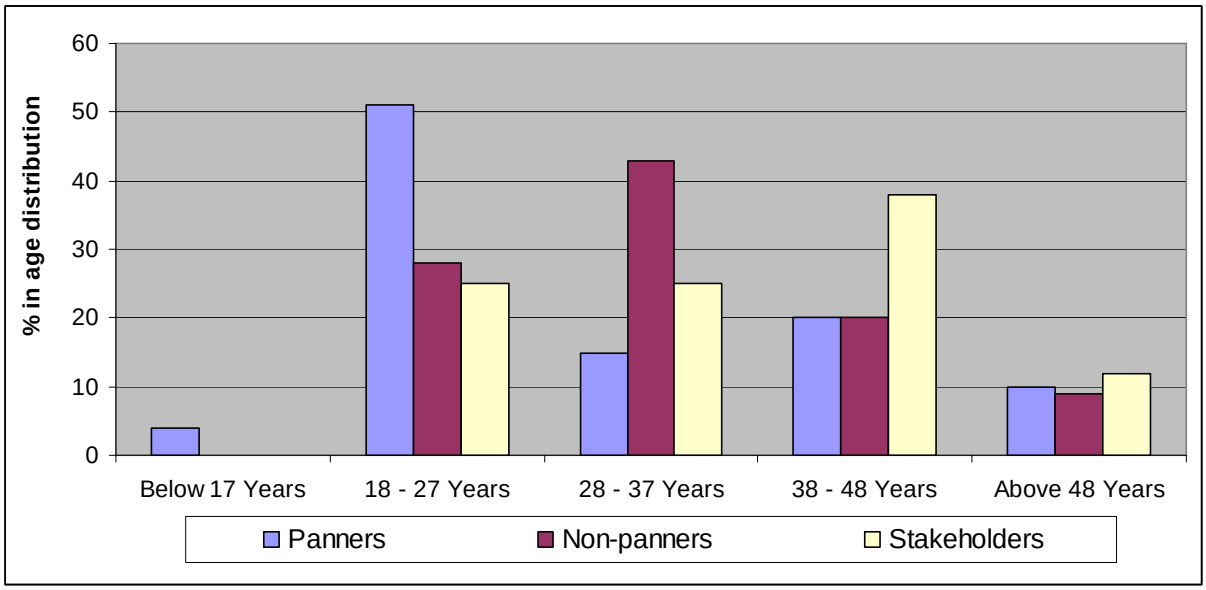


Table 4.2

The table above shows that there are some panners below the age of 17 years. Although their actual ages could not be ascertained; this amounts to child labour, as some would have been employed by claim owners. However, the majority of the panners are aged between 18 and 27, which constitutes 51 percent. This number constitutes young mothers and fathers trying to raise some income for their families. The study established that the Gwanda District Council

was making an effort to reduce the number of panners regarded as being under age. The reason being that they were unfit and unprepared for the gold panning operations which involve descending into a 30m pit, as in some cases, using a rope and bucket.

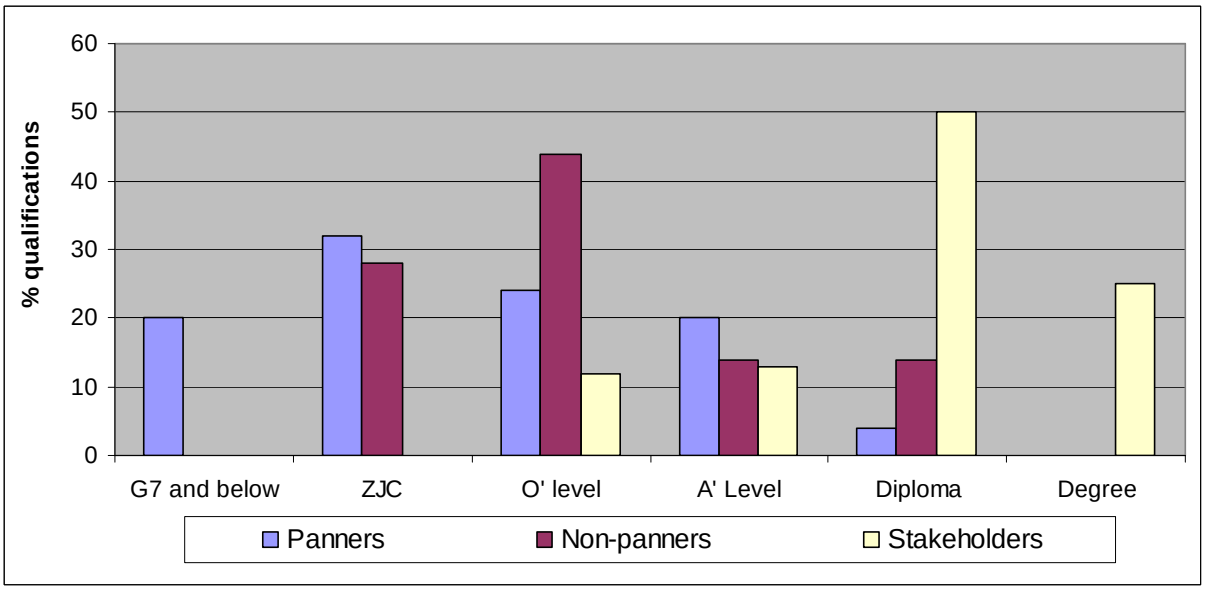
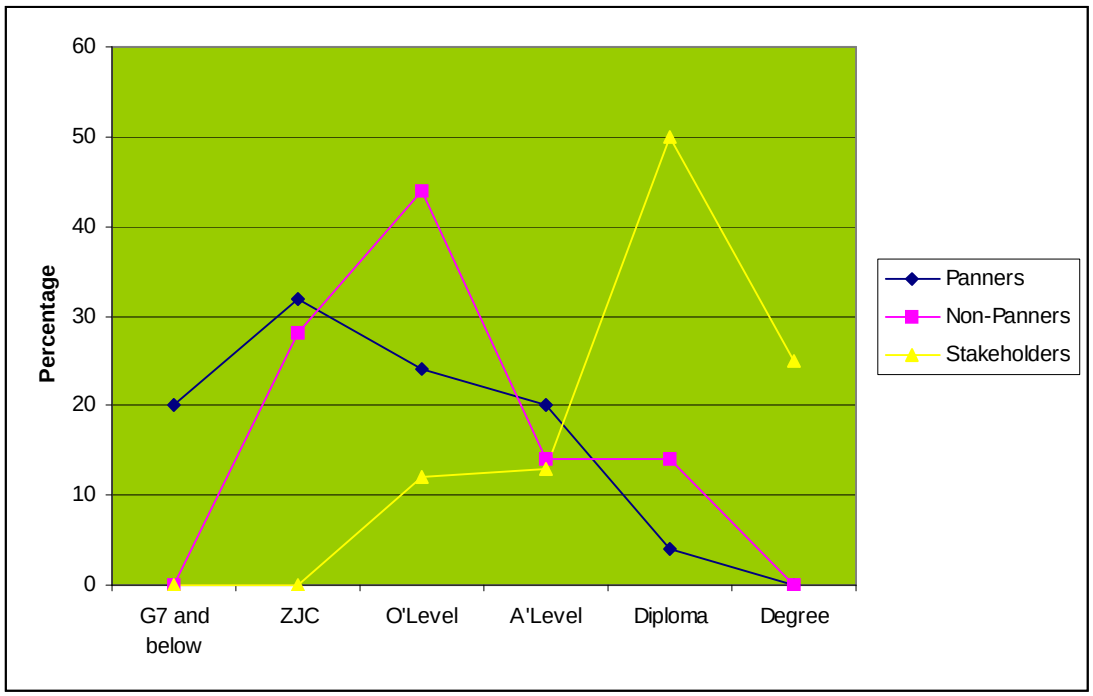


Table 4.3 Respondents by qualifications



The table shows that most of the panners are below the junior certificate level of education, which is form two. Basically, this illustrates that a good number of panners are school dropouts. However the study established that among the panners, 4% were holders of diplomas in education and agriculture. The level of education of most of the panners illustrates that they are unaware of the dangers they are causing the environment due to their gold panning activities. However, one of the two diploma-holders may be aware of the dangers of their operations to the environment. It was interesting to note that the two diploma holders were schoolteachers who had absconded from their teaching responsibilities to join gold panners to earn a much higher income.

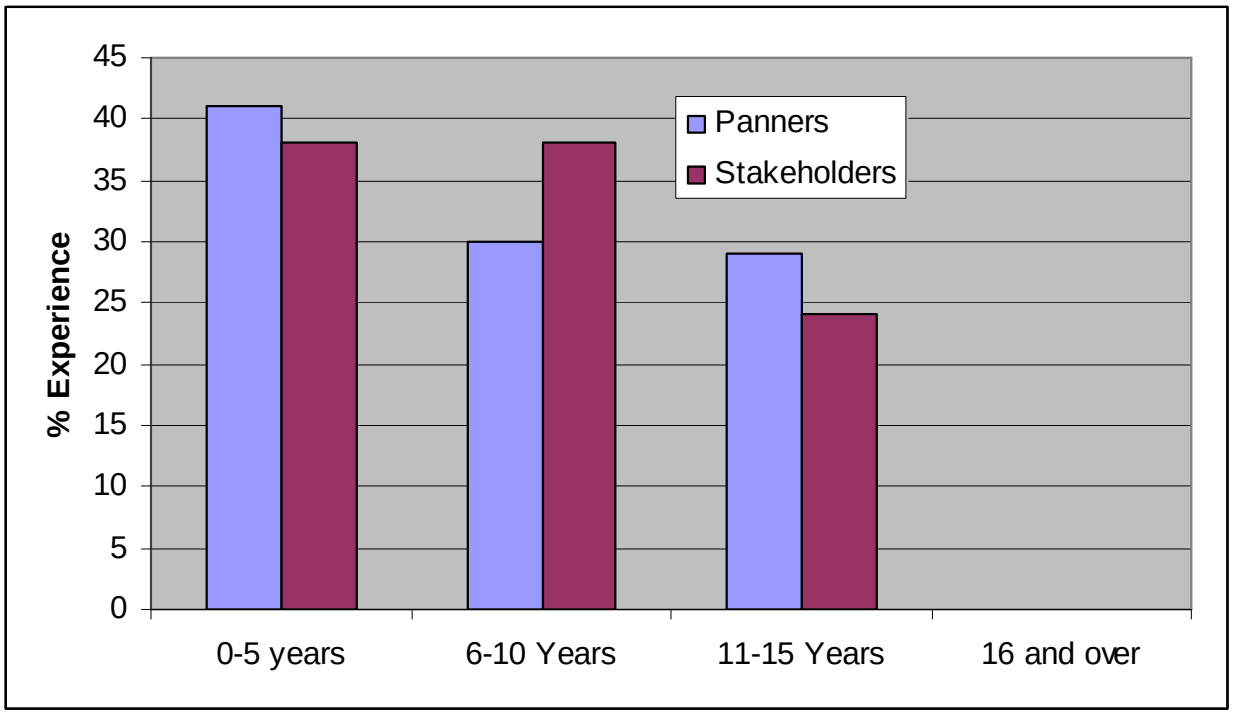


Table 4.4 Respondents by experience

The study established that some of the gold panners have more than 12 years of gold panning experience. One of the panners noted that he was a senior "*Gwecha/ Tsheketsha*" panner and had it been that he was employed at a mine, he would have been awarded medals for long service. It was interesting to note that most of them had indicated that they liked their jobs and would not wish to take any employment elsewhere other than gold panning. When asked

whether they were aware that they were causing serious damage to the environment, most of them responded by indicating that they were so much experienced, such that they were no longer a threat to the physical and social environment, given their vast experience as illegal gold panners.

When asked to indicate their marital status, an interesting picture was presented

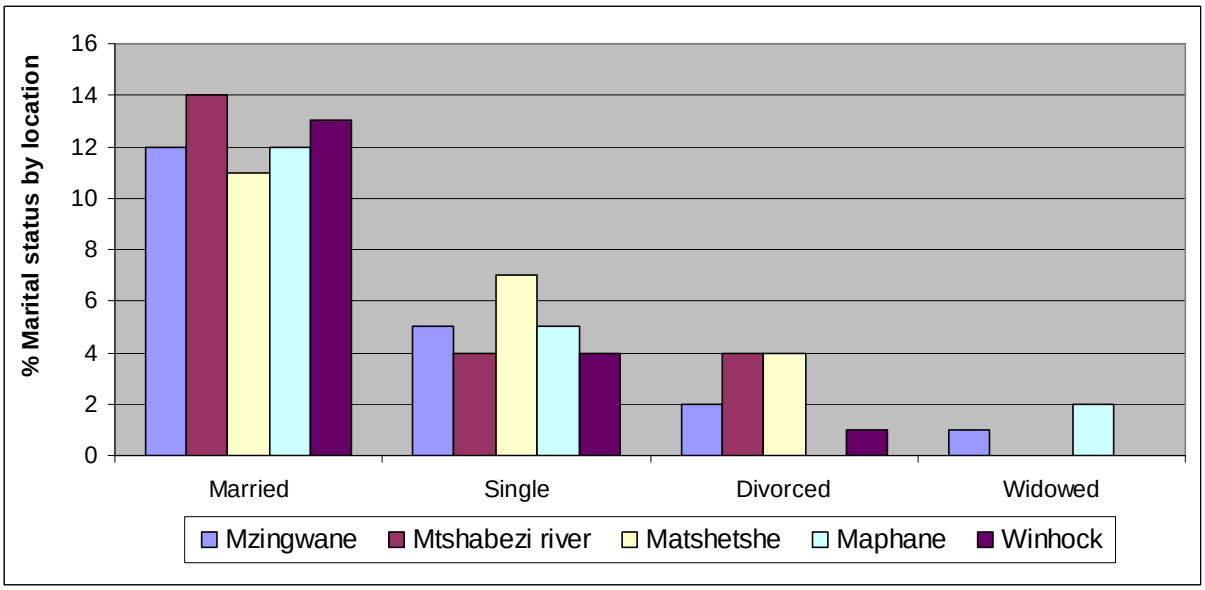


Table 4.5. Marital Status of panners and non panners by location

As shown in the table, the majority of panners and non-panners are married persons. This is an indication that gold panning is a poverty driven activity, during periods of economic hardships. This is in line with Chikowore (2002), who noted that in developing countries like Zimbabwe, most of the panners are rural based and poverty driven. The current economic hardships and critical food shortages in Zimbabwe have forced most rural families to resort to gold panning, creating yet another disaster to the environment operating concurrently with the economic recession. Also a reasonable number are single men and women, who are trying to assist in providing food security for their families. The economic hardships in Zimbabwe have hit hard across generations such that people of all ages are assisting to provide for the family. The researcher visited the sites where gold panners stay, discovered that most panners live in

pathetically small huts made from small plastics and some wooden poles. The conditions which make them prone to infectious diseases and HIV and AIDS given the fact that in some cases, single women stay in their huts close to single men.

While it could be acknowledged that the land comprising of river banks and even the dry river beds, have no real alternative economic use, besides some small market gardens which can be grown along the river banks. The estimated number of panners in the Gwanda District Rivers during the period of the study was alarming. At least 2000 panners on the riverbanks were capable of causing serious damage to the physical environment, despite the fact that the riverbanks could not be of any economic use. The estimate of 2 000 panners was made by relating the number of panners sampled to the total estimated population of panners at all potential sites and the length of the river along which the panners were located to the total number of panning sites in the sampling frame and the total estimated length of all possible panning rivers in the province. The estimate of 2 000 is probably low given the damage that has been caused on the ground surface and also, during the study time, many small rivers had dried up sufficiently to allow for effective gold panning and these were virtually abandoned and only some novice panners seen here and there. Most of the dried rivers showed extensive riverbed damage due to previous gold panning activities. In most cases they do not bother to close the dangerous pits created on the riverbeds.

The 2 000 panners should be viewed as a minimum number, considering the damage on the physical environment. More accurate estimates would have required either extensive river surveys by ground (foot) or aerial photography of the entire province. For the current study, doubling the number of panners as a possible maximum did a sensitive analysis and also looking at the physical damage caused to the ground surface.

From the interviews conducted with the panners, it was established that from the figure of 2 000 panners, more than 1 500 were full time panners who resided along the river banks, with another 500 operating from their homes. The full time panners stay in dilapidated infrastructure without access to proper sanitation facilities; they used some small pit latrines

very close to their sleeping huts and these latrines were often inadequate in number, resulting in high utilization rates.

Both the huts and latrines were smelly and very dirty, posing significant health hazards to the panners and their families alike, since full-time panners had their families along with them. The camping sites had no access to clean water within a walking distance. They got water from rivers and this is conducive to the spread of infectious diseases in and around the camp establishment. The huts are constructed without any ventilation, with daylight being the only source of illumination. In most cases however, the rooms are dim, even during the day.

Using the results for median weekly gold production and the number of full time and part time panners, the weeks activity produced 50kg of gold, while part time panners produced another 10kg of gold. Assuming that the 2 000 panners are constantly producing, this means serious damage to the environment, because the focus of the panners is to get as much gold with little attention paid to the impact on the physical environment.

Nearly 75% of the panners interviewed indicated that they did not know or realize the impact of gold panning to the physical environment and their health status. All they are after is extracting the gold and selling it to raise some income for their families and beat the economic hardships. From the observations and review of related literature, gold panning does not generate any environmental benefits besides resulting in health hazards created for people and animals. From the findings, roughly 70% of the full time panners and their families did not have access to safe water as indicated before and the majority of the panners were not using toilets but the bush close to their campsite was an alternative for them. The lack of sanitation facilities in most campsites for their families means that the river itself is the ultimate source of human waste, with most of the families doing their laundry directly in the river. All these have some effect on downstream users who may be users of the stream for their drinking water, since this is typical in rural areas that people may fetch water directly from a flowing stream for their home consumption.

The leader of the panners, who was interviewed, revealed that their squatter camp did not have proper sanitation facilities. He noted that the mining area and the river was the ultimate source of human waste. However, the panners themselves noted that they used the bush as their toilet.

On the issue of physical infrastructure, the observations established the following:

Location	Permanent accommodation	Availability of toilets	Borehole water	Recreation centre	Shopping centre	School nearby	Clinic
Umzingwani River	Nil	Nil	Nil	Nil	Nil		Nil
Mtshabezi River	Nil	Nil		Nil	Nil	Nil	Nil
Matshetshe River	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Maphane	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Winhock	Nil	Nil		Nil	Nil		Nil

Table 4.6 Availability of infrastructure on the panning sites

The table shows that most of the campsites for panners are deadly hazards with no toilets, no clinics and no clean water for their cleaning and cooking. One of the panners interviewed noted that she was not concerned with their accommodation and shelter,all she wanted was to get the gold, under whatever circumstances. When asked whether or not an alternative job would make her abandon gold panning, she noted that gold panning was her sole employment and also that she would never abandon the riverbanks. Apparently the women looked ill and rather hungry, wearing very dirty clothing, an indication that she does not have time to wash her body and prepare her meals, as most of her time is spent in the pits, digging for gold.

4.2.0 The impact of gold panning on the environment.

Gold panning, alluvial and some riverbed gold panning as presently practiced by many gold panners in Gwanda, has serious environmental impact. Bojo (1993), noted that the most significant concern is the river system siltation and the resulting impact on the quality of water flowing downstream for domestic and agricultural users.

As a result of gold panning, especially in the Mzingwane River, increased siltation occurs during heavy rains, especially in places where improper gold panning is practiced. The study established that due to gold panning in the Mzingwane area, there is serious soil compaction and deforestation along the river banks, which results in accelerated run off and the washing away of sifted material piled up loosely on the riverbank and in the riverbeds, resulting, in most cases, the collapse of the river beds. This finding is in line with the literature review, which established that the siltation of rivers from gold panning has the tendency of reducing the storage capacity and resultantly, the operational life of small dams downstream from the panning sites. The study established that most of the dams in Gwanda are already 70% silted and in most of the rivers it was so bad that it is no longer economic to construct new dams along the rivers where gold panning takes place, due to the high levels of rapid siltation. The main danger and problem is due to excavated tunnels, pulled down trees, large trenches, holes and pits, which are not filled back after extracting the mineral. When asked on whether or not they were aware of the dangers they were creating on the physical environment, the respondent gold panners indicated that they were unsure, making it difficult for the researcher to establish whether or not they were unsure of the dangers they were causing to the environment or they did no know that they were creating some dangers to the environment as a result of gold panning.

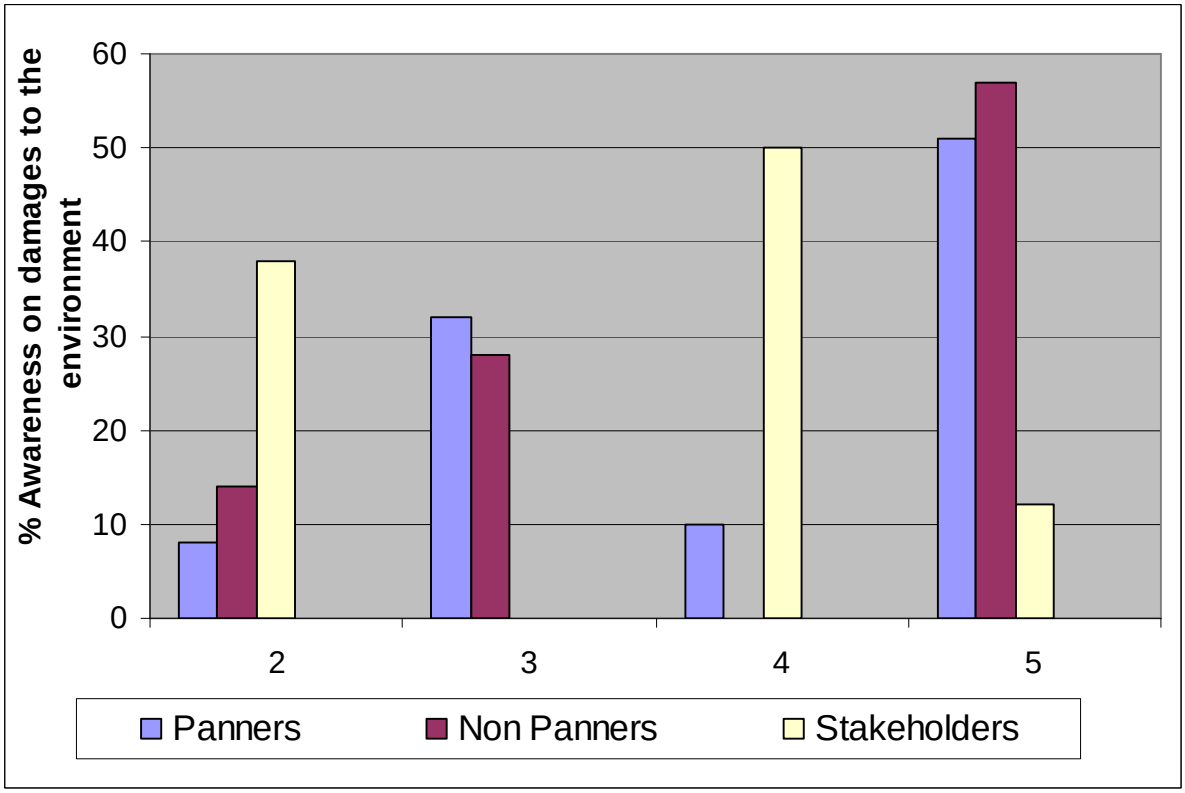


Table 4.7. Respondents' perceptions on whether or not they were aware of the damage caused to the environment.

The table shows that 51% of the panners of which 2% are females and 57% of non-panners, with 21% being females are not sure of the damages caused by their activities on the environment. This is the reason why they left a lot of trees up rooted and many open pits on the river banks. They are not aware of the environmental hazards caused by gold panning. While some panners and non-panners acknowledged that siltation arises as a result of gold panning, stakeholders were also of the same opinion that siltation is not only through gold panning but also through stream bank cultivation, poor crop production practices, over grazing and deforestation by people seeking fire wood and poles. It is interesting to note that panners and non panners except for stakeholders did not know the dangers or disasters caused by chemicals used in gold panning activities. The reason being that, most of the panners never received any training in gold production practices and hence ignorant in the dangers of using these chemicals.

Responses on whether the panners and non panners are aware of the dangers caused by the different chemicals they use.

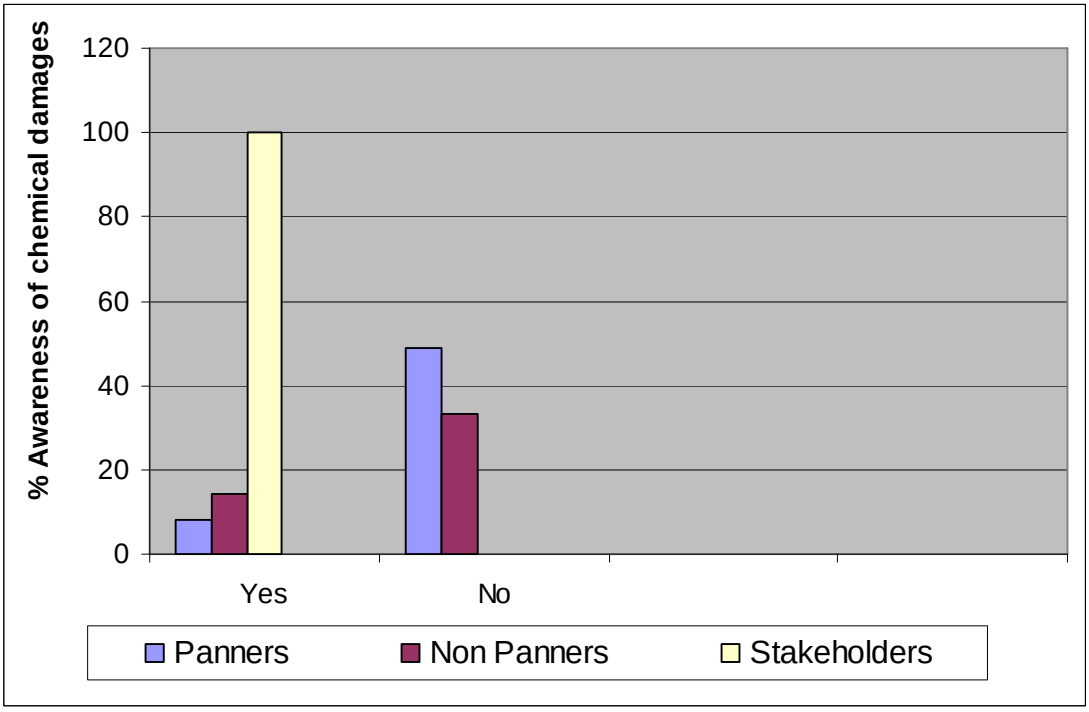


Table 4.8. Dangers caused by chemicals

The concentration of gold panners that make use of chemicals such as cyanide and mercury which may pollute water was also evident. The effect depends on the size of the mining operations, out of the 49 panners interviewed almost 70% of them indicated that they used mercury and cyanide to concentrate gold. It is now common knowledge that the uses of such chemicals and other waste materials from the panning sites are washed into the streams, rivers and dams. Mtshabezi is one river that was noted and it is evident that the pollution is high.

When panners asked whether they were aware of dangers caused by the chemicals on the water, the majority expressed ignorance as to what effect the chemicals have on water. The use of chemicals in gold panning is likely to have devastating and disastrous impacts on the aquatic environment as the pollution kills aquatic life. Mercury is a poisonous chemical to both human and the aquatic – based food chains through some bio- accumulation. The use of cyanide and mercury in gold concentration and amalgamation can poison water born animals, domestic and wild life. The study established that panners were not aware of all these dangers

of using chemicals although some could not give very strong reasons for not investigating on the effects of the chemicals. Little did they know that they were a threat to the ecosystem and the aquatic environment.

When asked whether panners and non-panners were aware of the government policies governing gold panning in Zimbabwe, most of them expressed ignorance on the existence of the statutory instrument and only knew it was illegal to pan.

Responses of panners and non panners on whether they are aware of government environmental regulation and policies governing gold panning.

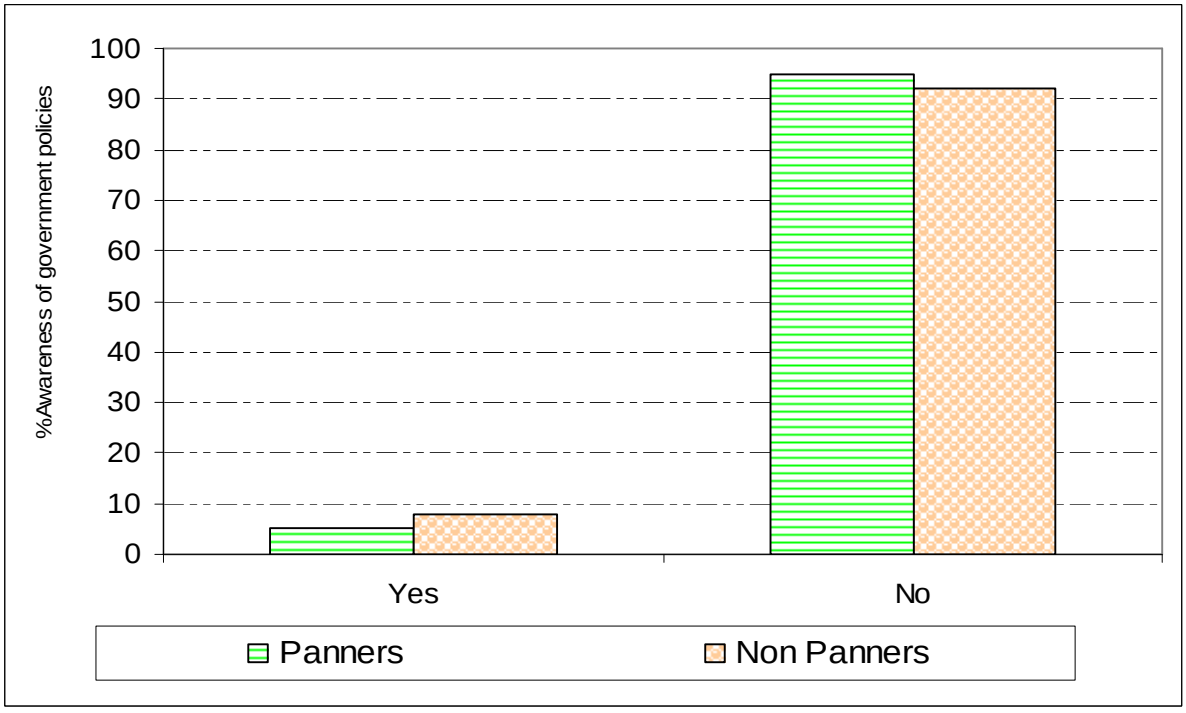
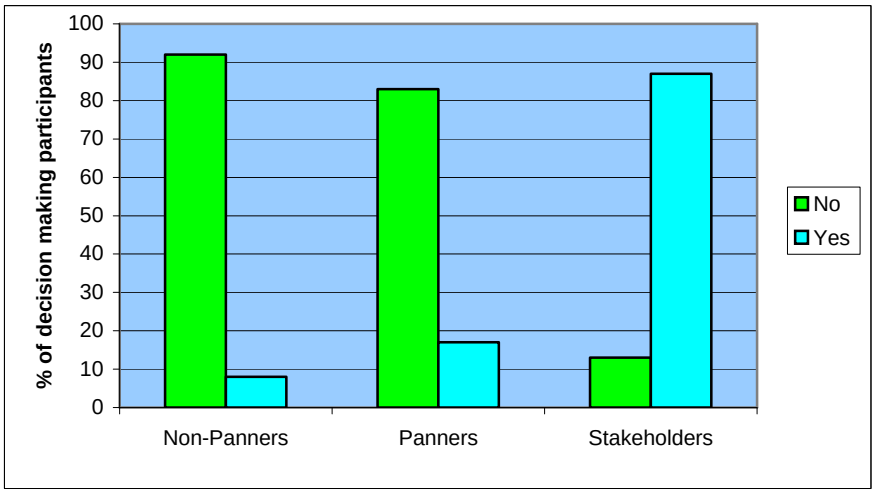
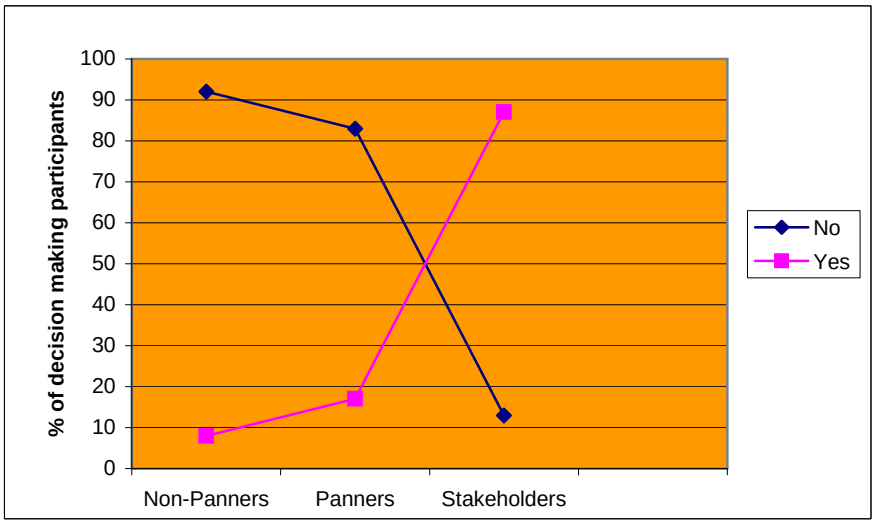


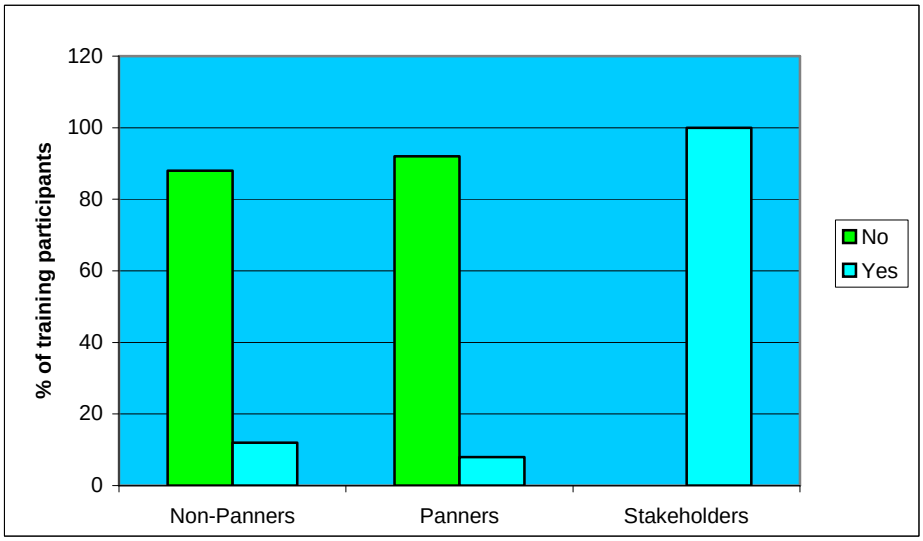
Table 4.9. Awareness on policies

From the look of things the majority of panners and non panners were not aware of the government environmental management and disaster management policies. No wonder why gold panners are immensely contributing to such environmental disasters. Among those that had a clue it happened that they had participated in workshops organized by Environmental Management Authority (EMA) before the government banned the gold panning operations in February 2008. This was either done elsewhere in other districts other than Gwanda. On

comparing data from different camps or sites there is a clear indication that most of the panners and non-panners are not aware of environmental policies that govern the management of such operations. It emerged from the analysis of the interview data that the few who knew migrated from the neighbouring district like Insiza and Esigodini who have undertaken some orientation with their authorities. Most of panners in this district lack such knowledge hence such hazards have been done on the rivers in the district. The same response was made on the training or participation policy-making programmes regarding gold panning. Even campsite leaders did not have any training and some claimed they were making efforts to come up with small mining association so that they can lobby for funding through the Ministry on Small businesses and Indigenization.







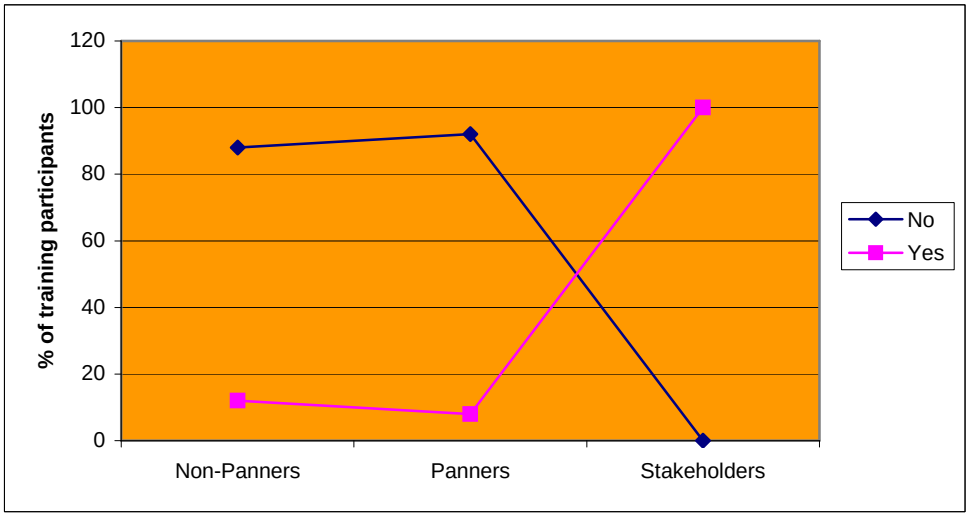


Table 4.10 Responses of panners, non panners and stakeholders who participated in any training in decision making regarding gold panning operations or production.

The table shows that the majority never participated in any training on the decision-making and business skills in gold panning. The environmental disasters they are creating are sheer out of ignorance and lack of training. Only stakeholders comprising of local authorities officials for Environmental Management Authorities and mining organizations have received some training gold mining and processing without endangering the environment through harp hazard and organized gold panning operations. One of the camp leaders interviewed noted that he has never participated in the training and does not need one as this will take too much of

his time and expose him to the authorities who will want to know his operations and how and where he was marketing his gold. Probed further he indicated that he has heard that if he joined or registered with mines they will assess his production and ask him to sell through the Reserve bank which pays very low prices. He also boasted of vast experience he has acquired through the panning without formal training.

In almost five camp sites covered by the study the majority of the panners interviewed had a negative attitude towards training programmes, the reason being that they did not want to be limited to one area of operation or site but to dig anywhere they wanted to without following formal and organized procedures. Organized procedures are safe but they claim that it will reduce their yield as they will be required to adhere to systematic and organized systems of production.

All in all the study established that the ecosystem was at risk due to gold panning which has resulted dangerous open pits all over and siltation of major rivers and pollution of dams. The high risk of HIV/AIDS pandemic due to prostitution as there are a lot of people mainly single and even children at ages around 15 years were seen roaming the camps. There is also need for the authorities to take a pro active role in disaster risk reduction strategies as the physical disasters caused on the landscape are so high.

About 75% of the panners interviewed felt they were better off than before gold panning for many of these reasons.

- It is now easy for them to get money for their household keeping and buying food as one is better with foreign currency than having local currency
- It is better to sell gold at black market than selling to central bank as it does not pay.
- In Zimbabwe all goods and services are pegged at parallel market rates and those panning are better off.
- Salaries for many in industry and public service sectors are very low and someone practicing gold panning is better off,

The estimated number of panners in the Gwanda district during the study period was a least 2 000. This estimate was made by relating the number of panners sampled with the total estimated population of panners at all potential sampling sites and the length of the river along which the panners were located to the total number of panning sites in the sampling frame and total estimated length of all possible "panning river" in the province. The estimate of 2 000 is probably low, because during the time of the survey, many smaller river had dried up too much for effective gold panning. Some of the dried up rivers up rivers showed extensive evidence to previous gold panning activity.

The 2 000 panners should be viewed as a minimum number. More accurate estimation would have required either extensive river surveys (by ground or foot) or aerial photography of the whole province throughout the year. For this study however, a sensitivity analysis was done by doubling the number of panners as a possible maximum and looked at how the economic results change.

From the figure of 2 000 panners, there were 1 428 full time and 672 part time panners. The median gold yields in the week prior to the survey for full time panners were 0,61 grams. Full time panners worked 51 weeks while part time panners worked 27 weeks. Using the results for median weekly gold production, number of full and part-time panners and the weeks of activity for each panner produced 45kgs while part time panners produced another 11kg of gold per year. Assuming 4 200 panners doubles the total estimated gold yield to 111kg.
From observation and review of relevant literature, gold panning as practiced in the study areas, does not generate any environmental benefits.

From the results, roughly 65% of the panners (or 1.365 panners) and their families did not have access to safe water and 88% (or 1 848 panners) and their families were not using a blair toilet. Based on discussions with the appropriate Ministries and other organizations, the average cost of installing a shallow blair toilet could be in the areas of $ 2 600. Each toilet would serve approximately 7 people. Thus for 1 848 panners 264 toilets would be requires at a cost of Z$158 000. If we assume twice the number of panners, these costs double to Z$316 000.

Measuring the Siltation from gold panning is difficult. One reasons lies in the fact that siltation of rivers in the province arises from several sources including gold panning, stream bank cultivation, poor arable crop production methods, overgrazing and deforestation. Even if the study could have measured siltation in the river, estimating the proportion due to gold panning alone would have been very difficult.

The study found that 71% of all trees in the panning sites were damaged, although there is no way to estimate the proportion of damage due to gold panners alone. Another survey would need to be done in the future to quantify the change in woodland cover over time.

Chapter 5
Summery,conclusions and recommendations

5.1 Introduction

The chapter presents the summary, conclusion and recommendations of the study on the Environmental damages caused by gold panning in Gwanda district. The summary and conclusions are gleaned from the findings of the study as presented by the panners, non panners and the stakeholders who include the local authorities, environmental management authority and mining authorities in the Gwanda district. On the bases of the findings some recommendations are presented to provide guidelines to policy makers, environmental management authorities, and potential stakeholders in disaster risk management.

5.2 Summary

The summary of the research is an accurate restatement of materials presented in a condensed form to provide the reader with a general perspective. Seaman (1987), has it that the research report is a written or spoken communication that informs the audience about the research findings and procedures with summaries providing the key findings of the study.

The current study set out to establish the major environmental damages caused by gold panning in Gwanda district. The major justification for choosing the research topic was to expose the negative and damages caused by illegal gold panning activities in Gwanda district, with a view to provide a baseline information for the effective management of the environmental management and disaster management strategies in the region. Also the study was undertaken to provide the mitigatory strategies in order to curtail the impacts of gold panning and the associated disasters. In carrying out the study, the study made use of the sub problems, which provided some guidelines in the research process. Environmental damages resulting from gold panning, like siltation of rivers, deforestation, soil erosion, land degradation, water aquatic based food chains destruction, water pollution and environmental damages and costs are outlined in the discussions. Data gathering techniques involved the use

of face-to-face interviews, questionnaires and observations among other research instruments. In the process of gathering some information, issues related to social effects of gold panning were also presented through the aforesaid techniques. These among other provided some conflicts over claim ownership among gold panners, poor sanitation facilities in the panning sites, high crime rates and the general spread of HIV/AIDS, as a result people over crowding in the bush without proper monitoring structures on behavior change and also monitoring the operations of their mining activities. These findings are presented according to their sources of information, which brings about the accuracy of the information gathered.

5.2.1 Environmental damages as seen by gold panners.

The majority of the panners noted that they were aware of the environmental damages caused by gold panning while majority were not aware of the impact of gold panning to the environment and the study established that gold panning in Gwanda district has resulted in disasters such as high levels of rivers and dams siltation, deforestation, severe soil erosion, land degradation along river beds and the destruction of aquatic based food chains destroyed due to water pollution and contamination due to chemicals such as mercury and cyanide affecting aquatic life and other water users down the stream.

The study also collected data on the forestry and noted that there are high incidences of deforestation surrounding the gold panning sites. The study found that 71% of the trees in the panning sites were damaged although it was not possible to estimate the proportion of damage due to gold panning.

The majority of the panners also noted that their operations were a serious health hazard given the conditions they were operating in. The study also noted that there were cases of people being trapped in disused mines or dug pits and a sad one happened during research where three men got into the disused mine and made fire for light and cooking and were drowsed by gases suspected to be carbon monoxide and died in there.

5.2,3 Environment damages as seen by stakeholders

The stakeholders comprise of the district council, Natural Resources Board and the Environmental Management Authorities and the Mining Authority. These were the key informants who provided fundamental information on gold panning and its effects on the environment and that it has caused serious disasters in the district especially on the physical environment.

Among the noted disasters was the uprooting and cutting down of indigenous tress that take too long to grow and exposing the soil to erosion and the hazardous use of chemicals that affect the ecosystem and that the rivers where these practices are taking place are sources of water for the communities and for the town of Gwanda hence posing a threat to life of several people.

The stakeholders also noted that there is loss of life every year in the sites either people being trapped in disused mines or trenches and that the rescue for such incidences are difficult and costly as there is no equipment or man power to undertake such exercises due to brain drain and economic hardships. Water pollution and contamination due to chemical usage has affected the vegetation and aquatic life so that some water species would be difficult to be seen and their habitation destroyed.

5.2.4 Environmental as seen by non panners

Non panners included people who were found by the researcher settled in the area but not involved in the panning activities and those living in the communities surrounding the panning sites. Also some were people who had visited the area to sell wares and some were family members of panners or boyfriends and girlfriends of panners and some had come to associate with the panners. All these people were able to identify the damages caused by this activity. The major damages identified were deforestation, water pollution, and some social impacts like the spread of disease due to lack of health hazards associated with squatter camps, like the spread of HIV/AIDS.

Non panners noted that tree cuttings and up rooting were the major damages along the rivers and that there were so many open trenches along the river and these could a death trap for

people and animals. The other hazard the non panners note was the dust storms experienced in winter which might affect the panners and their families. The problem was further compounded by lack of trees and vegetation around the panning sites and the squatter camps.

All in all, the study established that gold panning in Gwanda was a pose for a serious disaster in the area of water management due to dam and river siltation and the general water pollution in the major water sources due to use of chemicals and use of water in the processing of gold. Gold panning has resulted in digging up of channels and the banks as well as well as other surface trenching using picks and shovels resulting in an unknown and unfamiliar geographical features. In some cases the panning process requires the stripping of the overburden to expose the mineral horizon leaving deep dangerous trenches on the surface. The noticeable effects of these operations are some soil loosened and left to piled up adjacent the river banks with open pits and trenches all over the surface. The researcher feels that such loose soil is washed back into the river and cause siltation of the water sources thereby reducing the storage capacities of water facilities.

Poor water quality is also realised as a result of water pollution due to use of water which is disposed into rivers resulting into water getting muddy and in some cases contaminated by some toxic substances like cyanide and mercury.

5.3 Recommendations

In light these research findings and conclusions, the study recommends that the following measures to be taken to avoid further disasters.

5.3.1.

It should be realised that gold panning is classified under small scale gold mining and is largely poverty driven and harsh economic demands which would require a coordinated and collaborative approach from all stakeholders that are geared towards poverty alleviation in the region

.

5.3.2

Different ministries involved on land issues and usages and the national economists should come together and draft an operational document governing mining operations. The draft should come up with resolutions and solutions to the problem of gold panning and it should include all interested parties that is Ministries of Tourism and Environment, Water resources, Rural Development and local government, Agriculture, Health, Economic development and the Mines Authority.

5.3.3

Given availability of resources, which are always scarce from the economic point of view, the coordination efforts should be made to provide training and development programmes in issues resulting to gold panning basing on the assumption that gold panning in Zimbabwe become a viable economic activity and a potential source of income for most rural families. It is therefore necessary to provide a capacity building for people involved in gold panning.

5.3.4

There is need for educationist, environmentalist and other interested stakeholders to have a keen interest in the operations of gold panning so as to address the problems created by such operations. This could be done through the press and project assessments, seminars to alert gold panners on the need and importance of protecting the physical environment.

5.3.5

Where possible gold panners and non panners living in some camps within the sites should be made responsible for the rehabilitation of the environment that they would have damaged.

5.3.6

The Gwanda rural District Council authorities together with Environmental Management Authorities should come up with specific rules and regulations governing the operations of mining in the district. Mining permits should be issued by the local authority to trained people in the district and such people should be given claims or permits after the area has undergone impact assessment. The claim owners should also be trained in disaster risk reduction

strategies. Mitigation as a measure of disaster risk reduction strategy should also be incorporated into the trainings.

5.3.7

Gold panning should be restricted to mature and responsible people that is above the age of 18 years. The law should restrict panning in areas that are not designated to mining and the issue of squatter camps near rivers and dams discouraged and stopped.

While some of these recommendations may be bold and strict to the panners the researcher believes they will reduce a serious disaster in the district. Such statutes will assist in arresting the negative impacts resulting from gold panning on the physical environment.

It should however be noted that gold panning as a poverty and harsh economic driven activity can not be done away with in a day. It also plays a vital role in complementing food supplies and incomes to rural families.

In addition gold panning could also provide employment to the majority of rural folks and a viable gold panning operation in an area will also stem the common rural and urban drift and also contribute to food security. There is need of a concerted national effort to remove the negative side of things on gold panning that hinders the smooth development of the sector. Efforts need to be made to curtail all gold panning operations, which are creating a disaster to people's lives and the physical environment or the ecosystem.

5.3.8

The panners should re vegetate all areas they would have worked on and backfill all open areas and rip compacted surface areas. All responsible government departments should be allocated responsibilities so that they are able to monitor the gold extraction activities. This is because negative impacts out number the positive impacts and it is clear that to bring about sustainable development of the mining industry a commitment has to be made by both the miners and the stakeholders.

5.4 Mitigation measures

There is need for mitigation measures to protect the environment and the people down stream. There is need to control all activities and to register the panners and draw regulations that will guide operations. Avoid blasting and any other related noises and vibrations at night as this disturb people and animals. All archaeology/cultural artefacts discovered to be reported to the National Museums and Monuments. All working areas to be fenced off, to avoid animals and unauthorised people.

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Appendices

APPENDIX 1

NON PANNERS QUESTIONEIRE

QUESTIONNAIRE ID: District Code |__|__| Number |__|__|

DATE OF COMPLETION: _____/_____/2008
dd mm

Introduction

My name is Dumile Bhebhe; I am currently studying for a Masters Degree on Disaster, Risk Management at the University of Free State and carrying out a research. You have been selected from other villages to help provide your views about gold panning. The information that you provide will be used for academic purposes. This survey is voluntary and the information you give will be confidential. Please feel free, as no names will be quoted on the production of the document.

1	Indicate your sex	Male Female
2	Marital Status	Married Single Widowed Divorced Other specify……
3	Indicate your age	10 – 15 years 16 – 21 years 22 – 27 years

		28 – 33 years Above 34 years
4	Indicate your qualification	Grade 1 – 5 6 – 7 Form 1 – 4 5 – 6 Diploma……. Degree……. Other specify…….
3	How does people earn a living in this area ?	Gold panning Irrigation Casual labour Sell of livestock/crops Other specify……..
6	Do you think gold panning has had some adverse effects on the physical environment?	Yes No
7	Please explain your answer in number 6	…… ……..
8	How long have you lived in this area?	0 – 5 years 6 – 10 years 11 – 16 years 17 – 21 years Over 22 years
9	Do you think gold panning is an alternative way of generating income for the households?	1 Agree 2 Strongly agree 3 Do not agree 4 Strongly do not agree 5 Not sure

		Please explain,,,,,,,,,,,,,,,,,,,,,,,,,
10	Do you think households are into panning as ameans of earning a living?	Yes No Please explain…………………..
11	Gold panning in Gwanda district has seriously damaged the rivers?	Yes No Please explain,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
12	For how long has been gold panning taking place?	0 – 3 years 4 – 7 years 8 – 11 years More than 12 years
13	What do you think prompted gold panning?	Lack of employment Lack of household food Lack of other commitments Desire for quick money
14	Do you think gold panning has contributed to river siltation?	Yes No
15	Which of the following do you think are the effects of gold panning in your area?	1 River siltation 2 Soil erosion 3 Deforestation 4 Losses and modification of soils
16	Prevalent of HIV/AIDS in the area can be attributed to large numbers of people living along the river banks, give your answer in a scale of 1 – 5	1 2 3 4 5 Low High
17	What do you suggest should be done to reduce gold panning along river banks?	1 Provide descent means of mining 2 provide permits 3 Arrest all panners Other specify,,,,,,,,,,,,,,,, Designate all mining areas
18	In your own opinion what do you think has been the major effects of gold panning?	1 ,,

		2 ,, 3,, 4,,
19	What do you think should be done to reduce illegal gold panning in the area,	1…… 2 ,, 3,, 4,,
20	What do you think can be done to save our rivers from gold panning?	1,, 2,, 3,, 4,,

APPENDIX 2

PANNERS QUESTIONEIRE

QUESTIONNAIRE ID: District Code |__|__| Number |__|__|

DATE OF COMPLETION: _____/_____/2008
dd mm

Introduction

My name is Dumile Bhebhe; I am currently studying for a Masters Degree on Disaster, Risk Management at the University of Free State and carrying out a research. You have been selected from other villages to help provide your views about gold panning. The information that you provide will be used for academic purposes. This survey is voluntary and the information you give will be confidential. Please feel free, as no names will be quoted on the production of the document.

1	Indicate your sex	Male Female
2	Indicate your marital status?	1 Married 2 Single 3 Widowed 4 Divorced
3	Are you fining the work of gold panning suitable for women?	1 Yes 2 No Please explain……
4	Indicate your age	1 Below 17 years 2 18 – 27 years 3 28 – 37 years 4 38 – 47 years 5 Above 48 years
5	Indicate your qualification	1 Grade seven

		2 Junior Certificate 3 Ordinary Level 4 Advanced Level 5 Degree 6Ohter specify……
6	How many years have you been in this operation?	1 0 – 5years 2 6 – 10years 3 11 – 15 years 4 16 – 20 years 5 21 and above
7	What prompted you into gold panning?	1 income 2 lack of employment 3 severe droughts 4 Other specify……..
8	Are there any environmental damages caused by gold panning?	1 Yes 2 No Specify……..
9	Are you aware of government policies that regulate gold panning?	1 Yes 2 No Please explain…….
10	Have you participated in any training or decision making on gold panning?	1 Yes 2 No
11	Do you think you are using proper methods in gold extraction?	1 Yes 2 No Please explain……
12	Is it important to have environmental knowledge and skills in gold panning?	1 Yes 2 No Why?
13	Are you aware of any dangers of using chemicals in gold panning?	1 Yes 2 No
14	Are you authorized to do gold panning?	1 Yes 2 No Please explain……
15	Do you enjoy your operations?	1 Yes 2 No
16	Do you have proper chemical strategies?	1 Yes 2 No Please explain…….
17	What do you think should be done to reduce environmental damages caused by gold panning?	1 Training 2 Proper management of gold panning activities 3 Other specify……
18	What do think local authorities should do to enhance your operations?	1 Provide sites for panning 2 Issue permits 3 Provide loans 4 Other specify……..
19	What are the effects you have suffered in your operations?	1 Deaths 2 collapse of the shafts 3 Arrests 4 Other specify..

20	Give an alternative venture you will undertake if you abandon gold panning	1 Farming 2 Fishing 3 Carpentry 4 Other specify……

APPENDIX 3

STAKEHOLDERS QUESTIONEIRE

QUESTIONNAIRE ID: District Code |__|__| Number |__|__|

DATE OF COMPLETION: _____/_____/2008
dd mm

Introduction

My name is Dumile Bhebhe; I am currently studying for a Masters Degree on Disaster, Risk Management at the University of Free State and carrying out a research. You have been selected from other villages to help provide your views about gold panning. The information that you provide will be used for academic purposes. This survey is voluntary and the information you give will be confidential. Please feel free, as no names will be quoted on the production of the document.

1	Indicate your sex	Male Female
2	Indicate your marital status?	1 Married 2 Single 3 Widowed 4 Divorced
3	How long have you been in this organization?	1 0 – 5 years 2 6 – 10 years 3 11 – 15 years 4 16 – 20 years 5 21 and above 3 Other specify……
4	Indicate your age	1 Below 17 years

		2 18 – 27 years 3 28 – 37 years 4 38 – 47 years 5 Above 48 years
3	Indicate your highest qualification?	1 Grade 7 2 ZJC 3 “O” Level 4 “A” Level 5 Diploma 6 Degree 7 Other specify
4	How many years have you been in this operation?	1 0 – 5years 2 6 – 10years 3 11 – 15 years 4 16 – 20 years 5 21 and above
5	What is your position in the organization?	1 Supervisor 2 Manager 3 Trainer 4Blaster 5Other specify
6	How do you allocate panners’ sites?	1 Vetting of applications 2 Through council board 3 By advertising 4 Other specify
7	Do you have specific laws governing operations of gold panning?	1 Yes 2 No Explain your answer……..
8	Do you have structures of follow up on your laws and regulations as the responsible authority?	1 Yes 2 No Please explain……..
9	Do gold panners pay any levies/taxes to responsible authorities?	1 Yes 2 No Please explain……..
10	What is the money paid by panners used for by authorities?	1 Paying council workers 2 Maintain infrastructure 3 general purpose fund 4 Other specify……
11	Do you provide some trainings to panners?	1 Yes 2 No If yes how often?.....
12	How often do you provide training to panners?	1 Once a month 2 Once in three months 3 Once in 6 months 4 Once a year 5 Other specify……
13	Are the trainings effective enough to provide knowledge and skill?	1 Yes 2 No Please explain your answer……..
14	Who is responsible for trainings?	1 Mine Commissioner

		2 Geologist 3 Other panners 4 Chief Executive officer 5 Environmental Management Authority
15	What type of training is provided?	1 Environmental management 2 Management and supervision of mining activities 3 Mining skills 4 Panning methods 5 Other specify……..
16	Do you think gold panning has some serious effects on the the physical environment?	1 Yes 2 No Please specify……..
17	What do you think should be done to reduce the effects of gold panning on the environment?	1 Provide training 2 Arrest all panners 3 Supervise all panning activities 4 other specify…….
18	Does gold panning have negative effects on people's lives?	1 Yes 2 No 3 Please specify……..
19	Do you think the spread of HIV/AIDS is due to ramped gold panning activities in the area?	1 Yes 2 No Please specify…….
20	Do you think gold panning have some positive effects on peoples' lives?	1 Yes 2 No Please specify….
21	Do the following have any effects to people's lives< give your answer as yes/ no	1 Chemical poisoning 2 Land degradation 3 Air pollution
22	Do you provide any monitoring for gold panning?	1 Yes 2 No 3 Please explain…….
23	Do you have any strategies to address effects of gold panning?	1 Yes 2 No
24	Please explain your response in question 23	…… ……
25	What do think are the effects of gold panning to	a)Local communities…… b) physical environment……
26	In your opinion do you how can be gold panning effects be reduced?	1…… 2…….. 3……
27	Are panners involved in policy formulation?	1 Yes 2 No Explain your answer……