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Examining Socio-environmental Impacts of Illegal Gold Panning in Gwanda District, Matabeleland South, Zimbabwe

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Illegal gold panning has become a significant socio-environmental challenge in Gwanda District, Matabeleland South, Zimbabwe. The study objectives are to examine the socio-environmental impacts of illegal gold panning activities, focusing on the detrimental effects on the natural environment, local communities, and the overall socio-environmental structure of the district as well as to evaluate the strategies implemented to regulate or mitigate illegal gold panning in Gwanda District and assess their effectiveness. The research is guided by the understanding that while illegal gold panning provides livelihood opportunities to many rural residents due to high unemployment and poverty rates, it also leads to severe environmental degradation and socio-economic disruptions. This study employs a mixed-method research approach, utilizing a case study design. Data was collected through questionnaires, interviews, and field observations from

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key stakeholders, including gold panners, local residents, officials from the local authority, the Environmental Management Agency (EMA), and representatives from the government. A total sample of 160 respondents participated in the study, with 150 representing gold panners, mine owners, and local residents, and 10 serving as key informants. The findings of the study indicate that environmental impacts include deforestation, soil erosion, siltation of rivers, and the contamination of water bodies with mercury and other toxic chemicals used in gold extraction. These activities threaten biodiversity, reduce agricultural productivity, and undermine water security for both domestic and agricultural use. The social consequences of illegal gold panning are equally alarming. It exacerbates conflicts over land use, increases crime rates, and creates unsafe working conditions that often lead to injuries or fatalities. Moreover, while it has both positive and negative impacts on the livelihoods of community members, the lack of regulatory oversight fosters the growth of informal markets and encourages criminal activities such as theft and corruption. These issues undermine local governance and law enforcement efforts, further complicating the socio-economic landscape of the region. The findings reveal a complex interaction between poverty-driven survival strategies and the urgent need for sustainable natural resource management. These findings have significant implications for policy formulation and development strategies in Zimbabwe's mining sector. The research concludes that illegal gold panning in Gwanda District has caused significant environmental and social damage. To mitigate these negative impacts, a multi-faceted approach is necessary, including the formalization of artisanal mining, strict enforcement of environmental regulations, and the provision of alternative livelihood opportunities for local communities. The study underscores the importance of balancing socio-economic needs with environmental sustainability to protect the region's natural resources while supporting the well-being of local communities.

Keywords: Socio-environmental impacts; illegal gold panning; Gwanda district; alternative livelihoods.

1. INTRODUCTION

Gold panning has long been a significant environmental concern in Zimbabwe, with its negative impacts exacerbated in recent years by recurring droughts. These harsh climatic conditions have pushed more people to engage in illegal gold panning as a means of generating income. Since Zimbabwe's independence in 1980, gold panning along its major rivers has proliferated, contributing to environmental degradation. The country has experienced an increase in informal gold panning activities driven by several socio-economic factors, including high unemployment rates, widespread poverty, and the diminishing returns from peasant agriculture due to poor harvests. These conditions have left many Zimbabweans, especially in rural areas, with limited livelihood options, leading to a "gold rush" phenomenon (Mkodzongi and Spiegel 2019).

Unemployment following massive job losses in formal industries, a high percentage of school dropouts, and worsening agricultural yields due to climate variability have contributed to the growth of this informal mining sector (Spiegel 2015). This surge in illegal mining activities has been particularly evident in regions such as Gwanda District, where gold deposits have attracted job seekers from across the country, as the discovery of gold in an area leads to an influx of people hoping to earn an income (Bhebhe et al., 2013). Communities such as Matshetsheni, West Nicholson, and Collen Bawn have been heavily affected by these activities, which often occur without regulatory oversight.

Gold panning in Zimbabwe is driven by multiple factors, including a struggling economy, reduced agricultural yields due to drought, and the pursuit of basic living conditions. While gold panning offers an economic lifeline for many, it is widely regarded as more of an environmental threat than a sustainable economic activity (Sunga and Marinda 1998). Small-scale miners utilize various techniques, ranging from riverbank panning to open-pit mining. These activities, concentrated around rivers, abandoned mines, and dams, have significantly compromised water availability for domestic use, livestock, and irrigation. One of the most severe environmental impacts is siltation, while open-pit mining poses risks of injuries and fatalities, with some miners trapped in abandoned pits or being victimized by crime in remote areas. The illegal mining activities have drastically altered the physical geography of the region. In Gwanda District, this issue not only affects local communities but has regional implications, as neighboring areas rely

on water from rivers flowing through Gwanda. Despite efforts to mitigate the problem, the persistence and worsening of illegal mining raise concerns about the effectiveness of current interventions. This study seeks to examine the socio-environmental impacts of illegal gold panning on these communities, focusing on both the environmental degradation caused by mining operations and the broader socio-economic consequences on the livelihoods of residents. Understanding the implications of illegal gold panning is crucial for formulating sustainable management strategies that balance the need for economic survival with environmental conservation (Maponga and Mutemererwa 1995).

Illegal gold panning in Gwanda District, has escalated in recent years, driven by socio-economic pressures such as high unemployment, poverty, and declining agricultural productivity due to recurrent droughts. While gold panning serves as a vital source of income for many residents, it poses significant socio-environmental challenges. Despite various efforts to control illegal mining, the problem persists, raising concerns about the sustainability of local livelihoods and the long-term environmental consequences for Gwanda and its neighboring regions. This study aims to explore the socio-environmental impacts of illegal gold panning in Gwanda District and assess the effectiveness of current strategies in addressing these issues. The study aims to answer these questions: What are the key socio-environmental impacts of illegal gold panning in Gwanda District? What strategies have been implemented to regulate or mitigate illegal gold panning in Gwanda District, and how effective are they? Which alternative livelihood options could be introduced to reduce reliance on illegal gold panning in the region?

2. DESCRIPTION OF THE STUDY AREA

Gwanda District is situated in Matabeleland South Province, in the southwestern part of Zimbabwe. It covers approximately 47,000 square kilometers and is predominantly rural, with an economy largely based on mining and agriculture. The district is located about 120 kilometers southeast of Bulawayo, the second-largest city in Zimbabwe. The area falls under agro-ecological zones IV and V, which are characterized by low and erratic rainfall patterns, typically ranging between 450mm and 650mm per year Mugandani et al., 2012. These semi-arid conditions make the area prone to droughts, limiting agricultural productivity and pushing many residents into alternative livelihoods such as illegal gold

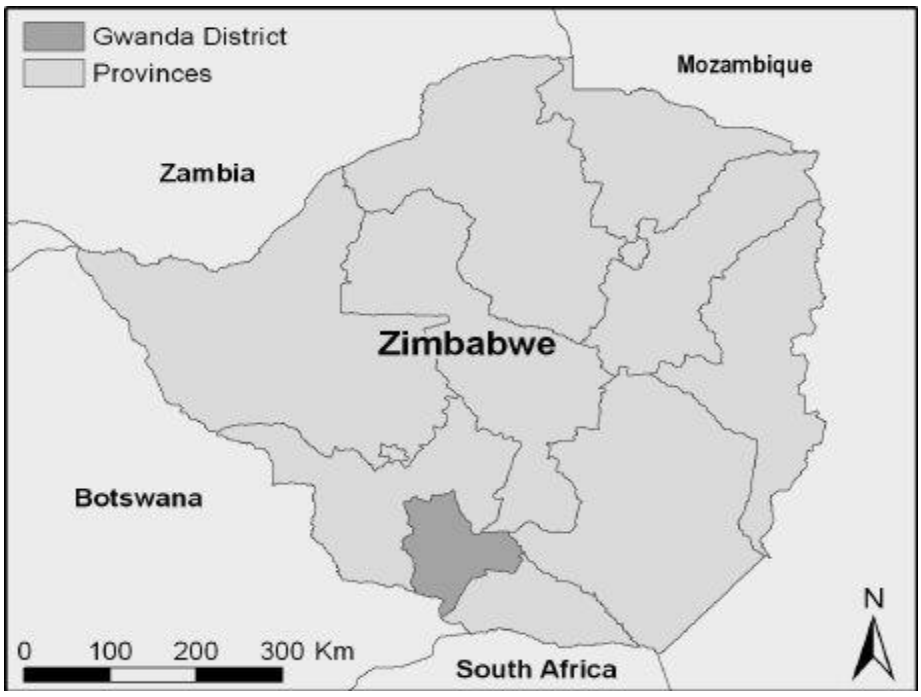

Fig. 1. Map showing the location of Gwanda district in Zimbabwe. Source: Bhebhe D., Kunguma O., Jordaan A. and Majonga H. (2013)

panning. Gwanda is rich in mineral resources, particularly gold, which has made it a hotspot for both formal mining operations and informal, small-scale gold panning activities. Matshetsheni, West Nicholson, and Collen Bawn are among the areas within the district where illegal gold panning is concentrated, often along riverbanks and abandoned mines. The Umzingwane and Tuli rivers flow through these areas, providing water for both domestic and agricultural use, but they are increasingly affected by siltation and pollution due to gold panning activities (Dube et al., 2016). Fig. 1 shows the location of Gwanda district in Zimbabwe.

The topography of Gwanda consists of gently undulating plains interspersed with rocky outcrops and hills, which are conducive to mining operations. The district's soils are generally shallow and infertile, making it difficult for agriculture to thrive, especially during prolonged dry periods (Mupakati and Tanyanyiwa 2017). Consequently, illegal gold mining has become a significant economic activity, despite its detrimental socio-environmental impacts, including deforestation, land degradation, and water pollution. The population of Gwanda District primarily comprises rural communities engaged in subsistence farming and livestock rearing. However, recurring droughts and limited economic opportunities have driven many people, especially the youth, into illegal gold panning as a source of livelihood. This shift has had far-reaching socio-environmental consequences, particularly in terms of environmental degradation and resource depletion (Matsa and Muringaniza 2010).

3. METHODOLOGY

This section outlines the research design, data collection methods, sampling techniques, and data analysis procedures used to investigate the socio-environmental impacts of illegal gold panning in Gwanda District, Matabeleland South, Zimbabwe. The study adopted a mixed-methods approach, integrating both qualitative and quantitative data. This approach allows for a comprehensive analysis of the socio-environmental impacts of illegal gold panning by combining numerical data with in-depth insights from community members and stakeholders. A case study design was employed to provide a detailed exploration of the impacts in the specific areas of Matshetsheni, West Nicholson, and Collen Bawn. In all the fields, the need for case studies comes from the desire to understand complex social phenomena (Yin 2009). This design was chosen because it enables an in-depth understanding of complex socio-environmental issues within a specific context (Creswell 2014). The case study research provides great strength in investigating units consisting of multiple variables of potential importance and it allows investigation to retain a holistic view of real-life events, such as impacts of gold panning on the environment (Merriam 2009).

Primary and secondary data were collected for the study. Primary data collection involved structured questionnaires, interviews, and field observations, while secondary data were obtained from relevant literature, government reports, and environmental studies. Structured questionnaires were administered to a random sample of 150 respondents, including gold panners, local residents, and small-scale miners. The questionnaires contained both closed and open-ended questions to gather information on the socio-economic benefits of gold panning and the environmental challenges associated with it (Bryman 2012). Semi-structured interviews were conducted with key informants, including local government officers, Environmental Management Agency (EMA) officers, and representatives from non-governmental organizations (NGOs) working on mining. These interviews provided deeper insights into the institutional responses to illegal gold panning and its impacts on communities (Kumar 2011). Direct field observations were conducted in the affected areas to document the physical environmental impacts of gold panning, such as siltation, deforestation, and riverbank erosion (Cohen et al., 2011). Relevant secondary data were sourced from government reports, research articles, and environmental assessments to provide context and support for the primary data. These included reports from the Environmental Management Agency (EMA), local council records, and academic publications on gold mining in Zimbabwe (Dube et al., 2016).

The study employed both probability and non-probability sampling methods. Stratified random sampling was used to select participants for the questionnaires, ensuring representation from different stakeholder groups, including gold panners, residents, and small-scale miners. The study area was divided into three strata: Matshetsheni, West Nicholson, and Collen Bawn. From these three areas the researcher

selected 10 small scale gold mines and then from those selected mines, 15 participants from each mine were randomly chosen so that all areas are represented in the study, giving to a total of 150 respondents who were given questionnaires. For the interviews, purposive sampling was used to select key informants based on their knowledge and involvement in environmental management and mining activities in the district. Ten key informants were interviewed, including local government officials, environmental officers, and NGO representatives (Patton 2002). A sample size of 160 participants was determined using Krejcie and Morgan's (1970) formula for sample size determination. Purposive sampling was chosen because it is a process by which sample population is acquired through the discretion given to a particular group or individuals of the population by the researcher because they hold information of the target population that is required by the researcher (Patton 2002).

Quantitative data from the questionnaires were analyzed using descriptive statistics, including frequency distributions, percentages, and means. The Statistical Package for the Social Sciences (SPSS) was used to process and analyze the data. Qualitative data from interviews and field observations were analyzed thematically. This involved coding and categorizing the data into key themes, such as socio-economic benefits, environmental degradation, and community perceptions of gold panning (Braun and Clarke 2006).

In conducting the research, ethical clearance was obtained from relevant authorities in the Gwanda District. Participation was voluntary, and informed consent was obtained from all respondents. The confidentiality and anonymity of respondents were maintained throughout the study (Resnik 2018).

4. LIMITATIONS OF THE STUDY

While this study provides valuable insights into the socio-environmental impacts of illegal gold panning in Gwanda District, Matabeleland South, several limitations must be acknowledged to present a balanced perspective. One of the challenges faced by the researcher was that of sampling bias. Given the informal nature of illegal gold panning, it was challenging to obtain a fully representative sample of all gold panners in the district. Many panners operate clandestinely due to the illegal status of their activities, which may have led to some reluctance in providing detailed or honest responses. This could have introduced bias in the data collection process. The other limitation was that the study was conducted over a relatively short period, which may not have allowed for the observation of long-term environmental impacts such as seasonal changes in river siltation or biodiversity loss. Longitudinal studies would offer more comprehensive insights into these evolving impacts. In addition to the above, the study focuses specifically on Gwanda District, while the findings may offer lessons applicable to other regions, the socio-economic and environmental conditions in this district are unique. As a result, the conclusions drawn may not be fully generalizable to other districts facing similar challenges. Furthermore, lack of longitudinal data was another challenge. This simple means that the research was conducted at a single point in time, limiting the ability to assess long-term trends in environmental degradation or socio-economic changes. A longitudinal approach would be more effective in analyzing the full extent of illegal gold panning's impacts.

Despite these limitations, the study provides a critical foundation for understanding the socio-environmental consequences of illegal gold panning in Gwanda District and offers a basis for future research and policy interventions.

5. RESULTS AND DISCUSSION

The study established that most of the gold panners have more than twelve years of gold panning experience. One of the panners noted that he was a senior ‘’ Tsheketsha” 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. Most of the gold panners involved in the discussions indicated that they preferred panning than formal employment because on good days they can make a lot of money. Most of them indicated that they are now experienced in their operations such that they sometimes do not realize how difficult it is to do their daily digging routines.

5.1 Land Degradation

The study found that illegal gold panning has led to significant land degradation in Gwanda District. Over 85% of respondents indicated that gold panning activities, particularly open-pit

mining and riverbank excavation, have destroyed large areas of land. About 80% of trees in the gold panning sites were damaged and deforestation was acting as a desertification catalyst causing siltation in nearby rivers. Key informants corroborated this, highlighting that land degradation is evident in abandoned pits and eroded riverbanks. Table 1 presents respondents' perceptions regarding the extent of land degradation resulting from illegal gold panning activities across various sites within the district. Among the gold panners interviewed, 80% acknowledged that the environmental damage was severe, while only 20% perceived the damage as minimal. Both local residents and key informants unanimously agreed (as shown in the Table 1 that those interviewed 100% said the degradation is severe) that gold panning has led to significant environmental degradation. Despite widespread awareness of the severe impact on the environment, gold panning persists due to various socio-economic factors, particularly as panners rely on these activities for their livelihoods.

From observations made, about 80% of the operations are open casts or shallow pits less than 30m deep and there are left uncovered and unprotected. Key informants explained that illegal gold panners often abandon the pits they dig, leaving the land scarred and unsuitable for agricultural or grazing purposes. Open pits are a risk to animals as well as other minor children who would be herding their livestock nearby. The study also found out that most of the dams were silted and in most of the rivers, that is, Umzingwane River near West Nicholson and small rivers in the Matshetsheni area, it is not economically viable to construct new dams because of the extent of damage caused by gold panning activities. It was also observed that dried rivers showed extensive riverbed damage due to previous gold panning activities. The Environmental Management Agency (EMA) officials interviewed noted that efforts to rehabilitate these areas have been insufficient due to lack of resources and enforcement challenges. They also emphasized that illegal gold mining will remain a threat to the environment especially if panners are not registered so that their activities would be regulated.

5.2 Water Pollution

Illegal gold panning has also severely impacted water sources in the Gwanda District. About 90% of the respondents reported that rivers and dams in the area have been polluted by siltation and chemicals used in gold extraction. Mercury and other toxic chemicals that are used to extract gold from ore are often carelessly disposed of in rivers, leading to the contamination of water bodies with hazardous materials. Mercury, in particular, poses a long-term threat as it accumulates in the food chain, affecting both aquatic life and the health of local populations dependent on these water sources. Additionally, the digging and washing of gold-bearing soil directly in rivers result in high levels of sedimentation, making the water murky and unfit for consumption or irrigation. Riverbanks, especially in Umzingwane river are eroded, and silt has reduced water quality and availability. The heavy presence of suspended particles in the water increases the risk of waterborne diseases and renders the water unsuitable for agricultural purposes, particularly irrigation, which is critical in this semi-arid region. Key informants, including EMA officials and local leaders, emphasized that the contamination of water sources poses a major threat to the livelihoods of residents who rely on these rivers for domestic use, irrigation, and livestock watering. This has prompted concern among local communities and environmental authorities, who emphasize the need for stringent measures to control panning activities and protect water resources for future generations.

5.3 Impacts on Biodiversity

The study also revealed that illegal gold panning activities have significantly impacted local biodiversity. More than 80% of the respondents noted a noticeable decline in plant and animal species in areas where gold panning is prevalent. Deforestation, caused by the clearing of vegetation to access gold deposits, has been a major contributing factor to the loss of biodiversity. Table 2 presents respondents' perceptions regarding the impact of illegal gold panning activities on biodiversity. Approximately 65% of the gold panners acknowledged a decline in biodiversity at the panning sites. Similarly, 85% of local residents concurred, reporting noticeable reductions in biodiversity. Moreover, 90% of mine owners and key informants expressed agreement, emphasizing the significant loss of biodiversity in areas affected by gold panning.

Table 1. Perception of Land Degradation Due to Illegal Gold Panning

Respondents	Severe Degradation	Minimal Degradation
Illegal Gold Panners (n=80)	80%	20%
Local Residents (n=40)	100%	0%
Mine Owners (n=30)	80%	20%
Key Informants (n=10)	100%	0%

Table 2. Perceived Impact on Biodiversity

Category	Percentage Reporting Decline in Biodiversity
Illegal Gold Panners	65%
Local Residents	85%
Mine Owners	9%
Key Informants	90%

Furthermore, gold panners in West Nicholson, Collen Bawn, and Matshetsheni areas often clear large tracts of land to access gold-bearing soil and riverbeds, removing vegetation and cutting down trees in the process. This practice results in the destruction of forest ecosystems and disruption of natural habitats. Deforestation is particularly severe along riverbanks, where gold panning activities intensify, leading to soil erosion and increased vulnerability to flooding. From the observations done, in West Nicholson, the extent of deforestation is visible through large areas of cleared woodland, especially near riverbanks and abandoned mining sites. In Collen Bawn and Matshetsheni, the forest cover has been drastically reduced, exacerbating soil degradation and reducing the availability of forest resources for local communities who rely on them for firewood and building materials. The loss of vegetation in these areas has also affected local water sources, as trees play a crucial role in maintaining water cycles and preventing soil erosion. Without adequate tree cover, the land becomes more prone to desertification, which further exacerbates the environmental challenges already faced by these communities. Key informants highlighted that the removal of vegetation has not only affected plant species but also disturbed wildlife habitats, leading to a decline in animal populations. Species such as small mammals and birds, which depend on riverine ecosystems, have been most affected. Moreover, the destruction of wetlands and forests, has disrupted the natural balance of ecosystems, further compounding the loss of biodiversity. These findings highlight a broad consensus across different stakeholder groups about the detrimental effects of illegal gold panning on local ecosystems, underscoring the urgency for intervention to mitigate further environmental degradation.

5.4 Impacts on Livelihoods

Fig. 2 provides a comparative overview of the socio-economic impacts of illegal gold panning on livelihoods as reported by various stakeholders, including illegal gold panners, local residents, mine owners, and key informants. The data highlights significant effects on local livelihoods, particularly in relation to loss of agricultural land and the decline in agricultural productivity in Gwanda District. According to Fig. 2, about 80% of the respondents engaged in illegal gold panning reported that it was their primary source of income, especially in areas where agricultural yields have been declining due to drought. Most illegal gold panners acknowledged the immediate financial benefit of their activities. They indicated that they have managed to buy houses in Gwanda town using the money they get from their panning operations. Some revealed that they are managing to send their children to school from the income they earn through gold panning. This reflects a widespread reliance on illegal mining for subsistence, which aligns with previous studies that have shown how illegal gold mining is a survival strategy in areas with high unemployment and limited formal economic opportunities (Chipangura 2019, Mkodzongi 2016). However, the activity comes with severe socio-economic costs, as panners typically sacrifice long-term sustainability for short-term economic benefit.

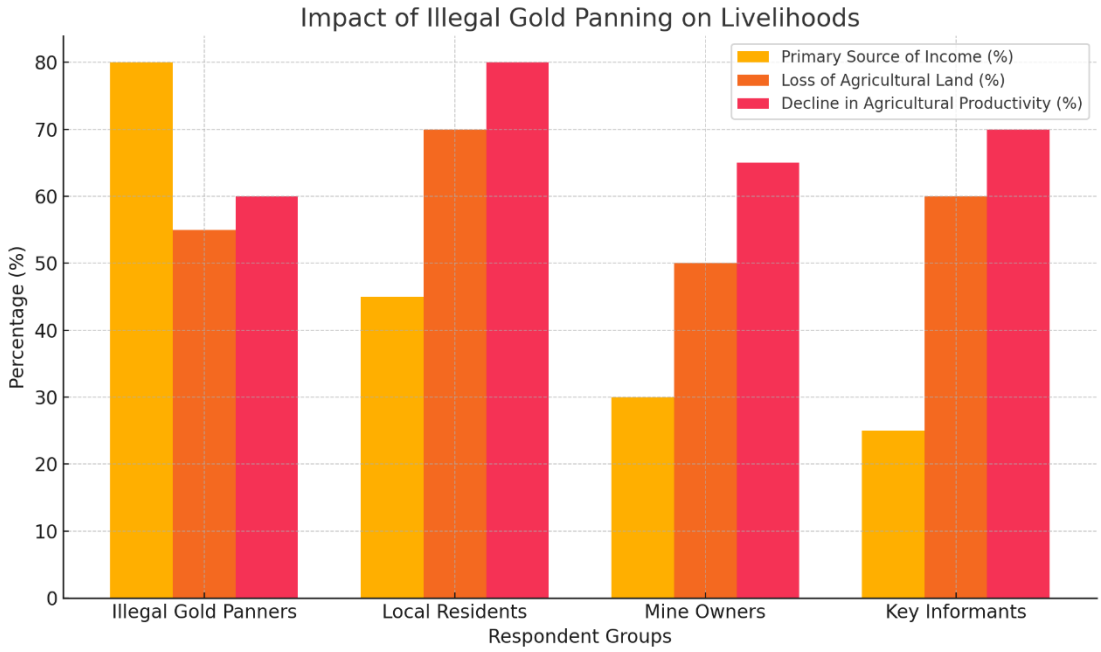

Fig. 2. Impact of Illegal Gold Panning on Livelihoods

Table 3. Health Impacts of Illegal Gold Panning

Health Issue	Percentage of Respondents Reporting Health Issues
Respiratory Problems	60%
Skin Diseases	55%
Waterborne Illnesses	70%
Injuries from Mining Accidents	40%

The graph also shows that 55% of illegal panners reported a loss of agricultural land, which directly affects food security and community sustainability. This loss of land is corroborated by 70% of local residents who also reported significant reductions in available agricultural land. Local farmers are unable to produce at previous levels due to both land degradation and reduced access to critical resources. This situation is consistent with the findings from literature which highlighted that illegal gold panning leads to extensive land degradation and reduces the land's capacity for productive agricultural use (Chitotombe 2015). Furthermore, 60% of illegal gold panners and 80% of local residents noted a decline in agricultural productivity. This decline is due not only to the loss of fertile land but also to the environmental degradation caused by panning, such as soil erosion and siltation of rivers, which have diminished the quality of both farmland and water sources (Zolani 2017). This is a critical finding, as it reflects how illegal mining activities indirectly undermine the region's food security, leaving communities in an increasingly precarious position. The views of mine owners and key informants further reinforce these conclusions. About 50% of mine owners and 60% of key informants reported loss of agricultural land, while 65% of mine owners and 70% of key informants noted declines in productivity. These perspectives highlight a shared concern across stakeholder groups regarding the long-term socio-economic impacts of illegal gold panning. This suggests that beyond the immediate financial gain, illegal gold panning has cascading effects on community livelihoods, agricultural production, and overall rural development (Mujere 2016). The findings demonstrate a strong correlation between illegal gold panning activities and declining agricultural productivity, reinforcing the need for alternative livelihood strategies and stricter environmental regulations. These results support the literature, which indicates that unregulated mining often leads to long-term socio-economic and environmental consequences that extend far

beyond the immediate economic benefits (Spiegel 2015, Hentschel 2002).

5.5 Health Impacts

Findings indicate that the health of both the panners and local communities has been negatively affected by illegal gold panning. Table 3 presents the health issues reported by respondents as a result of illegal gold panning activities. The data shows that illegal mining activities have significant health repercussions for the local population, with respiratory problems, skin diseases, waterborne illnesses, and injuries from mining accidents being the most frequently reported issues.

The most prevalent health issue, as shown in the Table 3, is waterborne illnesses, reported by 70% of the respondents. This finding is consistent with the literature, which highlights that illegal gold panning often results in the contamination of water sources, particularly through the use of mercury and cyanide during gold extraction (Hilson and Pardie 2006). Communities that rely on these water sources for drinking, cooking, and agriculture are exposed to high levels of toxic substances, leading to widespread health issues such as cholera, typhoid, and dysentery (Ogola et al., 2002). The contamination of water sources also threatens biodiversity and agricultural productivity, exacerbating the broader environmental impact of illegal mining activities. Respiratory problems were reported by 60% of the respondents. This is likely due to the dust and particulate matter generated during mining operations, which are often carried out without the use of protective gear or proper ventilation systems (Spiegel 2009). Studies have shown that the dust produced during gold mining contains harmful particles, including silica, which can lead to respiratory diseases such as silicosis, bronchitis, and even lung cancer (Emmanuel 2004). In communities near mining sites, prolonged exposure to dust exacerbates respiratory conditions, particularly among vulnerable populations such as children and the elderly.

Skin diseases were reported by 55% of respondents. This health issue is often linked to the direct handling of toxic chemicals used in the gold panning process, including mercury and cyanide, without proper protective equipment (Tschakert and Singha 2007). It was discovered that in Gwanda district, miners work in direct contact with contaminated water and soil, increasing their risk of developing skin conditions such as dermatitis, rashes, and ulcers. Skin diseases are further exacerbated by poor hygiene practices and inadequate access to clean water for washing and sanitation in these mining communities. Injuries from mining accidents were reported by 40% of respondents, underscoring the unsafe working conditions prevalent in illegal gold panning sites. These injuries often result from collapsing mine shafts, falls, and the use of rudimentary tools and techniques (Hentschel et al., 2002). The absence of formal safety protocols, combined with a lack of oversight, leads to frequent accidents that result in severe injuries or fatalities. Artisanal miners often face significant risks while working in unsafe environments, and this contributes to the high rate of accidents in illegal mining operations (Kitula et al., 2006).

The findings from Table 3 are in line with other studies on the health impacts of illegal gold mining. For instance, in another study done in Zimbabwe, found that artisanal miners face high health risks due to their exposure to harmful substances, poor working conditions, and inadequate access to healthcare services.[24] Similarly, in other mining regions in sub-Saharan Africa, such as Ghana and Tanzania, miners and surrounding communities experience comparable health impacts, emphasizing the widespread consequences of informal and unregulated mining activities (Kitula et al., 2006, Hilson 2006).

From the observations done at the mining sites visited, there were unplanned squatter camps located close to rivers with poor or no sanitary facilities. The full-time miners reside along the riverbanks in dilapidated structures made from mud, plastics and wooden poles without access to proper sanitation facilities. They used small pit latrines that were situated close to their huts. There were few latrines resulting in high utilization rates. Both the huts and latrines emitted offensive smells and were very dirty. This posed significant health hazards to the gold miners and their families. There was no access to clean water within walking distance and miners fetched water from the nearby rivers. Key informants noted that the lack of protective equipment, unsafe mining practices, and environmental contamination were the main contributors to the health issues. The most affected populations were the illegal miners themselves, as well as local residents,

particularly children, who drank contaminated water from rivers and dams polluted by mining activities.

5.6 Social Impacts

Illegal gold panning has also led to significant social changes in Gwanda District, and these are depicted in Fig. 3. About 65% of the respondents mentioned that the influx of gold panners into the district has strained social services, including schools, healthcare facilities, and housing. The researcher also observed that those mining sites are overcrowded with many people, some women were seen to be involved in vending activities. This was said to have been because of people migrating to this mineral rich environment from other communities. Additionally, conflicts have arisen between the local population and the incoming miners, particularly over land use (55%) and water resources (70%). About 45% of the respondents reported that gold panning has contributed to increased crime rates including theft, muggings, land-use conflicts and violence, as panners compete for gold-rich areas. It was revealed that the death of panners happen regularly especially at shopping centres, bars as well as night clubs. Mining syndicates have been formed in the panning zones and often clash over control of the mining sites resulting in injuries or death of several people. One of the respondents from one panning site lamented that gangs with machetes sometimes attack gold panners and had this to say:

"At times when they come, we flee. But if it's a night raid, we are in trouble. But if we feel it's too much, we gang up and fight back. They may run away or overpower us. Gold panning is all about trying to look for money for our families' survival."

Further discussions with the gold panners from all the sampled sites indicated that gang violence flourishes around gold mining sites where the rule of law is weak. Most of the respondents also reported an increase in accidents due to unsafe mining practices, particularly the collapse of open-pit mines and riverbanks. Participants recalled cases where people had been trapped in disused mines or dug pits. Additionally, panners often work without protective gear, increasing the risk of injuries. The local police confirmed that crime rates had risen in gold-panning areas, and efforts to enforce law and order have been hindered by the remoteness of some mining locations and the lack of adequate policing resources.

5.7 Impacts on Overall Well-Being

Illegal gold panning has a mixed impact on the overall well-being of local residents. While it provides short-term financial relief, especially during economic downturns and droughts, the long-term consequences on health, social stability, and environmental sustainability are largely negative. Over 80% of the respondents reported that they do not view gold panning as a sustainable livelihood and believe that the degradation of their environment will have long-lasting repercussions for future generations.

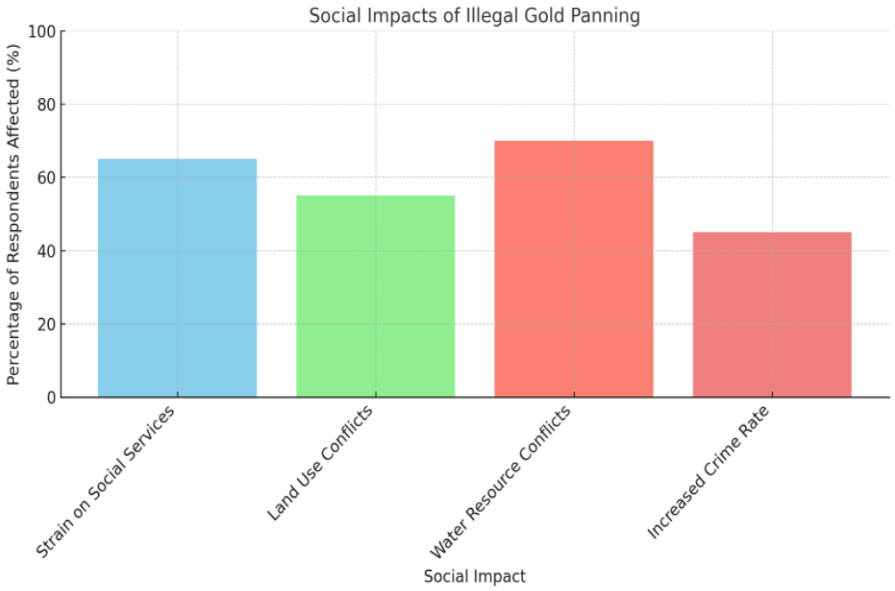

Fig. 3. Social Impacts of illegal gold panning

Table 4. Perceptions of the Long-Term Sustainability of Gold Panning

Respondents	Sustainable Livelihood (%)	Not Sustainable (%)
Illegal Gold Panners (n=80)	30%	70%
Local Residents (n=40)	25%	75%
Mine Owners (n=30)	40%	60%
Key Informants (n=10)	20%	80%

Table 5. Preferred Alternative Livelihood Options

Alternative Livelihood Option	Percentage of Respondents Supporting Option
Small-Scale Agriculture	65%
Livestock Farming	50%
Formal Mining Cooperatives	45%
Vocational Training	30%
Tourism	25%

Table 6. Barriers to Adopting Alternative Livelihoods

Barrier	Percentage of Respondents Reporting Barrier
Lack of Access to Capital	55%
Lack of Skills	40%
Insufficient Infrastructure	35%
Poor Access to Markets	25%

Table 7. Environmental Benefits of Alternative Livelihood Options

Livelihood Option	Environmental Impact
Small-Scale Agriculture	Reduced soil erosion, sustainable land use
Livestock Farming	Lower water consumption, reduced land degradation
Formal Mining Cooperatives	Better environmental management, reduced mercury use
Vocational Training and Tourism	Minimal environmental impact, potential for eco-tourism

Key informants emphasized that without alternative livelihood options and stronger regulatory frameworks, illegal gold panning will continue to undermine the district's long-term economic stability and environmental health. Additionally, local leaders expressed concerns about the impact of illegal mining on the district's youth, many of whom are forgoing formal education in favor of quick earnings from gold panning.

5.8 Perceived Viability of Alternative Livelihood Options

When asked about potential alternatives to illegal gold panning, respondents suggested several livelihood options that could provide sustainable incomes. The most frequently mentioned alternatives were small-scale agriculture (65%), livestock farming (50%), and formal mining cooperatives (45%). Vocational training (30%) and tourism (25%) were also suggested, but these were less favored due to the perceived higher barriers to entry and the lack of necessary skills or infrastructure.

The data indicates that most respondents view small-scale agriculture and livestock farming as the most feasible alternatives. Key informants also supported these options, citing their alignment with the region's agro-ecological conditions. Livestock farming, in particular, was highlighted as an appropriate livelihood strategy due to the region's semi-arid climate, which supports cattle and goat farming more sustainably than crop farming alone.

5.9 Potential Barriers to Adopting Alternative Livelihoods

Despite the positive response to alternative livelihoods, respondents identified several barriers that could limit the adoption of these activities. These barriers shown in the Table 7 below, included limited access to capital (55%), lack of skills (40%), and insufficient infrastructure (35%). Many panners expressed concerns about their ability to transition to other livelihoods without external support in the form of training, financial assistance, or access to markets.

The most significant barrier identified was the lack of access to capital. Many respondents noted that they did not have the financial means to invest in agricultural inputs, livestock, or equipment necessary to transition to new livelihoods. Similarly, the lack of infrastructure, particularly access to markets, was seen as a major impediment to developing sustainable agricultural and livestock activities.

Key informants, including local government officials and community leaders, provided additional insights into how alternative livelihoods could be successfully implemented in the region. They recommended the establishment of cooperatives to pool resources and reduce individual financial burdens. They also suggested that vocational training centers could help diversify the skill set of local workers, enabling them to engage in other industries such as carpentry, brickmaking, and repair services. Key informants also emphasized the importance of formalizing mining activities through cooperatives, which would allow small-scale miners to continue their work legally, with environmental safeguards in place. Formal mining cooperatives could reduce the environmental damage caused by unregulated panning while ensuring that workers receive fair compensation.

Transitioning from illegal gold panning to alternative livelihoods could not only improve economic outcomes for local residents but also reduce the environmental degradation associated with unregulated mining as shown in Table 7. By shifting to small-scale agriculture and livestock farming, communities can reduce soil erosion and water pollution caused by mining activities.

Findings of the study revealed that illegal gold panning has raised the standard of living of many people in Gwanda district as participants explained that they are able to support their families from the money they get through their panning activities. However, the socio-economic aids (employment and income generation) of small-scale mining environment are seriously outweighed by devastating environmental costs or negative social impacts (Shoko 2002). Results of the study showed that societies around Gwanda district are forced to bear the negative social costs of illegal gold panning operations. Socially, people are overcrowded in those mining areas leading to outbreak of diseases.

The findings clearly indicate that illegal gold panning in Gwanda District has had profound socio-environmental impacts, particularly on land, water sources, and biodiversity. The widespread land degradation and deforestation have left the land unproductive and unsuitable for agriculture, which is a primary livelihood for the local population. This is consistent with findings from other regions in Zimbabwe, where illegal mining activities have led to extensive land degradation and reduced agricultural productivity (Phiri 2016). Water pollution is another major consequence of illegal gold panning, with rivers and dams in the district becoming heavily polluted by siltation and chemicals. This has led to health problems for local communities and has reduced access to clean water, exacerbating existing water shortages in the drought-prone region (Dube and Phiri 2017). The contamination of water sources by mercury is particularly alarming, as it poses long-term health risks not only to the panners but also to the wider community. From the observations gold panning does not generate any ecological benefits besides causing health hazards for people and animals. From the findings, it was noted that most of the time people as well as animals do not access safe water as indicated before and the majority of the panners are not using toilets but the bush close to their campsite. This culture of using bush toilets is prone to prevail considering the fact they practice a nomadic way of life. The lack of sanitation facilities in most mining sites implies that the river is the ultimate source of human waste, with most of the families doing their laundry directly in the river. All these have negative effect on downstream users who may be users of the stream for their consumption. Biodiversity loss is a critical issue, as the destruction of habitats has led to a significant decline in plant and animal species. This disruption of ecosystems further threatens the

livelihoods of communities who depend on natural resources for survival (Ncube 2018). The loss of biodiversity also reduces the ecological services provided by these environments, such as soil retention and water filtration.

The findings of this study also demonstrate that while illegal gold panning provides short-term economic benefits, particularly considering high unemployment rates and declining agricultural productivity, it has severe negative socio-environmental consequences for people in Gwanda District. The degradation of land and water resources, coupled with health risks from pollution, poses a significant threat to the well-being of local communities. Similar findings have been reported in other regions of Zimbabwe, where the socio-economic pressures driving illegal mining activities often outweigh the long-term sustainability concerns.[21] Furthermore, the study reveals that illegal gold panning has disrupted social structures and increased conflicts over land and water resources. This finding is consistent with reports from other mining communities, where resource competition and environmental degradation have led to social unrest (Mabhena 2012). The strain on social services and the rise in crime further exacerbate the challenges faced by local authorities in managing the socio-environmental impacts of illegal mining.

The findings of this study also suggest that several alternative livelihood options could be introduced in Gwanda District to reduce reliance on illegal gold panning. Small-scale agriculture and livestock farming emerged as the most viable options due to the region's agro-ecological conditions and the existing knowledge base among local residents. These activities, however, require financial investment, skills training, and infrastructure development to become sustainable alternatives to illegal mining. Formalizing mining cooperatives also presents an opportunity to retain the economic benefits of gold mining while minimizing its negative environmental impacts. By providing miners with legal frameworks and environmental guidelines, formal cooperatives can help mitigate the damage caused by unregulated panning activities. However, the successful implementation of these alternatives will depend on addressing the significant barriers identified by the respondents, particularly the lack of access to capital and markets. Without external support from government agencies, non-governmental organizations, or private investors, the transition to alternative livelihoods may be slow or ineffective.

6. CONCLUSION

The study on the socio-environmental impacts of illegal gold panning in Gwanda District, Matabeleland South, Zimbabwe, highlights significant challenges to both the environment and local communities. Key findings reveal that illegal gold panning activities have severely degraded land and water resources, contributing to widespread deforestation, soil erosion, and siltation of rivers and dams, which are vital for local agriculture and livelihoods. The loss of biodiversity has further compounded environmental issues, threatening ecosystem stability and the long-term sustainability of the district's natural resources. Socio-environmentally, while illegal gold panning has provided a temporary means of livelihood for many individuals, it has also resulted in severe consequences. Increased crime rates, unsafe working conditions, and the health risks associated with the lack of safety measures in panning operations have emerged as critical issues. The research also identified significant impacts on livelihoods, with community members facing a trade-off between immediate economic gains and long-term environmental degradation that threatens food security and overall quality of life. To address these challenges, the study recommends several practical interventions, including:

- Formalization of small-scale mining operations through mining cooperatives to regulate activities, improve safety standards, and ensure environmental compliance.
- Agricultural diversification programs aimed at providing alternative livelihoods for panners, reducing reliance on gold panning.
- Community-led conservation initiatives focused on reforestation and land rehabilitation, involving local stakeholders to foster ownership and long-term success.
- Strengthening law enforcement to prevent illegal panning activities and protect key environmental resources such as rivers and forests.

  However, the success of these initiatives will depend on active collaboration between local communities, government authorities, and environmental agencies.

The study underscores the urgent need for comprehensive policy interventions and sustainable development strategies that balance economic opportunities with environmental conservation to ensure the future resilience of Gwanda District.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

ETHICAL APPROVAL

The research adhered to the ethical standards set forth to ensure the dignity, rights, and safety of all participants. The study was approved by the relevant authorities in Gwanda District.

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COMPETING INTERESTS

Author havs declared that no competing interests exist.

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