PriMera Scientific
Medicine and Public Health
Volume 6 Issue 5 May 2025
DOI: 10.56831/PSMPH-06-211
ISSN: 2833-5627

PriMera Scientific Publications

Environmental Conditions of Aquatic Mining Sites in the Tshopo Province: a Descriptive Study in the Banalia Territory

Type: Case Study
Received: March 25, 2025
Published: May 03, 2025

Citation:
Mondele Bolingo John., et al. "Environmental Conditions of Aquatic Mining Sites in the Tshopo Province: a Descriptive Study in the Banalia Territory". PriMera Scientific Medicine and Public Health 6.5 (2025): 08-14.

Copyright:
© 2025 Mondele Bolingo John., et al. This is an open-access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Mondele Bolingo John[1,3]*, Bitoko Litule Antoine[3], Kakule Lwanga Lwanga[1], Tagoto Tepungipame Alliance[1], Basandja Longembe Eugene[1], Kazadi Malumba Zoe[2] and Panda Lukongo Kitronza[1]

[1]*University of Kisangani, Faculty of Medicine and Pharmacy, Department of Public Health, Congo*

[2]*University of Kisangani, Faculty of Sciences, Department of Biotechnology, Congo*

[3]*National Health Promotion Communication Program, TSHOPO Provincial Health Division, Congo*

***Corresponding Author:** Mondele Bolingo John, University of Kisangani, Faculty of Medicine and Pharmacy, Department of Public Health, Congo; National Health Promotion Communication Program, TSHOPO Provincial Health Division, Congo.

Summary

Introduction: Small-scale mining represents a significant portion of global mining activity and is carried out under diverse conditions. This study was conducted to describe the environmental conditions of mining areas in the Banalia region of Tshopo province.

Methods: a descriptive study was conducted among 422 people living in two mining households in the territory of Banalia, selected by the systematic sampling technique, during the period from March 18 to June 14, 2024. Descriptive statistics were carried out using proportion and mean ± SD.

Results: the average age of the respondents was 38.2 ± 6.9 years; secondary education level (65%), married marital status (46%) and seniority of 10 years or more (81%) were dominant; 89% of the dwellings were tents, the evacuation of fecal matter was done by ordinary pit toilets (55%) and defecation in the watercourse (40%); the most represented sources of drinking water were surface water (50%) and natural springs (39%), 80% of the population did not treat water. The vast majority of miners drank alcoholic beverages (84%) and 63% were smokers, unprotected sexual intercourse was dominant (91%).

Conclusion: Mining homes are characterized by an unsanitary and polluted physical environment and depraved behavior of the occupants, which constitute health risk factors. Specific preventive measures are necessary in mining homes.

Keywords: Assessment; environment; aquatic mining center; Banalia; DRC

Introduction

Mining, regardless of its scale, poses significant risks to the health of workers, surrounding communities, and the environment in general. Artisanal and small-scale mining (ASM) is of particular concern, representing a significant portion of global mining activity. It is characterized by precarious working conditions, a lack of regulation, limited access to healthcare, and the use of often rudimentary and dangerous techniques [1].

Health risks in mining areas are diverse and include factors such as age (mining children), gender (women), lack of personal protective equipment (PPE), and ignorance of protective measures [2]. Of particular concern among these risks is exposure to chemicals such as mercury and cyanide, used in amalgamation and gold mining, respectively. These substances can be inhaled, absorbed, or ingested, leading to serious health problems [3]. In addition, the use of power-driven machinery in confined spaces increases the risk of poisoning due to insufficient ventilation [4].

The most common biological diseases in these settings include vector-borne and water-borne infections, as well as sexually transmitted infections such as HIV/AIDS and tuberculosis. These risks are exacerbated by crowded conditions and poor water and sanitation infrastructure, which is often inadequate in mining camps [5-6]. Stagnant water in these environments promotes the breeding of mosquitoes, vectors of diseases such as malaria and dengue fever [7].

Musculoskeletal disorders are also common among miners, often caused by heavy lifting and inappropriate postures while working [4]. In addition, trauma resulting from rockfalls, explosions, and improper use of equipment are ever-present hazards, leading to biomechanical and other trauma injuries [8-9].

The International Labour Organization (ILO) estimates that approximately 1 million children aged 5 to 7 are involved in small-scale mining activities worldwide [10]. Their participation, which covers all stages of ASGM, is often considered one of the "worst forms of child labour" according to ILO Convention No. 182. Eliminating this practice is complex due to its family-based, temporary and informal nature, as well as the associated levels of poverty [10].

In the Democratic Republic of Congo, studies conducted by the United Nations Environment Programme (UNEP) in 2016 revealed that the mining sector contributes to pollution, deforestation, and biodiversity loss, while posing security problems for local populations [11].

ASM in the Aruwimi Basin, Tshopo Province, is a key economic activity for many communities. Miners, often seasonal and from diverse backgrounds, often work as part of their families, increasing their vulnerability to health risks [12]. The low income generated by EMAPE increases this vulnerability, with negative consequences for the health of workers and surrounding populations [12].

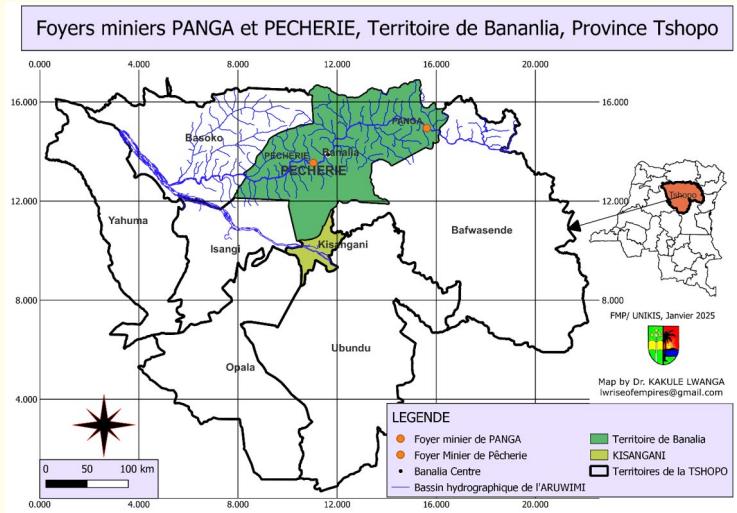
Evacuations due to landslide accidents, drowning, respiratory infections, the increase in cases of diarrhea, the high frequency of STIs / AIDS and the recurrence of meningitis epidemics in the mining concentrations of Panga, fishing and Mangi in the territory of Banalia, where the victims are more diggers or divers, motivate us to conduct this study to try to answer the question. "What are the environmental characteristics of the aquatic mining sites in the Aruwimi basin in the DRC?

The objective of this study was to describe the environmental conditions of mining areas in the Banalia territory in Tshopo province.

Materials and Methods

Study site

This study was conducted in the aquatic mining areas of the Banalia territory, located 128 km from the city of Kisangani. The Banalia territory has an estimated population of 332,681 inhabitants. [12] spread over an area of 24,430 km^2; it is full of several aquatic exploitation centers, the most important of which are Panga and Pêcherie.



The study was conducted in two mining areas of Panga and Pêcherie.

The study population

It consisted of the inhabitants of the mining communities: local authorities and divers (casaboulleurs). The population of mining operators is not known due to lack of census data and their constant mobility.

Type and period of study

A cross-sectional descriptive study was conducted during the period from March 18 to June 14, 2024.

Sampling

To determine the number of subjects to be included in the study, we used the SCHWARTZ formula as follows: $n=Z2\ p*q/d^2$.

Considering Z= 1.96; p as the proportion of people exposed to risk in the mining environment which is unknown (0.50); with the margin of error (d) estimated at 0.05 and an anticipated non-response rate of 10%, the sample size will be 422 subjects.

These 422 will be distributed in the two most populated mining camps: PANGA and PECHERIE in proportion to their size.

At the level of each camp, we had randomly drawn six avenues and at the level of each avenue the statistical units were identified by the systematic sampling technique as follows: counting of housing units (N); Calculation of sampling steps (k); Identification of the first household to be surveyed by the random choice of a number between 1 and k; Progressive addition of sampling steps up to the number required per avenue.

Data collection technique

Data were collected using Kobo Collect software embedded in the smartphone. We used interviews and direct observation, using an interview guide.

Data analysis technique

Data collected using smartphones were organized into an Excel database that was exported to STATA 5 for analysis. The description of the characteristics of the respondents and the environment was done using proportions for categorical variables and the mean ± SD and median (p75-p25) for quantitative variables depending on whether the distribution was symmetrical or not.

Ethical considerations

This study received authorization from the ethics committee of UNIKIS, the DPS and the Banalia territorial administration.

Participation in the study was voluntary with informed consent, and data analysis and dissemination were anonymous.

Results

Characteristics N=422	*Terms and conditions*	*Frequency*	*Percentage*
Age (mean ± SD)	38.2 ± 6.9		
Age group (years)	16 to 25	18	4
	26 to 30	37	9
	31 to 35	107	25
	36 to 40	80	19
	41 to 45	114	27
	46 to 50	66	16
Educational level N= 422	None	11	3
	Primary	21	5
	Secondary	281	65
	Higher and university	109	26
Marital status	Bachelor	87	21
	Married	195	46
	Free union	128	30
	Divorced/Separated	12	3
Length of career Median (p75 p25)	14 (17 – 10)		
	1 to 3	12	3
	4 to 9	67	16
	10 and over	340	81

Table 1: Socio-demographic characteristics of respondents.

The mean age of aquatic miners was 38.2 ± 6.9 years, with the dominant age range being 41 to 45 years; secondary education and married marital status were dominant. The median duration of work by miners in our study was 10 years and more.

Features	*Terms and conditions*	*Frequency*	*Percentage*
Type of accommodation N=422	Hut	0	0
	Tent	374	89
	Case	18	4
	Semi-durable materials	30	7
Fecal evacuation techniques N=422	Ordinary grave	231	55
	Open air	12	3
	River	170	40
	Anywhere	9	2
Drinking water source N=422	Natural sources	166	39
	Watercourse	210	50
	Bottled/sachet water	17	4
	Any water available	13	3
	Other	16	4
Water treatment N=409	Yes	80	20
	No	329	80
Water treatment techniques N=80	Boiling	0	0
	Chemicals	75	94
	Solar disinfection	5	6

Table 2: Physical environmental conditions of mining centres.

The environmental conditions of the mining sites were characterized by tent dwellings, disposal of fecal matter in ordinary pits and streams and use of stream water as a source of drinking water. The practice of water treatment was weakly observed (1/5) and the use of chemicals was the most used water treatment technique.

Features	*Terms and conditions*	*Frequency*	*Percentage*
Consumption of alcoholic beverages N=410	Yes	354	84
	No	66	16
Reasons for drinking alcoholic beverages N=354	Habit/pleasure/lifestyle	290	82
	Stress	108	31
	Fortifying	128	36
	Fight against the cold	72	20
Are you a smoker? N=419	Yes	288	69
	No	131	31
Why do you smoke? N=288	Habit/pleasure	129	45
	Stress	90	31
	Fortifying	170	59
You have occasional unprotected sex with other partners N=422	Yes	385	91
	No	37	9

Table 3: Characteristics of the social environment.

The vast majority of water miners drank alcoholic beverages, a behavior justified by the vast majority as habit/pleasure/lifestyle, and tobacco, used as a tonic. The vast majority of miners engaged in unprotected sex.

Discussion

Socio-demographic characteristics of the respondents

The results of this study show that the average age of aquatic miners in the Aruwimi Basin was 38.2 ± 6.9 years, with a predominance of the 41-45 age group. These findings are consistent with those of the International Labour Organization (ILO), which indicates that the majority of artisanal and small-scale mining (ASM) workers are working-age adults, although child labour is also documented in several regions [13]. In a study conducted in Ghana, the profile of artisanal miners was similar, with an average age between 35 and 40 years [14].

Regarding the level of education, 65% of miners had reached secondary school, while 26% had higher or university education. This finding differs slightly from observations made in West Africa, particularly in Ghana, where the education rate of miners was generally lower, with a majority not having gone beyond primary school [15]. This situation could be explained by the fact that most miners are people who, for various reasons, have not managed to complete the full cycle of formal training and do not have a diploma capable of making them competitive on the job market, they are more vulnerable to various trades and jobs in the informal sector.

Conditions of the physical environment of mining sites

The living conditions of workers in the mining settlements studied were precarious, characterized by a predominance of tent dwellings (89%), rudimentary sanitation and the majority use of river water (50%) as the main source of drinking water, with 55% using ordinary pit toilets and 40% defecating in rivers. These observations are consistent with those reported by Human Rights Watch, which highlights that mining camps in several regions of sub-Saharan Africa often lack adequate sanitation infrastructure [16].

Defecation in water is a potential source of contamination and exposes people to the risk of waterborne diseases such as cholera and diarrhea, as highlighted in WHO reports on water and sanitation management in mining areas [17].

In these conditions of limited access to drinking water, water treatment should be an alternative, unfortunately, only 20% of farmers reported treating water before consumption, mainly using chemicals (94%). This treatment rate remains lower than the recommendations of UNICEF, which emphasizes that access to safe drinking water is a crucial issue in artisanal mining areas [18].

Characteristics of the social environment

The study highlighted high alcohol (84%) and tobacco (69%) consumption among miners. These behaviors, often adopted to manage stress and fatigue, are frequently documented in studies of mining communities. A survey conducted in Bolivia shows similar results, with more than 75% of miners regularly consuming alcoholic beverages [19].

Tobacco use is a major health risk behavior and is the leading cause of preventable death in developed countries. A global health issue, the WHO estimates that it is responsible for 3 million deaths each year [20].

It is therefore recommended to monitor the evolution of its consumption and to measure its consequences on health [21]. It is important to strengthen awareness-raising actions in mining households to reduce the risk of death from cardiovascular diseases and improve the performance of workers in mining households.

Analysis of sexual practices indicates that 91% of the workers surveyed had unprotected casual sex. This trend is alarming because it exposes the population to an increased risk of sexually transmitted infections (STIs), including HIV/AIDS. According to UNAIDS, HIV prevalence rates are often higher in mining areas due to worker mobility and lack of access to preventive health services [22]. A study conducted in South Africa showed that HIV prevalence in mining communities was up to three times higher than in surrounding rural populations [23].

Conclusion

Mining homes are characterized by an unsanitary and polluted physical environment and depraved behavior of the occupants, which constitute health risk factors. Specific preventive measures are necessary in mining homes.

References

1. Hinton JJ, Veiga MM and Beinhoff C. "Women and Artisanal Mining: Gender Roles and the Road Ahead". The World Bank (2003).
2. Yakovleva N. "Corporate Social Responsibility in the Mining Industries". Corporate Social Responsibility and Environmental Management (2007).
3. United Nations Environment Programme. "Practical Guide: Reducing Mercury Use in the Artisanal Gold Mining and Panning Sector". Geneva: United Nations Environment Programme (2012).
4. Donoghue A. "Occupational health hazards in mining: an overview". Occupational Medicine 54.5 (2004): 283-289.
5. Mthembu S, Hlongwa M and Shongwe M. "The impact of informal settlements on health outcomes: a case study of informal settlements in South Africa". BMC Public Health 19.1 (2019): 1234.
6. Lissau A., et al. "HIV and tuberculosis among miners in South Africa: an emerging health crisis". Int J Tuberc Lung Dis 18.3 (2014): 346-353.
7. Pommier de Santi V., et al. "Malaria in French Guiana linked to illegal gold mining". Emerging Infectious Diseases 22.2 (2016): 344-346.
8. Calys-Tagoe BN., et al. "Injury profiles associated with artisanal and small-scale gold mining in Tarwwa, Ghana". International Journal of Environmental Research and Public Health 12.7 (2015): 7922-37.
9. Long NR, Renne EP and Basu N. "Understanding the social context of the ASGM sector in Ghana: A qualitative description of the demographic, health, and nutritional characteristics of a small-scale gold mining community in Ghana". International Journal of Environmental Research and Public Health 12 (2015): 12679-12696.
10. International Labor Organization. "The burden of gold: child labor in small-scale mines and quarries". World of Work 54 (2005): 16-20.
11. Cirimwami L, Baguma G and Mushagalusa O. Mining and biodiversity: the case of Twangiza Mining in eastern DRC (2016).
12. Mangambu Mokoso JD, Asimbo Bondoo N and Ekele Mbenga R. "Perspectives on the Environmental Impacts of Semi-Industrial Mining Projects in the Congo Basin: Case of the Aruwimi River (Basoko Territory, DR Congo)". European Scientific Journal, ESJ 17.29 (2021): 328.
13. International Labour Organization. "Mining and Child Labor". Geneva: ILO (2021).
14. Hilson G and Pardie S. "Artisanal Gold Mining and Rural Development Policies in Ghana". Resour Policy 57 (2018): 87-94.
15. Banchirigah SM. "Challenges with Eradicating Illegal Mining in Ghana: A Perspective from the Grassroots". Resour Policy 32.1-2 (2017): 29-38.
16. Human Rights Watch. "A Poisonous Mix: Child Labor, Mercury, and Artisanal Gold Mining in Mali". (2019).
17. World Health Organization. "Water, Sanitation, and Hygiene in Mining Communities". WHO Report (2020).
18. UNICEF. "Drinking Water and Sanitation in Mining Areas of the DRC". UNICEF Report (2021).
19. Bose-O'Reilly S, Lettmeier B and Roider G. "Mercury Exposure and Health Impacts among Individuals in the Artisanal and Small-Scale Gold Mining Community: A Comprehensive Review". About Health Perspective 116.1 (2018): 1-9.
20. Pierrot J, Underne M and Kuchcik L. "Tobacco: what is the health risk?". Rev Prat 62.3 (2012): 333-6.
21. Hill C and Laplache A. "Smoking and mortality: epidemiological aspects". Weekly epidemiological bulletin 22.23 (2003): 98-100.
22. Joint United Nations Programme on HIV/AIDS (UNAIDS). "HIV and Mining Communities". UNAIDS Report (2021).
23. Corno L and de Walque D. "Mines, Migration and HIV/AIDS in Southern Africa". J Afr Econ 19.1 (2018): 33-73.