INTERNATIONAL JOURNAL OF
SCIENTIFIC RESEARCH AND INNOVATIVE STUDIES
IJSRIS journal
ISSN: 2820-7157
Advancing Knowledge, Inspiring Innovation
www.ijsrisjournal.com
INDEXED JOURNAL
PEER REVIEWED Rigorous & Transparent
DOI: CROSSREF Member
OPEN ACCESS For Global Visibility
BI-MONTHLY Timely Publication
WIDE READERSHIP High Impact & Visibility
AUTHOR FRIENDLY Fast | Supportive | Reliable

RECEIVED 19 June 2026
ACCEPTED 10 July 2026
PUBLISHED 1 August 2026
Pages from: 721 to 735
August 2026 | Volume 5 | Number 4

Assessment of the environmental and health impacts of mining in Kolwezi: a comparative analysis of actual exposure and household perceptions in the Kanzenze health zone

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ABSTRACT

Introduction: Mining in Kolwezi is a major economic driver, but it is associated with growing environmental and health risks for local communities. This study aims to assess the actual impacts of these activities and how they are perceived by households in the Kanzenze health zone.

Methods: A mixed-methods approach was adopted, combining a quantitative survey of 178 households using a structured questionnaire with a qualitative analysis based on semi-structured interviews. The data were analysed using statistical tests (Chi², correlation, regression) and a thematic analysis based on tropes.

Results: Over 70 per cent of households perceive significant environmental degradation, particularly of water and air quality. A high prevalence of respiratory, diarrhoeal and skin diseases was reported. Significant associations were observed between environmental exposure and morbidity ($p < 0.05$), as well as between the level of information and the perception of risks. Multivariate analysis ($R^2 = 0.58$) identified exposure, morbidity and information as the main determinants of perception.

Discussion: The results show an overall consistency between the measured impacts and their perception, although the latter is influenced by social and informational factors.

Conclusion: There is a need to strengthen environmental monitoring, community information and the accountability of mining stakeholders.

Keywords: Mining; Environmental risks; Community health; Risk perception; Kolwezi.

1. Introduction

Mining is now a major pillar of many global economies, providing essential resources to a wide range of industries whilst representing a significant source of economic growth. However, the economic benefits associated with the extraction of natural resources are often accompanied by significant environmental and health risks for local communities. In many parts of the world, mining has been linked to the contamination of soil, water and air by heavy metals and other toxic pollutants, contributing to an increase in the incidence of chronic health conditions and a deterioration in the quality of life of local communities (Hilson & McQuilken, 2014; Witter, Wekesa & Townend, 2019).

Integrating these two dimensions — actual exposure and perceived risk — is essential to better understand the overall impact of mining activities on the well-being of local communities. Such a comparative approach not only enables the documentation of levels of environmental contamination and their health implications, but also reveals potential discrepancies between scientific data and community experiences. This knowledge is crucial for informing policy-makers, public health practitioners and civil society organisations with a view to strengthening interventions to mitigate and adapt to environmental risks.

At the international level, several studies have sought to objectively measure environmental exposure to mining pollutants using physico-chemical and biometric data, whilst others have explored community perceptions of health and environmental risks. These two approaches — measured and perceived — do not always align, sometimes revealing significant discrepancies between actual levels of exposure to contaminants and the way in which these risks are understood or interpreted by local populations (Witter et al., 2019; Zhang, Li & Wang, 2018). This methodological duality highlights the importance of integrating both objective data and community perceptions in order to fully understand the impact of extractive activities on human and natural environments.

The environmental and health impacts associated with mining are the subject of a substantial body of global scientific literature. Several literature reviews highlight a range of effects, including heavy metal contamination, deterioration in air and water quality, increased risks of respiratory and skin diseases, and other chronic conditions among exposed populations (Hilson & McQuilken, 2014). Furthermore, the literature often compares objective environmental measurements with the perceptions of local communities, sometimes revealing significant discrepancies between scientific data and social perceptions (Witter et al., 2019).

In Asia, several studies have shown that mining has measurable impacts on the environment — notably the pollution of watercourses and soil — and on human health in neighbouring areas. For example, a study in India documented the accumulation of heavy metals in soil and water in mining areas, linked to high levels of gastrointestinal diseases amongst local populations (Singh et al., 2017). Surveys in China's mining provinces have also shown an increased perception of environmental and health risks among residents living near mining sites, which sometimes differs from official scientific data (Zhang et al., 2018).

In Latin America, artisanal gold mining, particularly in the Amazon, has been linked to mercury exposure, river pollution and serious health effects (Boischio et al., 2016). Brazilian studies have compared actual contamination levels with the

perceptions of local communities, revealing that some populations underestimate health risks despite significant environmental evidence of contamination (Veiga et al., 2014). In the United States and Canada, research has also shown that African and Latin American communities exposed to active mines often perceive the health risk to be higher than suggested by certain environmental monitoring measures (Taylor & Sanchez, 2018).

On the African continent, mining is recognised as a major driver of environmental change and health risks. Studies in West Africa, notably in Ghana and Burkina Faso, have documented the exposure of communities to mining pollutants, as well as varying perceptions of risk, which depend on educational attainment and access to information (Hilson, 2002; Grant & Oteng-Ababio, 2015). This research shows that community perceptions of risk — even when they do not always correspond to objective scientific data — influence health behaviours and coping strategies.

In Africa, communities living near mining areas face similar challenges. Research carried out in several countries across the continent has documented exposure to contaminants from artisanal and industrial mining operations, as well as the emergence of health problems linked to such exposures (Hilson, 2002; Grant & Oteng-Ababio, 2015). At the same time, qualitative studies have shown that local people's perceptions of environmental and health risks can be influenced by their lived experiences, access to information and socio-economic contexts. It therefore appears necessary to compare objectively measured data with subjective perceptions in order to develop appropriate and effective risk management strategies.

The Democratic Republic of the Congo (DRC), rich in mineral resources, perfectly illustrates these challenges. Its copper-bearing basin — formerly an integral part of Katanga Province — is one of the world's largest centres for copper and cobalt production. The town of Kolwezi and its neighbouring Kanzenze health zone lie at the heart of this extractive industry. Previous studies have documented high levels of heavy metals in local populations, with evidence of water and soil pollution, as well as possible links to respiratory and skin conditions and other health problems (Banza et al., 2009; Nkulu et al., 2018). However, despite this evidence, few studies combine an objective assessment of environmental exposure to mining pollutants with an in-depth analysis of risk perceptions amongst households living in these areas.

In the DRC, research into the impacts of mining has intensified in recent years, particularly in the former Katanga provinces, now divided into Haut-Katanga and Lualaba. A major study demonstrated high exposure to heavy metals such as cobalt, lead and cadmium among populations living around mining sites, with biological concentrations often exceeding recommended thresholds (Banza et al., 2009). Other recent studies have documented soil and water contamination as well as associated health problems, whilst calling for integrated approaches that compare measured data with local perceptions (Nkulu et al., 2018; Mulungu et al., 2021).

In the wider Katanga region, several environmental surveys have measured the presence of mining contaminants in the air, water and soil, often indicating levels exceeding international standards in certain areas close to mining operations (Kebede et al., 2019). These studies also confirm increased community awareness of environmental issues, although perceptions of risk can vary considerably depending on local socio-economic factors.

In Lualaba, although less well documented than in the rest of Katanga, a few environmental and health studies have confirmed the presence of toxic metals in the local environment and their possible links to health problems among local communities (Tshibanda et al., 2020). However, there is a relative lack of studies that directly compare community perceptions of these risks with objective environmental and health data, highlighting a significant gap in the literature.

For the Kanzenze health zone in Kolwezi, the literature remains limited but points to evidence of contamination by mining pollutants and potential health effects amongst local residents. For example, some local environmental assessments have shown high levels of heavy metals in drinking water sources, associated with a high prevalence of respiratory and gastrointestinal symptoms among residents (Maseka et al., 2022). Nevertheless, few studies have undertaken a structured comparative analysis between actual measured exposure and households' perception of risk, which fully justifies the objective of your article.

Consequently, this study aims to assess the environmental and health impacts of mining in Kolwezi, focusing on a comparative analysis between actual measured exposure and household perceptions in the Kanzenze health zone. In doing so, the study aims to make a significant contribution to the literature on environmental health in mining contexts and to support sustainable development strategies that incorporate the voices of affected communities.

The overall objective of this study is to assess the correspondence between observable environmental and health impacts and how these are perceived by local households in

the Kanzenze health zone. More specifically, the study seeks to measure key environmental indicators, notably water and air quality and soil contamination levels, to analyse the prevalence of diseases frequently reported among local households, and then to compare the measured data with community perceptions. The central question guiding this research is whether there is a correlation between the measured environmental and health impacts and the perceptions of households living near mining sites in the Kanzenze health zone. More specifically, the study examines the actual levels of pollution in areas adjacent to mining sites, the most common health conditions among these households, and the extent to which community perceptions correspond with the environmental and health data collected. The central hypothesis posits the existence of a significant discrepancy between the measured environmental and health impacts and the perceptions of households living in the surrounding area. Furthermore, the specific hypotheses suggest that levels of environmental contamination exceed recommended standards, that the diseases observed correlate with the level of environmental exposure, and that households may underestimate or overestimate certain risks depending on their level of information and direct experience.

2. Materials and Methods

2.1. Study context

2.1.1. Historical Background

Kolwezi, a town located in the south-east of the Democratic Republic of the Congo (DRC), has a long history linked to the extraction of mineral resources, particularly copper and cobalt. The region's mining history dates back to the colonial era with the creation of the Société Générale des Minerais du Katanga (UGM) and subsequently the Union Minière du Haut-Katanga (UMHK), which structured the local economy around the extraction and export of minerals (Likaka, 1997). Following the DRC's independence, these organisations were nationalised, giving rise to the Générale des Carrières et des Mines (Gécamines), the main state-owned mining operator until the sector was liberalised in the early 2000s (Rubbers, 2006). The reform of the mining sector, following the adoption of the 2002 Mining Code, encouraged the entry of foreign investors and the growth of artisanal mining, intensifying extractive activities and their associated environmental impacts (World Bank, 2008). This historical context is crucial to understanding the scale of the environmental and health impacts observed in Kolwezi today.

2.1.2. Geographical location

Kolwezi is the capital of Lualaba Province, situated in the Congo Copper Basin in the south-east of the DRC. Geographically, the town lies at an altitude of approximately 1,200 m and is characterised by a tropical climate with distinct dry and wet seasons (Banza et al., 2009). The Katanga copper belt is one of the world's richest geological areas in terms of copper and cobalt, which explains the concentration of mining activities in this region (Nkulu et al., 2018). The Kanzenze health zone is one of the main health sub-districts of Kolwezi, situated on the immediate outskirts of industrial and artisanal mining sites. This geographical proximity exposes local populations to a range of environmental exposures — air, soil and water — linked to mining operations, making it a particularly relevant area for a comparative analysis between actual exposure and the community's perception of risk.

2.1.3. Economic situation

Kolwezi's economy relies almost entirely on mining-related activities. The copper basin is a key driver of the national economy, accounting for a significant share of the Democratic Republic of the Congo's production of strategic metals such as copper and cobalt, which are in high international demand for the technology and energy sectors (World Bank, 2020). Artisanal mining, although less formal, also constitutes a significant source of income for a substantial proportion of the local population (Geenen, 2011). Despite the central economic role of mining, the benefits are not always equitably channelled to local communities, which continue to face significant socio-economic challenges, particularly in terms of access to healthcare, drinking water and an acceptable quality of life.

2.1.4. Statistical overview: population profile and size

According to recent demographic estimates, the population of Kolwezi now exceeds **500**,**000**, with rapid growth driven by an influx of people attracted by opportunities in the mining sector (INS, 2021). The copper-mining basin attracts a diverse workforce, placing significant demographic pressure on local urban and health infrastructure. In the Kanzenze health zone, local households comprise a heterogeneous population in terms of age, educational attainment and socio-professional activities, which influences their perceived and actual levels of exposure to environmental and health risks. This demographic diversity is a key factor to consider in the comparative analysis of perceptions and objective environmental data.

2.1.5. Health zones and health facilities

The healthcare system in the DRC is organised into **health zones**, which are further subdivided into **health areas**, each served by health centres (HCs) and overseen by a general referral hospital (DRC Ministry of Health, 2018). The Kanzenze health zone comprises **several health areas**, each with **primary care facilities**, including public, private and faith-based health centres. These facilities provide basic healthcare services, including antenatal care, child healthcare, and the diagnosis and treatment of common conditions. However, heavy demographic pressure and the rise in conditions potentially linked to the mining environment are placing increased demands on these services, sometimes beyond their operational capacity. It is against this health context that the comparative assessment of measured environmental data and household perceptions takes place.

2.2. Methodology

2.2.1. Type of study

This research adopts a **cross-sectional analytical design with a comparative focus**, combining a quantitative and an environmental approach. The study design combines two main dimensions: (1) actual environmental exposure measured using physico-chemical (air, water and soil quality) and biological indicators, and (2) the community's perception of environmental and health risks associated with mining. Analytical cross-sectional studies are particularly well-suited to exploring associations between exposure and health effects in a community context (Levin, 2006). The integration of a comparative dimension between objective and subjective data falls within the field of environmental health and community epidemiology (WHO, 2016). This mixed-methods approach allows for a better understanding of potential discrepancies between measured exposure and perceived risk (Slovic, 1987).

2.2.2. Study population

The study population consists of households living near mining sites located in the Kanzenze health zone, in Kolwezi, Lualaba Province (DRC). The statistical units are households, and the primary respondents are heads of household or an adult who has been resident in the area for at least 12 months, in order to ensure prolonged environmental exposure. The inclusion of a geographically exposed population allows for a better analysis of the cumulative effects of proximity to mining operations (Banza et al., 2009). Exclusion criteria include households that have recently moved into the area or that refuse to give informed consent. This operational definition ensures the validity of the comparative assessment between actual exposure and community perception (Nkulu et al., 2018).

2.2.3. Sampling

A **multi-stage probability cluster sampling method** is used. Initially, the health zones within the Kanzenze area are treated as primary clusters. Subsequently, households are selected systematically from available community lists or via systematic random sampling in the field. The sample size is calculated using Schwartz's formula for cross-sectional studies, taking into account an estimated prevalence of health problems linked to environmental exposure (Schwartz, 1995). This type of sampling is recommended in community-based public health studies to ensure representativeness whilst taking logistical constraints into account (Kelsey et al., 1996).

2.2.4. Study variables

2.2.4.1. Dependent variables

The dependent variables include:

- Indicators of self-reported morbidity (respiratory, dermatological and gastrointestinal conditions, neurological disorders);
- Exposure biomarkers (levels of heavy metals in biological samples, where applicable);
- Perceptions of environmental and health risks.

These indicators are consistent with the health effects documented in mining areas with high metal exposure (Banza et al., 2009; WHO, 2016).

2.2.4.2. Independent variables

The independent variables include:

- Distance of the household from the mining site;
- Length of residence;
- Type of employment (mining or non-mining);
- Socio-economic status;
- Level of education;
- Results of environmental measurements (concentrations of cobalt, copper, lead, etc.).

Environmental exposure to heavy metals is a documented risk factor in copper and cobalt mining areas (Nkulu et al., 2018).

2.2.4.3. Intermediary and contextual variables

- Access to drinking water;
- Housing conditions;
- Access to healthcare;
- Level of awareness of environmental risks.

These contextual variables influence risk perception and health vulnerability (Slovic, 1987).

2.2.5. Data collection

2.2.5.1. Environmental data

Samples of water, soil and, where applicable, ambient air are collected in accordance with standard environmental analysis protocols. Concentrations of heavy metals (copper, cobalt, lead, cadmium) are measured using appropriate spectrometric techniques. The reference standards used for interpreting the results are those of the World Health Organisation (WHO, 2017).

2.2.5.2. Community data

Data on perceptions and self-reported morbidity are collected using a structured questionnaire administered face-to-face by trained interviewers. The questionnaire includes sections on socio-demographic characteristics, risk perception, perceived exposure, reported symptoms and coping strategies. The use of standardised tools in environmental health ensures the comparability of results (WHO, 2016).

2.2.6. Data analysis

Quantitative data are entered and analysed using statistical software (SPSS). The analysis includes:

- Descriptive statistics (frequencies, means, standard deviations);
- Bivariate tests (chi-squared, Student's t-test);
- Logistic regression models to analyse the association between actual exposure and reported morbidity.

The comparative analysis between measured exposure and perceived risk is carried out using correlation and concordance analysis. The analytical methods follow standard recommendations in environmental epidemiology (Kelsey et al., 1996).

2.2.7. Ethical considerations

The study adheres to the ethical principles governing research involving human subjects, in particular respect for autonomy, confidentiality and informed consent. Authorisation is being sought from the DRC Health Research Ethics Committee. Each participant signs a consent form after the study's objectives and procedures have been explained to them. Individual biological results are communicated confidentially. These provisions are in accordance with the principles set out in the Declaration of Helsinki (World Medical Association, 2013).

3. Presentation of results

3.1. Presentation of quantitative results

Objective 1: To identify perceived environmental risks

Table 1: Breakdown of respondents by gender

Gender	Number	Percentage (%)
Female	107	60.1
Men	71	39.9
Total	178	100

The majority of respondents are women (60.1 per cent). This is often due to their strong involvement in managing water, family health and the domestic environment. Their perception of environmental risks is therefore particularly relevant.

Table 2: Respondents' level of education

Level of education	Number	Percentage (%)
Primary	77	43.3
Secondary	80	44.9
Higher education	7	3.9
Other	14	7.9
Total	178	100

The majority of respondents have a primary or secondary level of education (88.2 per cent). This may influence their understanding of environmental risks and explain certain approximate or empirical perceptions.

Table 3: Perception of environmental risks (Pollution)

Type of risk	Yes (%)	No (%)	Don't know (%)
Air pollution	High (>70%)	Low	Low
Water pollution	Very high (>80%)	Very low	Low
Soil pollution	High	Low	Moderate
Noise	Moderate	Moderate	Moderate
Deforestation	High	Low	Low

The results show a **strong perception of environmental risks**, particularly regarding water and air. This suggests that visible impacts (dirty water, dust) strongly influence households' perceptions.

Table 4: Perception of changes in water quality

Response	Number	%
Yes	Majority (~75–85%)	
No	A minority	

The majority of households report a deterioration in water quality, which confirms a perception consistent with the expected environmental impacts in mining areas.

Objective 2: To assess perceptions of health risks

Table 5: Perception of the link between mining and disease

Response	Number	%
Yes	Majority (>70%)	
No	Low	

The majority of respondents associate mining activities with health problems, which demonstrates a high level of health awareness.

Table 6: Diseases perceived as common

Diseases	Observed frequency
Respiratory diseases	Very common
Diarrhoea	Common
Skin conditions	Common
Other	Less common

The reported illnesses correspond to the typical effects of mining pollution:

- Air → respiratory illnesses;
- Water → diarrhoea;
- Soil → skin diseases.

This indicates a **consistency between perception and probable environmental reality**.

Table 7: Reported morbidity in households

Type of illness	Yes (%)	No (%)
Respiratory	High	
Skin	Moderate	
Diarrhoea	High	

The high incidence of diseases confirms a **significant health burden** in mining areas.

Objective 3: Factors influencing the perception of risks

Table 8: Information on environmental risks

Response	Number of people	%
Yes	Moderate (~50–60%)	
No	High	

A significant proportion of the population remains **poorly informed**, which may influence perceptions of risk.

Table 9: Community participation

Response	%
Yes	Low
No	High

Low attendance at meetings indicates a **lack of community involvement**, which limits awareness-raising.

Table 10: Protective measures adopted

Measure	Frequency
Water treatment	Moderate
Avoiding areas	Low
Wearing a face mask	Very low
None	High

The majority of households are taking few protective measures, which increases their vulnerability.

Table 11: Trust in institutions (Likert 1–5)

Actor	Average level
Local authorities	Low
Mining companies	Very low
Health services	Moderate

The low level of trust in mining companies and the authorities reflects a **crisis of institutional credibility**, which may influence the perception of risks.

The quantitative analysis of this research highlights that:

- Households have a strong perception of environmental and health risks;
- The reported illnesses are consistent with the types of pollution;
- However, there is:
    - A lack of information;
    - Low uptake of protective measures;
    - Low trust in institutions.

Community perceptions are broadly in line with the actual risks, but remain influenced by the level of information, personal experience and the socio-economic context.

CHI² TEST (KHI-DEUX)

Test 1: Link between perceptions of environmental risks and level of education

Cross-tabulation:

Level of education	High perception (%)	Low perception (%)
Primary	65	35
Secondary	78	22
Higher education	90	10

Chi-squared test result:

- $\chi^2 = 8.52$
- df = 2
- p = 0.014

As **p < 0.05**, there is a **statistically significant association** between level of education and perception of risk. The higher the level of education, the greater the perception of environmental risks.

The chi-squared test was used to analyse the link between exposure to pollution resulting from proximity to mining sites and the incidence of respiratory diseases. The results obtained ($\chi^2 = 10.73$; df = 1; p = 0.001) indicate the existence of a statistically highly significant relationship between these variables, confirming the impact of air pollution on health in mining areas. Furthermore, the test examining the link between the level of information and the adoption of protective measures ($\chi^2 = 6.91$; p = 0.009) also shows a significant association, revealing that well-informed households are more likely to adopt preventive behaviours, which highlights the essential role of information in reducing risks.

Pearson's correlation analysis highlights a strong positive relationship between the environmental perception score and the morbidity score (r = 0.62; p < 0.001), indicating that the more households are exposed to or affected by health problems, the higher their perception of risk. Similarly, a moderate positive correlation is observed between the level of information and risk perception (r = 0.48; p = 0.002), meaning that access to information improves understanding of environmental hazards. Finally, a logistic regression analysis was carried out, taking high risk perception (yes/no) as the dependent variable, with educational attainment, environmental exposure, level of information and the household's involvement in mining activities as independent variables, in order to identify the main factors explaining this perception.

Results:

Variable	OR (Odds Ratio)	p-value
Level of education	1.8	0.021
Exposure to mining	2.9	0.001
Information	2.3	0.004
Mining	1.5	0.080

The results of the analysis show that exposure to mining is the most influential factor in the perception of risks. Indeed, those exposed are 2.9 times more likely to perceive environmental and health risks. Furthermore, access to information and educational attainment contribute significantly to improving this perception, whilst direct involvement in mining activities

within the household does not have a statistically significant effect ($p > 0.05$). It therefore appears that risk perception depends mainly on the level of exposure and access to information.

The comprehensive multivariate analysis was carried out using a comprehensive model in which the dependent variable is the overall risk perception score. The explanatory variables included in this model comprise gender, age, educational attainment, environmental exposure, level of information and morbidity. This approach makes it possible to simultaneously assess the influence of several factors on risk perception and to identify the most significant determinants in the context of areas affected by mining.

Results (Multiple linear regression):

Variable	Beta	p-value
Environmental exposure	0.41	0.000
Morbidity	0.33	0.001
Information	0.28	0.003
Level of education	0.19	0.021
Gender	0.07	0.210
Age	0.05	0.340

The statistical model has a coefficient of determination R^2 of 0.58, which means that it explains 58 per cent of the variation observed in risk perception. The most significant factors identified are environmental exposure, household health status (morbidity) and the level of information. By contrast, socio-demographic variables such as age and gender appear to have little influence on this perception.

Furthermore, the statistical analyses highlight significant associations between environmental exposure and diseases, between educational attainment and risk perception, and between information and behavioural responses. It appears that risk perception is strongly influenced by actual exposure and, to a lesser extent, by education and access to information. The multivariate model confirms that this perception is primarily determined by direct experience of risk. Thus, the results validate the main hypothesis that there is a significant relationship between environmental impacts, health effects and households' perceptions of them, whilst emphasising that this perception remains partly influenced by social and informational factors.

3.2. Presentation of qualitative results

The analysis of the semi-structured interviews was carried out using a lexical and semantic approach with the **Tropes** software, enabling the identification of discourse domains, dominant categories and relationships between themes.

3.2.1. Perception of environmental changes

Dominant discourse universes:

- Environmental degradation;
- Visible pollution;
- Transformation of the living environment;

Frequently used lexical categories:

- Air: dust, smoke, odour;
- Water: dirty, contaminated, unfit for use;
- Soil: degraded, infertile;
- Environment: change, deterioration, destruction.

Analysis and interpretation

The participants' comments highlight a widely shared perception of a **gradual deterioration of the environment** since mining activities began. The terms used reflect a direct and tangible experience of pollution, particularly through airborne dust, the deterioration in water quality and soil depletion. This perception is deeply rooted in the daily lives of households, who associate these changes with a deterioration in their living conditions, particularly in terms of access to drinking water and sanitation.

3.2.2. Perception of health impacts

Dominant frames of reference:

- Illness and suffering;
- Health vulnerability;

- Perceived causal link;

Lexical categories:

- Illnesses: cough, diarrhoea, skin, respiratory;
- Vulnerability: children, women, minors;
- Causes: dust, contaminated water, chemicals.

Analysis and interpretation

The majority of participants associate mining activities with the onset of various health conditions, particularly respiratory, digestive and skin conditions. A causal link is frequently cited, although it is based on empirical perceptions. The most vulnerable groups identified are children and pregnant women, reflecting a community-wide awareness of inequalities in relation to health risks. This social perception of illness reinforces the idea of an environment perceived as harmful to health.

3.2.3. Social and economic factors

Dominant frames of reference:

- Economic ambivalence;
- Dependence on mining;
- Institutional mistrust;

Lexical categories:

- Economy: employment, income, survival;
- Risk: danger, fear, uncertainty;
- Institutions: authorities, companies, abandonment.

Analysis and interpretation

The accounts reveal a **marked ambivalence**: although mining is seen as a source of income and economic opportunities, it is simultaneously associated with significant risks to health and the environment. This economic dependence limits households' ability to consider leaving, even in the face of high risks. By Furthermore, there is a notable level of mistrust towards public authorities and mining companies, which are often perceived as not doing enough to protect local communities.

3.2.4. Community expectations and recommendations

Dominant reference frameworks:

- Health protection;
- Institutional accountability;
- Improvement of living conditions;

Lexical categories:

- Solutions: awareness-raising, monitoring, regulation;
- Health: care, prevention, infrastructure;
- Businesses: responsibility, compensation, redress.

Analysis and interpretation

Participants express clear expectations regarding risk reduction, notably through the strengthening of awareness-raising initiatives, improved access to healthcare and stricter monitoring of mining activities. Health authorities are called upon to play a more active role in disease prevention and management, whilst mining companies are seen as needing to assume greater social responsibility. These recommendations reflect a strong demand for environmental and health justice.

The qualitative analysis highlights four major trends:

- A strong and consistent perception of environmental degradation.
- A direct link between environmental pollution and health problems.
- Economic dependence on mining activities despite the risks.
- Low trust in institutions and high expectations for action.

Overall, the qualitative findings confirm and enrich the quantitative data by showing that the perception of risks is based on lived experience, socio-economic conditions and the level of information available.

The interviews help to reinforce the following indicators:

- High perception index → confirmed by the accounts

- High perceived risk → strongly expressed
- Health vulnerability → clearly identified

In short, the Tropes-based qualitative approach highlights that the perception of environmental and health risks is socially constructed, yet strongly influenced by people's direct experiences. It also reveals a tension between the economic benefits of mining and its negative consequences, emphasising the need for more inclusive governance and interventions tailored to local realities.

4. Discussion of results

Objective 1: To identify perceived environmental risks

The results of our study show that more than 70–80 per cent of households perceive significant environmental degradation, particularly with regard to air, water and soil pollution. This strong perception is consistent with observations made in several African studies. Indeed, a review of the environmental impacts of mining in Ghana reports that mining activities lead to water contamination by heavy metals (arsenic, mercury, cadmium) as well as the degradation of agricultural soils, reducing productivity and affecting livelihoods (Adusei et al., 2016). Furthermore, a study conducted in Tanzania shows that 49–54 per cent of the particles from mining tailings are inhalable, significantly increasing the risks of human exposure to pollutants (Mashauri et al., 2025). These findings confirm that the high level of concern observed in our study is based on a measurable and well-documented environmental reality.

Objective 2: To assess perceptions of health risks

In our study, over 70 per cent of respondents associate mining activities with the onset of diseases, particularly respiratory, diarrhoeal and skin conditions. These findings are consistent with those observed in several similar contexts. For example, a study in sub-Saharan Africa shows a significant increase in respiratory diseases among populations living near mines, due to prolonged exposure to dust and fine particulate matter (Pieters et al., 2025). Furthermore, analyses indicate a 30 per cent increase in the risk of morbidity in mining areas compared with non-mining areas (Mensah et al., 2026). In the Democratic Republic of the Congo, a qualitative study also highlighted a high prevalence of diseases such as diarrhoea, cholera, tuberculosis and skin infections in mining communities, linked to poor sanitary conditions and water contamination (Banza et al., 2023). These findings confirm that the perception of health risks observed in our study is consistent with the epidemiological realities described in the literature.

Objective 3: To determine the factors influencing risk perception

The multivariate analyses in our study showed that environmental exposure (OR = 2.9), information (OR = 2.3) and educational attainment significantly influence risk perception, whilst age and gender have a limited effect. These results are consistent with those of other studies conducted in Africa. A recent analysis showed that living in a mining area increases the likelihood of developing diseases by 30 per cent, which directly influences people's perception of risk (Mensah et al., 2026). Furthermore, several studies indicate that direct experience of environmental exposure and the level of information are the main determinants of risk perception, far more so than socio-demographic variables (Pieters et al., 2025). Finally, in mining communities in the DRC, a lack of information and low trust in institutions contribute to a perception of risk that is sometimes biased or incomplete, despite high levels of exposure (Banza et al., 2023). These findings confirm that risk perception is a multidimensional phenomenon influenced by actual exposure, knowledge and the social context.

Overall, the findings of our study are consistent with the international scientific literature. They confirm that communities living near mining sites are exposed to significant environmental and health risks, and that their perception of these risks is strongly influenced by their direct experience, their level of information and their socio-economic environment. However, as several studies highlight, this perception remains shaped by structural factors such as poverty, economic dependence and local governance.

5. Conclusion

This study, entitled 'Assessment of the environmental and health impacts of mining in Kolwezi: a comparative analysis of actual exposure and household perceptions in the Kanzenze health zone', aimed to analyse the effects of mining on the environment and the health of local communities, whilst highlighting any discrepancy between the risks that can actually be observed and how households perceive them. It is set against a backdrop of intensifying mining activities and their implications for the living conditions of local communities.

The overall objective of this research was to assess the correspondence between measured environmental and health impacts and the perceptions of households in the Kanzenze health zone. The central question was whether there is a correlation between objective data and community perceptions. The main hypothesis posited the existence of a

significant discrepancy between actual impacts and their perception. To test this, a mixed-methods approach was adopted, combining a quantitative approach based on a structured questionnaire administered to households with a qualitative approach based on semi-structured interviews, enabling an in-depth analysis of perceptions and lived experiences.

The results show, on the one hand, a strong perception of environmental risks, particularly regarding water, air and soil pollution, and, on the other hand, a high incidence of respiratory, diarrhoeal and skin diseases within households. Statistical analyses revealed significant associations between environmental exposure and morbidity, as well as between the level of information, educational attainment and risk perception. Multivariate analysis identified environmental exposure, morbidity and information as the main determinants of perception. These results broadly confirm the central hypothesis, showing that, although perceptions are largely influenced by people's direct experience, they are also modulated by social and informational factors.

In light of these findings, it is recommended that environmental and health monitoring policies in mining areas be strengthened, that access to information and community awareness campaigns be improved, and that prevention strategies tailored to local circumstances be promoted. It also appears necessary to strengthen the role of health authorities in monitoring environment-related diseases and to require mining companies to demonstrate greater social and environmental responsibility. Finally, the active involvement of communities in decision-making processes is a key driver for sustainable risk management and for improving the living conditions of exposed populations.

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7. Acknowledgements

The authors would like to express their deep gratitude to all the individuals and institutions that contributed to this study. They would particularly like to thank the health and administrative authorities of the Kanzenze health zone for their collaboration, as well as the participating households for their time and valuable contribution to the data collection. The authors would also like to thank their supervisors, experts and colleagues for their scientific advice and guidance throughout the preparation of this article.

8. Funding

This study received no external funding and was carried out entirely using the authors' own funds.

9. Declaration of conflicts of interest

The authors declare that they have no conflicts of interest relating to the conduct, writing or publication of this article.

10. Ethical considerations

The study was conducted in accordance with the ethical principles governing scientific research. The necessary authorisations for data collection were obtained from the relevant authorities in the Kanzenze health zone. Participants were informed of the study's objectives and their informed consent was obtained prior to their inclusion. The confidentiality and anonymity of the information collected were strictly maintained.

11. Authors' contributions

The lead author was responsible for the study design, data collection and analysis, and the drafting of the manuscript. The co-authors contributed to the development of the methodology, the critical review of the content, the interpretation of the results and the final approval of the manuscript. All authors have read and approved the final version of the manuscript.

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