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# **Occupational health and safety concerns in the artisanal and small-scale mining sector:** reporting on findings from Brazil, Colombia, Zimbabwe and Uganda

Professor Gavin Hilson

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# Acknowledgements

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**Conflict of interest**

The authors have declared no conflicts of interest.

# Abstract

This report shares findings from the NEBOSH-funded project 'OHS Issues for Artisanal and Small-Scale Miners – Global Challenges', fieldwork for which was carried out in Brazil, Colombia, Zimbabwe and Uganda, four countries with dynamic artisanal and small-scale mining (ASM) economies. The aim of this project was to "protect and improve the health, safety, livelihoods and wellbeing of people who work in artisanal and small-scale mining (ASM) and who live in the communities affected by their operations". ASM sites were selected and subsequently visited in all four countries, where a standardised survey instrument was employed to interview individuals engaged in the sector. A concerted effort was made, where possible, to 'locate' the major occupational and health risks (real and perceived) in scholarly and policy debates on ASM.

Guided by analysis contained in an initial literature review, considerable attention was paid to broadening understanding of why – similar to most countries with burgeoning ASM economies – the sector is so persistently informal across Brazil, Colombia, Zimbabwe and Uganda. These informal (or semi-legalised in the most advanced cases) ASM activities are generally unregulated and unmonitored and are therefore commonly associated with specific characteristics, including a questionable health and safety record.

# Introduction

The occupational health and safety concerns of artisanal and small-scale mining (ASM) – low-tech, labour-intensive mineral extraction and processing – have been well documented. For decades, scholars have drawn attention to the precarious conditions in which the tens of millions of people engaged in ASM across the world work. In many cases, they have little choice because their decisions to pursue work in the sector are governed by the challenging economic circumstances they and their families face.[1]

The reviews of occupational health and safety at ASM sites are indeed diverse. From the material published, however, there are three categories into which this burgeoning body of scholarship can be placed. The **first category** focuses on the questionable conditions of ASM working environments, in particular the hazards associated with poor (mine) planning. Examples include rock falls, pit cave-ins and accidents associated with machine use.[2]

The **second category** focuses on the health-related impacts associated with chemical additives, notably mercury and cyanide,[3] both of which are used to extract gold from ore. Their use has captured the interests of scholars who have undertaken work to provide a glimpse of what health-related ailments those exposed to elemental mercury (and subsequently, methylmercury) and cyanide are at risk of contracting. The **third category** focuses on the diseases linked to the work conditions individuals engaged in ASM are at risk of contracting. Key examples include silicosis, waterborne diseases, and sexually transmitted infections transferred between workers and residents of local communities.[4]

To better understand the occupational health and safety concerns at ASM sites, research was carried out in four countries where the sector is deeply rooted and dynamic: Brazil, Colombia, Zimbabwe and Uganda. This research was funded by NEBOSH, under the project, 'OHS Issues for Artisanal and Small-Scale Miners – Global Challenges'. The aim of this project was to "protect and improve the health, safety, livelihoods and wellbeing of people who work in artisanal and small-scale mining (ASM) and who live in the communities affected by their operations". In each of the four countries, ASM sites were selected and visited, and then a standardised survey instrument was employed to interview individuals engaged in the sector. A concerted effort was made to shift away from gold, the extraction of which using mercury and cyanide has been covered extensively in the literature on occupational health and safety. In fact, a case could be made that coverage of the impacts of cyanide and mercury use in gold extraction has been so exhaustive that it has obfuscated analysis of the broader occupational health and safety problems plaguing ASM.

Throughout the research, attempts were made to 'locate' the occupational health and safety concerns at ASM sites in scholarly and policy debates on the sector. Specifically, and to recap, in the preliminary literature review carried out for this project,[5] considerable attention was paid to broadening understanding of why ASM is so persistently informal across the globe.

1. **Schwartz, F.W., Lee, S., Darrah, T.H. (2021).** A Review of the Scope of Artisanal and Small-Scale Mining Worldwide, Poverty, and the Associated Health Impacts. GeoHealth 5(1):e2020GH000325; Omotehinse, A.O., Ogunlade, S. (2022). A systematic review of artisanal and small-scale mining: Impacts in alleviating poverty in Africa. SN Social Sciences 2(197):26.
2. **Bansah, K.J., Yalley, A.B., Dumakor-Dupey, N. (2016).** The hazardous nature of small scale underground mining in Ghana. Journal of Sustainable Mining 15(1):8–25; Smith, N.M., Ali, S., Bofinger, C., Collins, N. (2016). Human health and safety in artisanal and small-scale mining: an integrated approach to risk mitigation. Journal of Cleaner Production 129:43–52.
3. **van Straaten, P. (2000).** Mercury contamination associated with small-scale gold mining in Tanzania and Zimbabwe. Science of The Total Environment 259(1–3):105–113; Esdaile, L.J., Chalker, J.M. (2018). The Mercury Problem in Artisanal and Small-Scale Gold Mining. ChemEurJ 24(27): 6905–6916.
4. **Majaha, M., Chikwari, C.D., Kizito, S., Moyo, D., Ssewamala, F. (2024).** HIV and alcohol misuse among miners in Zimbabwe. The Lancet 404(10471):2538.
5. **Hilson, G. (2025).** Occupational health and safety concerns in the artisanal and small-scale mining sector: A review. Resources Policy 110, Art. 105733.

A combination of exorbitant permit fees, bureaucratic licensing application procedures, and a shortage of mineralised land due to significant territory being demarcated as concessions to mineral exploration and mining companies, discourages people from engaging in ASM formalisation processes.

It is the trajectory which these circumstances push individuals along, however, that is of central importance to the present discussion. In the informal settings where most ASM activities are found, including those visited in the four study countries, operations unsurprisingly exhibit the attributes commonly associated with entities that are unregulated and largely unmonitored. Heading this list is a questionable health and safety record.

This report shares findings from the research conducted in Brazil, Colombia, Zimbabwe and Uganda. It proceeds, in Section 2, by outlining the research methodology adopted. Attention is then paid to the findings gathered in each of the four countries: Section 3, Brazil; Section 4, Colombia; Section 5, Zimbabwe; and Section 6, Uganda. Section 7 presents concluding remarks. The findings contribute to the three categories of literature on occupational health and safety in ASM identified above.

# 2. Methodology

The report draws on findings retrieved using a standardised survey instrument (Appendix I), which was refined on multiple occasions, based on feedback from participating researchers and the project's main investigators. The survey instrument was developed to gather data which the team believed could address the main aim of the project (i.e. "to protect and improve the health, safety, livelihoods and wellbeing of people who work in artisanal and small-scale mining (ASM) and who live in the communities affected by their operations"). Research was carried out simultaneously across the four study countries.

In Brazil, 171 miners were interviewed across four sites. Three of these sites – Araçuaí, Itinga and Coronel Murta – are in the state of Minas Gerais. The fourth, Vila Nova (district of Porto Grande), is in the state of Amapá. In Colombia, data were gathered from interviews with 33 miners operating in Quibdó and Tadó, in the Department of Chocó. In Zimbabwe, 189 miners were interviewed in Kadoma, Sanyati District. Finally, in Uganda, 49 miners were interviewed in Kabale, Wakiso, Kasanda, Amudat and Moroto.

The details of the individuals interviewed are shared in **Table 1.** This and additional quantitative information, along with complementary qualitative data, was inputted into KoboToolbox in real time; it was later coded and analysed, much of which is presented in this report. The sections that follow draw on these data, with the goal of painting a picture of occupational health and safety concerns at ASM sites in the four study countries.

**Table 1:** Details of individuals interviewed in the study countries

| Country | Number interviewed | | Marital status | | | | No. of children (mean) | Age (mean) | Education level | | | | Number of years mining |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Men | Women | Married | Single | Divorced | Widowed | | | P | S | T | None | |
| Brazil | 161 | 10 | 62 | 92 | 13 | 4 | 2.95 | 45.4 | 89 | 73 | 5 | 41 | 18.04 |
| Colombia | 22 | 9 | 14 | 14 | 2 | 1 | 4.74 | 58.7 | 13 | 8 | 7 | 3 | 36.74 |
| Uganda | 25 | 27 | 34 | 7 | 7 | 3 | 3.14 | 33.25 | 22 | 17 | 3 | 12 | 5.14 |
| Zimbabwe | 106 | 83 | 117 | 39 | 14 | 18 | 2.6 | 37 | 124 | 47 | 8 | 9 | 8.68 |

# 3. Brazil

In Brazil, researchers first visited Araçuaí, Itinga and Coronel Murta (Minas Gerais). Additional research was then taken at Vila Nova (Porto Grande) (Amapá) (*Figure 1*). The findings from fieldwork are shared in this section. In Brazil, ASM operators must comply with a range of regulations and legislation (**Table 2**), which has proved burdensome, discouraging legalisation and ultimately fueling the sector's informality.

**Table 2:** Main laws governing ASM in Brazil

| Relevant Laws and Licence for ASM | Details of Licensing / Formalisation Process for ASM | Major Barriers to Formalisation | Main Health and Safety Regulations for ASM |
|---|---|---|---|
| Mining Code of 1967; Federal Constitution of 1988; Law No. 7805/1989; Law No. 9,605/1998; Law No. 11,685/2008; Decree No. 9.470/2018; Law No. 15,190/2025 | Federal Constitution of 1988: Promote ASM organisation in cooperatives.<br><br>Law No. 7805/1989: established the Mining Permit Regime (PLG) in alluvial, eluvial and colluvial forms.<br><br>Law No. 9,605/1998: Environmental Crimes Law prohibits mineral exploration or extraction without authorisation or licence.<br><br>Law No. 11,685/2008: Defines a garimpeiro 'miner' as a Brazilian national who individually or collectively[6] extracts mineral substances[7] suitable for artisanal mining, and a garimpo 'mining site' as the locality where such extraction occurs with exploitation of the deposit.<br><br>Decree No. 9.470/2018: Promulgates the Minamata Convention on Mercury, establishing the international treaty that limits the use of mercury in Brazilian territory.<br><br>Law No. 15,190/2025: established rules for licensing activities or projects that use environmental resources and may cause pollution or environmental degradation. | Restricted access to areas for formalisation due to mineral rights already held by other title holders.<br><br>Lack of technical assistance for formalisation. Weak governance and limited professional capacity in some cooperatives.<br><br>Presence and expansion of organised criminal groups in the gold supply chain.<br><br>Structural fragmentation and informality of the artisanal mining sector, facilitating the operation of illegal networks.<br><br>Lack of funding for technical and environmental studies. | Regulatory Standard No. 6 (NR-6) established guidelines for the provision, use and management of personal protective equipment (PPE) in all work sectors.<br><br>Regulatory Standard No. 22 (NR-22) defines parameters for planning and developing mining activities, with a focus on workers' health and safety.<br><br>Risk Management Program (PGR) established procedures to identify, assess and control occupational risks through the Risk Inventory and Action Plan.<br><br>Internal Commission for Accident Prevention in Mining (CIPAMIN) identifies risks, proposes improvements and supports accident prevention being mandatory for mining companies with 10 or more employees. |

6. Formalisation categories are (I) autonomous work, (II) work under a family economy regime, (III) individual work with the formation of an employment relationship, (IV) partnership contracts registered by private instrument in a notary office, and (V) participation in cooperatives or other forms of association.
7. Minerals considered suitable for artisanal mining include gold, diamonds, cassiterite, columbite, tantalite and wolframite in alluvial, eluvial and colluvial deposits, as well as scheelite, other gemstones, rutile, quartz, beryl, muscovite, spodumene, lepidolite, feldspar and mica.

*Figure 1: Locations of study sites visited in Brazil*

## 3.1 Site descriptions and methodology

### 3.1.1 Minas Gerais

The fieldwork conducted in Minas Gerais began with a preliminary remote engagement. Initial contact was established by phone with a cooperative leader in Araçuaí, during which the team outlined the project's objectives, scope and methodological approach. From 8 to 10 July 2025, the Lithium Business event took place in Araçuaí. The Brazil-based team members participated, with the hope of meeting members of the cooperative's executive to communicate the next steps of the fieldwork. Contact was initiated with a professor from the Federal Institute campus in Araçuaí to explore academic collaboration and possibilities for local institutional support for data collection.

The fieldwork was then divided into two phases. The first phase consisted of a pre-field visit, during which meetings were held with local actors. No formal interviews were conducted at this point because the project had not received approval from the university Ethics Committee. The team also mapped key actors in the sector and assessed logistical conditions for data collection. The second phase was carried out after the project was approved by the Ethics Committee. Access to mine sites was facilitated by cooperative leaders and expanded through access with local miners. The team travelled by car to several mining operations and conducted interviews with miners both during the day and in the evening.

The fieldwork in Minas Gerais was undertaken in August 2025 in the Middle Jequitinhonha Valley (*Figure 1*). The work began in the municipality of Montes Claros, from where the team travelled approximately 380 km by car, following the BR-451, LMG-677 and BR-367 highways, to reach Araçuaí. They visited four strategic locations: the municipality of Araçuaí, the quilombola community of Jenipapo 3, the district of Taquaral de Minas (Itinga) and the municipality of Coronel Murta. The selection of these sites was facilitated with local mining leaders and considered based on their socioeconomic importance locally.

The team held six meetings with cooperative leaders, community representatives and technical stakeholders focused on presenting the project and understanding the challenges faced by local communities. The discussions revealed a growing social and political movement in favour of formalising artisanal mining activities. The emphasis on occupational health and safety was expected to provide an important contribution to strengthening such initiatives at the local level. The team observed eight mining operations involving gemstone and lithium extraction and they visited one hospital and two Basic Health Units (UBSs), which are local public healthcare facilities in Brazil.

### 3.1.2 Amapá

In Amapá, the fieldwork methodology followed a structure similar to that adopted in Minas Gerais. Initial contact was established through email and phone meetings with professors at the Mining Technical Program at the Federal Institute of Amapá. The team presented the project objectives, and discussions were held to define how the Institute could support the field activities. A technical cooperation agreement was established, and two students were recruited to assist with the fieldwork.

In parallel, virtual meetings were conducted with representatives from the State Secretariat of Mining of Amapá and with a leader from the Vila Nova Mining Cooperative. The purpose was to formally present and clarify the scope of the project and align the logistics for field access. The fieldwork dates were coordinated with the Vila Nova Mining Cooperative to organise data collection in the region. The team stayed at the cooperative's accommodation. Access to mine sites was facilitated both by the cooperative and independent miners who were not formally associated but who granted authorisation to the research team to visit their operations and conduct interviews.

For decades, the main vocation in this state has been mineral extraction. In 1937, gold was discovered in lands in and around the Araguari River, which attracted immigrants who would go on to occupy the lands of the current municipality of Porto Grande. After a series of conflicts and impasses between the miners and Mineração Amapari, the holder of exploration rights here, an intervention was made by the federal courts. In 2009, following a court decision, the COOPGAVIN won the right to develop gold mining and agricultural activities in an area of 406 hectares previously under the company's domain.[8]

In Vila Nova, the team observed multiple mining fronts distributed throughout the area. On each front, local leadership exercises practical control over operations and is recognised by the other workers as responsible for the space, functioning as a kind of 'informal owner'. This arrangement persists even in the presence of a cooperative. There are an indeterminate number of inactive mining fronts and more than 15 active mining fronts in the area. They are all medium-sized and developed predominantly by open-pit means, with an average length of between 50 and 200 metres. Each front has, on average, 15 miners.

8. Oliveira, M. J. (2010). Diagnóstico do setor mineral do Estado do Amapá. IEPA, Macapá.

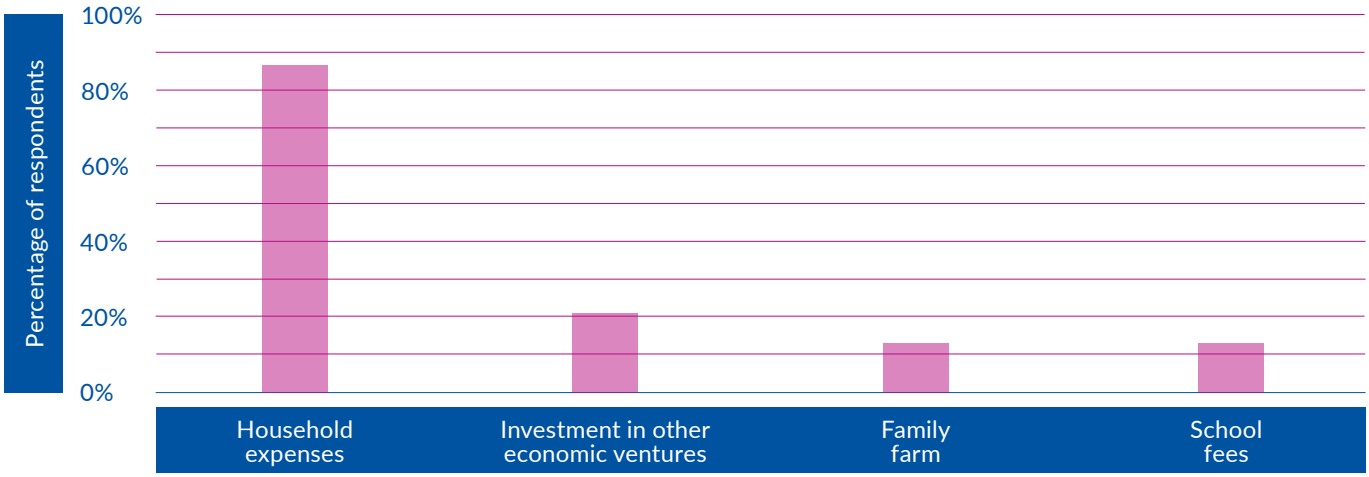
## 3.2 Findings

### 3.2.1 General

Most (53.8%) interviewees claimed to be married, although a high percentage (36%) were divorced. Only a small number (2.34%) were uneducated; approximately 52% had only completed their primary education, while 42.7% had finished secondary education. The average number of years' experience mining among the group was 18.04, although some insisted they had been mining for more than four decades.

More than 80% of respondents claimed to be engaging in ASM to generate income to help cover household expenses. Contrastingly, approximately 20% of respondents reported that they use their earnings to finance other economic activities, while 13% claimed to use monies to support the family farm and another 13% to pay children's school fees (*Figure 2*). Thirteen respondents indicated 'other' when asked what they spend their earnings on, a list that included a motorbike and a driver's licence. Regardless, overall, these findings, along with observations made at individual sites, point to the miners who the team interacted with across all four study locations being driven to work in the sector out of desperation.

*Figure 2: What respondents use mine earnings for*




When quizzed on accident types, 42% cited "pit collapse" as the most common health and safety threat. This was followed by "falls" (28.6%), "use of machinery" (27%) and "crushing" (12%). Roughly one third (35.7%) indicated that there were "other" concerns that were pressing on the health and safety front. When probed further, respondents reported threats from dangers linked to explosives, through illnesses caused by dust inhalation and exposure to fumes, to being stung or bitten by a venomous animal.

These concerns are more pressing at the sites visited in Minas Gerais, where informality is far more widespread than in Amapá. Close to 90% of respondents in Minas Gerais indicated that they were operating informally. The lack of a regulatory presence means that these areas are generally unmonitored. This puts the lengthy distances the 88 individuals interviewed in Minas Gerais are from a health clinic (15.2 km on average per respondent) into the spotlight: in unregulated terrain, a coordinated response to an accident is less likely. Not having the security of tenure that a permissão de lavra garimpeira and a licença ambiental provide puts these miners at a distinct disadvantage when it comes to accessing education and resources on occupational health and safety from the state because, as Plate 1 and Plate 2 capture, work conditions are extremely poor at sites in Minas Gerais.

*Plate 1. Extraction front on a slope with instability risks, where access is narrow*

*Plate 2. Mining shaft accessed via an improvised wooden ladder, with high instability and safety risks*

Miners in Minas Gerais are constantly on the move and, without the security of a permit, are unlikely to engage. This was on full display during the site visit when many interviewees expressed reluctance to communicate, over fears of the team reporting them to the authorities. Their paranoia was justified: they were guarded because of recent police actions in the area aimed at cracking down on informal ASM activities. Before concluding the fieldwork, team members did broach this issue with local leaders and reassured them that the information would be presented in a neutral and analytical manner, without identifying operations or exposing them to enforcement actions. But concerns remained high.

### 3.2.2 Minas Gerais

#### *3.2.2.1 More on informality*

In Araçuaí, there is a strong presence of gemstones: black, blue, bicolor and colorless tourmaline, milky and solid quartz, quartz crystals, rose quartz, citrine, smoky quartz, beryl, garnet, spodumene, cassiterite, tantalite-columbite and autunite. In Araçuaí and Coronel Murta, the local market for precious stones is highly concentrated, and the dynamics of commercialisation are problematic, because miners sell their stones at very low prices to intermediaries who operate as loan sharks and resell the material for up to 10 times as much in urban centres such as Teófilo Otoni and Governador Valadares.

The issue of small-scale lithium mining was considered to be of little relevance by most of the interviewees. Only in one area the team visited was lithium extraction carried out manually by miners who store it in bags and sell it in the parallel market. Informal reports suggest that similar practices occur in other parts of Araçuaí, although this was not directly verified by the team.

Much of the mining activity in the region occurs informally. This is mainly because other people or companies own the mining rights, which prevents miners from being able to formalise and work legally. From the point of view of the governance of the ASM sector, formalising mining has been strongly associated with adopting the cooperative model. Local leaders have promoted this strategy because they understand that it can facilitate access to mining regularisation.

High informality has led to frequent police operations in the region, which interviewees believe has led to a significant reduction in mining activity and to workers being arrested. This has directly impacted on the income of families who depend on mining. The issue of police operations had a major impact on the fieldwork. There could have been more interviews but miners were afraid of sharing details with the team, despite the support and mediation of local leaders. Even in areas where family farming predominates and there is less direct contact with mining, the sector still appears to be a complementary source of income. A cultural memory linked to mining was also evident: residents of rural communities often observe stones and rock formations on their lands in the hope of identifying possible deposits underground.

Across the seven informal gemstone mining operations visited, parallel informal lithium extraction was taking place; only one of the gemstone mining operations visited was licensed. In Araçuaí, the team observed open pits (garimpos) approximately 20 metres deep, with manually excavated horizontal galleries extending for hundreds of metres. In other areas, they identified shafts supported with wooden structures and equipped with ducts and air pumps for ventilation. Material transport was carried out manually using wheelbarrows and sacks, which were later stacked and stored in the field for sale. The team also found abandoned excavations; there was little evidence of appropriate mine closure procedures having been followed.

The selection of gemstone mine sites visited was informed by the team's knowledge and experience, along with the physical and geological characteristics of the area – soil type, topography, water runoff, infiltration conditions and local lithological structures. The concentration of gemstones in cavities varies across veins. In some cases, gemstones are highly concentrated in small pockets, whereas in others they are dispersed over larger contact zones. When miners identify areas with a high probability of occurrence, they resort to using hydraulic breakers and explosives to access the deposits. Once the site has been defined, tunnels or shafts, commonly known as catras, are drilled and opened and excavated vertically in rectangular or square shapes, for access to galleries that extend horizontally. These tunnels may follow a straight line or branch in different directions, depending on local conditions, reaching considerable depths.

The team visited the District of Taquaral de Minas, where they identified abandoned small open-pit catras. These excavations had an exploratory character, carried out with the aim of verifying the presence of gemstones. It was clear that if no relevant mineral occurrence was found, pits were left exposed or were partially reclaimed. A panoramic observation of the mountainous region revealed numerous such marks on the landscape, aligned side by side, forming a clear pattern of environmental degradation. This process can cause siltation, soil instability and cumulative environmental impact. Another aspect recorded during the fieldwork was extraction mounds with white stains, visible on the mountainous terrain; this is commonly associated with illegal mining. When police operations were carried out by environmental agencies, some miners opted to work at night to avoid surveillance. The team observed, between 4 and 5pm, individuals riding motorcycles and carrying toolboxes (hammers, torches) to mining fronts.

#### *3.2.2.2 Occupational health and safety concerns*

The operations visited were small in scale, and carried out without adequate protective measures and often under poor lighting conditions. This combination of factors compromises workers' physical integrity and significantly increases the risk of accidents and exposure to occupational diseases.

Since most mining activities take place informally, there are no written, legally binding instructions. Most operators abide by verbal agreements. Working conditions are extremely precarious. Many workers are exposed to high risks, with no access to health or life insurance. Individuals are often barefoot or in open rubber sandals and work in wet clothing due to high humidity and temperature. There is a high risk of pit collapses, because many support structures are made of wood and rarely maintained. The risk of falls when moving through the tunnels and accessing deeper levels of the mines is also high.

Among the main occupational and health-related risks observed at lithium extraction points was fine silica dust, overexposure to which can lead to respiratory problems such as silicosis. This is induced by intensive drilling in dry, poorly ventilated and/or enclosed conditions, similar to what has been reported at other ASM sites in the country.[9] Although miners are aware of these risks, few use appropriate PPE. Where protection is employed, most of the strategies are improvised: wearing low-efficiency masks, using eye drops, and even drinking paratudo (a local alcoholic beverage made from herbs, roots and extracts, which is believed to have medicinal properties capable of reducing the harmful effects of mining).

Most of the miners present acknowledged the health risks associated with ASM. But limited access to educational resources and the appropriate PPE restricts their ability to operate safely and to change their practices. The use and handling of explosives was also identified as a potential safety hazard, since most are sold illegally and without any form of regulation. The miners shared details of a worker who had lost vision in his right eye due to improper handling of explosives inside the mine. Yet, despite the accident, the individual continues to work as a miner. During one of the visits, the team sought to gauge miners' interest in training and capacity-building programmes. Most expressed interest, emphasising that the ideal approach would be on-site training because this allows for practical demonstrations of how tasks should be performed. One of the topics discussed was providing a blasting course that focuses heavily on the handling of explosives and re-entry times; this would be a valuable resource for miners at most of the sites visited. Regarding the trade of informally extracted lithium, bags of ore were observed being removed directly from mining fronts and stored in the field for commercialisation. Although discussions were held with local leaders, it was not possible to clarify the dynamics of this lithium trade. It was noted, however, that intermediaries acquire the material and resell it in other locations.

9. Souza, T.P., Watte, G., Gusso, A.M., Souza, R., Moreira, J.D.S., Knorst, M.M. (2017). Silicosis prevalence and risk factors in semi-precious stone mining in Brazil. American Journal of Industrial Medicine 60(6): 529–536.

#### *3.2.2.3 Field visits to healthcare units*

The team visited São Vicente de Paulo Hospital in Araçuaí and two UBSs – the Posto de Saúde da Comunidade de Jenipapo 3 and the Unidade Básica de Saúde Percílio Pereira da Silva. As indicated, UBSs are local public health facilities in Brazil that provide basic medical care, disease prevention and population health monitoring. They also coordinate health campaigns on issues such as dengue fever, malaria, COVID-19, vaccinations, hepatitis, sexually transmitted diseases, yellow fever, oral health, mental health and first aid.

At one of the UBSs, team members were received by the head nurse. It quickly became apparent that there was little awareness of whether miners attended the facility. In general, all patients are treated without distinction of occupation. It was discovered that many miners do not register or report work-related accidents to avoid exposing the whereabouts of their activities and incurring regulatory inspections. This behaviour creates significant challenges for formulating and implementing effective public health policies targeting artisanal miners.

### 3.2.3 Amapá

#### *3.2.3.1 General*

Fieldwork took place within the area titled to COOPGAVIN in the Vila Nova Mining Community. Access to the site is primarily via BR-210, approximately 182 km from the state capital of Macapá. In Vila Nova, the team confirmed multiple mining fronts, distributed widely across the concession. At each front, local leadership exercises practical control over operations and is recognised by other workers as being responsible for the space, functioning in the capacity of an 'informal owner'. This arrangement persists even in the presence of a cooperative.

Mining activities follow, on average, two daily shifts. The first takes place from 8 am to 11:30 am and the second from 2 pm to 6 pm; an average shift lasts between seven and eight hours per day. The general scale of mining was classified as 'medium' – a practical division of tasks between workers and a certain work routine, but no formal planning. Miners do not wear PPE, with the occasional exception of helmets, gloves and rubber boots.

The work environment is characterised by multiple concurrent occupational hazards. Observed physical risks include noise, heat, dust, vibration, risk of falls, and exposure to moving machinery. Workers are also exposed to chemical agents such as oil and grease, as well as biological hazards associated with contact with contaminated water and microorganisms that could lead to outbreaks of diseases, many of which may not yet be documented.[10] Identified ergonomic risks are related to high levels of physical effort and inadequate working postures, which are aggravated by the fact that mining activities take place in open-pit setups. In addition, workers are exposed to psychosocial stressors, including fatigue and pressure to increase productivity.

During fieldwork, some interviewees stated that they used mercury, while others denied doing so. In practice, mercury was not shown to the field team, under the justification that mining activities were halted at the time of the interviews. However, local leaders later confirmed that mercury use is common.

10. A good example of this is in South Africa, where sporotrichosis, a disease that arises from a fungal infection caused by members of the Ascomycete genus Sporothrix, has been widespread in the past. It was strongly associated with gold mining in the country, and a large number of workers were infected with it in the 1930s and 1940s. It is believed to have been brought on by hot humid conditions and timber supports used in mine shafts. It is a potentially reemerging disease where traditional mining techniques feature. See Govender, N.P., Maphanga, T.G., Zulu, T.G., Patel, J., Walaza, S., Jacobs, C., Ebonwu, J.I., Ntuli, S., Naicker, S.D., Thomas, J. (2015). An Outbreak of Lymphocutaneous Sporotrichosis among Mine-Workers in South Africa. PLoS Neglected Tropical Diseases 9(9): e0004096; Fuchs, T., Visagie, C.M., Wingfield, B.D., Wingfield, M.J. (2024). Sporothrix and Sporotrichosis: A South African Perspective on a Growing Global Health Threat. Mycoses 67(10):e13806.

### *3.2.3.2 More on mercury*

Of the 82 interviewees who were asked "How important is mercury to mining?", all indicated it was indispensable. Responses such as "[mercury is] Cheaper and more practical", "Difficult to operate without it due to high investment costs", "Easier with mercury", "Gold is very fine; requires mercury" and "No alternative available" were elicited. Even the 41 people who admitted to knowing about potential alternatives to mercury, citing innovative sluice boxes and centrifugal processes, conceded that any transition away from amalgamation would be challenging.

The even bigger challenge in a location such as Amapá would be instituting an occupational health and safety programme linked to mercury use, given the legal statuses of sites. Strictly speaking, a holder of a small-scale mining licence (permissão de lavra garimpeira) can use mercury but the IBAMA (Brazil's federal environmental agency) has banned imports of it. In practical terms, therefore, no legal supplies of mercury are circulating in Brazil's ASM communities. To use mercury, the holder of a permissão de lavra garimpeira must 1) secure a valid Environmental Licence to Operate, which is issued by the relevant agency (normally, the provincial/state-level environmental authority), with the explicit authorisation to use mercury; and 2) register with IBAMA in accordance with the Instrução Normativa 26, de 10 de dezembro de 2024, the most recent regulation that provides guidance on how to import, use, recycle and dispose of mercury.

The mercury supplies circulating in Amapá, therefore, have been informally sourced but are being managed by individuals who are legally entitled to do so. This supply chain for mercury here is likely embedded within Amapá's complex gold distribution network. The miners and cooperatives found here sell gold to authorised buyers, who are legally registered and operate out of shops. Observations, however, suggest that some of the gold being produced in Amapá on an artisanal and small scale circulates in informal channels. The price paid per gram of gold varies significantly by region, especially in remote areas. The distance from major cities in particular impacts on the local price miners receive for gold.

How, then, can these occupational health and safety concerns be aligned with formalising the sector? There are rumours of Brazil pursuing implementation of occupational health and safety regulations specific to ASM. In the meantime, the most practical strategy for addressing these concerns is to ensure ASM groups have the requisite titles to access mineral deposits legitimately. Only then can more focused action – both research and policy intervention – be taken to address the occupational health and safety concerns identified in the field research conducted in Minas Gerais and Amapá.

# 4. Colombia

## 4.1 Site descriptions and methodology

The two main locations targeted in Colombia were Quibdó and Tadó, both of which are in the Department of Chocó (Figure 3). Interviews with artisanal miners were conducted in the main square (parque principal) of Tadó during a public event jointly organised by the municipal government (alcaldía) and the departmental government (Gobernación del Chocó). The purpose of this event was to collect census-type information from the local population and to disseminate basic information on education and health. In addition to quantitative data (population, income, access to services), several qualitative observations and narratives contextualise the situation in Quibdó and Tadó.

Access to these artisanal miners was facilitated by the National Mining Commission (April 2025), with participation from mining union leaders to support safe and feasible contact with workers. Although data collection was initially planned for May 2025, interviews were postponed until the structured questionnaire received formal Ethics Committee approval (July 2025), following a review process coordinated with the Commission. After approval, fieldwork was planned across multiple departments (including Nariño, Caldas and Chocó). However, local authorities in Nariño and Caldas later advised against proceeding due to security considerations; consequently, data collection was concentrated in Chocó. Several attempts were made to administer the survey instrument during public outreach activities in Quibdó and surrounding areas (August–September 2025) but these were affected by event cancellation, low attendance of informal-sector miners, and lack of authorisation for the research team to participate in a large community activity.

Ultimately, survey interviews were conducted in November 2025 during the public event in Tadó (Chocó), convened with support from the Ministry of Health and the departmental government. Approximately 600 miners from Tadó and nearby villages were invited; attendance was substantially lower than expected following reported security threats in the days preceding the event. Thirty-one miners consented to participate and completed the interviewer-administered questionnaire. Many participants emphasised that they did not use mercury and viewed it as unnecessary, frequently referencing its illegality and potential implications for eligibility for government support. The laws in place governing ASM in Colombia are shared in Table 3.

Interviewees' responses indicate a potential social desirability and legal-risk reporting bias in self-reported mercury-related practices.

*Figure 3: Location of public event in Tadó*

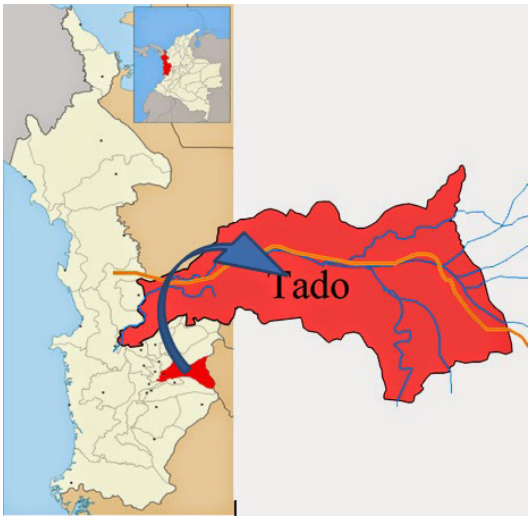


**Table 3:** Main laws governing ASM in Colombia[11]

| Relevant Laws and Licence for ASM | Details of Licensing / Formalisation Process for ASM | Major Barriers to Formalisation | Main Health and Safety Regulations for ASM |
|---|---|---|---|
| Law 681, 2001; Law 1955, 2011; and Law 1753, 2015. | Law 685: national mining code. One-size-fits-all approach: the same requirements for all types of mechanised mining.<br><br>Law 1955: different requirements for 'traditional' and 'subsistence' mining.<br><br>Law 1753: regulates to some extent mining coexistence. | Low trust in state institutions.<br><br>Many different avenues for ASM formalisation create confusion; instruments change all the time.<br><br>A lack of funding for technical and environmental studies.<br><br>Uncertainty where mining is allowed.<br><br>Informal/illegal miners in titled areas.<br><br>A shortage of updated and reliable titling and geological information.<br><br>A lack of technical assistance.<br><br>Constant changes in regulations, which causes uncertainty.<br><br>A lack of coordination between mining and environmental authorities.<br><br>Significant delays in licensing procedures. | There is no legal framework in Colombia that addresses health and safety issues for ASM.<br><br>But miners are required to comply with health and safety measures at their operations contained within the country's broader regulatory apparatus (SST, Seguridad y Salud en el Trabajo).<br><br>The more established mines usually employ people who specialise in these topics.<br><br>The primary goal seems to be to prevent accidents and physical exhaustion, and to ensure chemicals and explosives are handled in ways that reduce risks. |

### 4.1.1 Tadó

Tadó is a municipality in the Department of Chocó, founded on 19 March 1533. It has an estimated population of 20,000, of whom roughly 11,000 live in the urban centre. The local economy is heavily supported by mining – predominantly informal activities – with a focus on gold and platinum. These activities are complemented by informal agriculture, mainly the harvesting of subsistence crops such as plantain and cassava (yuca).

The miners interviewed in Tadó identified themselves as artisanal miners, or *barequeros*.[12] They reported having migrated from surrounding rural communities (*veredas*) including Angostura, Carmelo, Corcobado, Gingarabá, Guarato, Manungará, Mumbú, Playa de Oro, Tabor and Tapón. Although they are actively involved in mining, most stated that they did not know who holds the formal (mining) titles in the areas where they work, nor whether the operations are licensed. The ore they extract is sold in a specific spot in the main square of Tadó. This pattern, combined with the lack of clarity about ownership and permits, underlines the largely informal/illegal character of the mining economy.

11. Refined from information obtained from Kauffmann, C. (2025). Personal Communication.
12. A local label given to traditional artisanal miners who pan for gold.

Family structures are predominantly informal unions (*unión libre*), with an average of five children per household. Miners reported that children generally attend school; however, access to university or tertiary education is rare. In terms of income, miners reported that in a "good" week they may earn between 200,000 and 300,000 COP, but there is no stable daily income: they only earn when they find gold, and if they do not find anything, they earn nothing. Women participate actively in mining and often perform similar tasks to men. Several women reported that they prefer mining over domestic work, which is poorly paid and often associated with abuse or mistreatment. When asked why they remain in mining, the most common answer was: "There are no other options; we have no other opportunities." Regarding access to health services, the time it takes to reach emergency care ranges from 15 minutes to three hours, depending on the distance from the mine, road conditions and transportation availability. Tadó and its surrounding areas are heavily affected by illegal armed groups controlling movement in and out of the territory, particularly on the road to the neighbouring department of Valle del Cauca. This significantly restricts mobility, employment options, and access to health and other basic services (Box 1).

The fieldwork coincided with the funeral of two 16-year-old boys who had died the previous day in a work-related accident. They had accepted a temporary job loading a truck to earn money to hire formal clothing for their high-school graduation ceremony. The truck suffered a brake failure and ran them over, killing them instantly. From around 2pm, almost all commercial and daily activities in Tadó were suspended as the entire town took part in the funeral procession. Community members said that many young people die either in mining accidents or in informal work incidents, indicating how normalised fatal occupational events have become in local life.

**Box 1: Between Rocks and Families: Stories of Miners in the Informal Mining of Tadó**

Mining activities in the Tadó region of Chocó predominantly occur informally, often without the required environmental licences. This sector is characterised by a mixed-gender workforce, and it represents a trade that has been passed down through generations, becoming an integral part of family identity and local economy.

The profile of mining workers is distinctive. On average, they have dedicated more than 50 years to mining labour, reflecting the longevity and continuity of this occupation in the region. The family structure is also notable; miners marry up to three times and belong to families with high birth rates, resulting in extensive family networks deeply intertwined with mining activities.

In terms of lifestyle and habits, alcohol consumption is significant, while access to health insurance and services remains precarious. Despite the challenges posed by inadequate infrastructure and occupational safety, many workers exhibit apparent good physical health, which may be indicative of the demanding manual labour they engage in daily. Illegal mining in Tadó not only serves as a source of income but also acts as a cultural and social component that shapes the lives of families and communities. This trade, though fraught with risks, is valued and passed down through generations, establishing a way of life that blends tradition, resilience and exposure to occupational and health hazards.

### 4.1.2 Quibdó

Quibdó is the capital city of the Department of Chocó and the seat of the departmental government. Yet, despite its status as a capital, the city is underdeveloped with failing infrastructure. Many vehicles are in poor condition, streets are narrow and poorly maintained, and traffic rules are largely ignored. Driving behaviour is often reckless, increasing the risk of road traffic accidents.

During the visit, there were power cuts after 6pm, affecting everyday life, safety, and businesses and services. Internet access is also limited and intermittent. Although people are generally welcoming, there is an intense sense of resignation regarding their living conditions and the lack of opportunities beyond mining and small-scale agriculture. As the departmental capital, Quibdó concentrates formal state structures (the governor's office, departmental agencies, higher-level health services, etc.), but the perception on the ground is that having these institutions has neither translated into substantial improvements in living conditions or effective regulation of mining or security, nor led to improved access to basic services across the wider region.

## 4.2 Findings

### 4.2.1 General

The findings point to most of the miners interviewed falling into the 'poverty-driven' category of operator. Close to 70% of respondents reported that they rely on their earnings to pay for household expenses. For some interviewees, the revenue earned from ASM supplements their main source of revenue from other activities. They gave responses such as "[I am] supported by agriculture", "[I am] supported by other activities", "It depends on the time of year" and "Enough to survive". For others, however, ASM is truly complementary and essential economically, providing an equivalent or even more significant source of income to other economic activities, often across seasons. This group gave responses such as "[It] alternates with agriculture by planting bananas", "[It is] seasonal, and must plan money very well", "[It] supports income with construction work" and "[I] supplemented the money with agricultural work". Close to 90% of these interviewees reported using these mine earnings to help cover household expenses.

A concern is that 54% of these interviewees claimed to be working in unlicensed areas. The reasons given included "Ease of extraction by the landowner", "There is no other option and we have needs", "There are no other options", "It is very expensive to have a licence" and "I don't know of any licensed sites". The latter two points are particularly important because they capture what has been said about Colombia's ASM formalisation processes for decades: that they are complex and discourage legalisation (Table 3). As explained by Massé and Munevar,[13] this is largely attributable to a plethora of overlapping legislation and directives. The authors rightly claim that while the country's 2001 Mining Code indicates that "the right to explore and exploit mines that are state property can only be granted through a concession title registered in the National Mining Registry" (Law 685, art. 14, 2001), the moves that the country's policymakers have since made run counter to this. This includes allowing *barequeros* who had applied to formalise their operations (including the first batch who did so between 2002 and 2004, and the second batch after 2010) to produce gold legally while their application for their small-scale mining licence (título minero para pequeña minería) was being reviewed. Those who are registered in the mayor's office in their respective municipality are also authorised to produce gold without a title (Decrees 276 of 17 February 2015, 0933 of 9 May 2013 and 2390 of 24 October 2002), which has further complicated matters, particularly among law enforcement officers, who are often unsure whether these operators are legally entitled to work.

Administrative delays in processing these requests are inevitable, blurring the division between 'illegal' and 'legal' miners, and 'informal' and 'criminal' activity. Records reveal that in a single sampled month (July 2013), 39% of the 8,125 requests for ASM formalisation were rejected for not following the correct (formalisation) procedures developed based on Law 1320 of 2010 and Decree 933 of 2013. It is therefore unsurprising that at least 85% of Colombia's ASM operators work in the informal economy.[14]

13. Massé, F., Munevar, J. (2016). Due Diligence in Colombia's Gold Supply Chain: Overview. OECD, Paris, p.6.
14. Veiga, M.M., Marshall, B.G. (2019). The Colombian artisanal mining sector: formalization is a heavy burden. The Extractive Industries and Society 6(1):223–228; Kaufmann, C., Côte, M. (2021). Frames of extractivism: Small-scale goldmining formalization and state violence in Colombia. Political Geography 91(1):102496.

Why is this persistent informality a problem? The short answer is, much like Brazil, an accident is unlikely to attract a coordinated state-led response. Virtually all the interviewees claimed to recognise that there are major dangers and hazards at sites (more than 90% cited “crushing” as the primary threat), although most (90%) reported never having had an accident. The concern, however, is that should anyone require treatment, the closest medical facility is, on average, 16.5 km away.

### 4.2.2 More on working conditions

One particularly striking story was that of a miner who described how he is fully immersed in the river, all day. He uses a rudimentary diving suit and attaches weights to his body so he can access deeper areas where gold may be found. He separates the material using traditional pans (bateas). In many cases, full immersion yields no metal at all, forcing him to repeat the cycle multiple times during the day. Many miners eat little or not at all and remain in wet clothes until the end of their shift. This combination of prolonged immersion, heavy physical work, inadequate nutrition and continuous exposure to cold and moisture has obvious implications for musculoskeletal and overall health.

Another noteworthy case was that of a 78-year-old miner who continues to work because, in his words, if he stopped, he and his family would not have enough to cover their basic needs, particularly food. Contrastingly, a 62-year-old miner reported that he had managed to acquire a small plot where he now grows plantain, which allows him to survive when mining yields are low. This illustrates how even a small productive asset can provide a minimal safety net in an extremely precarious context.

Ninety-one per cent of the miners consulted identified accidents, especially cave-ins and crush injuries, as their greatest risk. They stated that these accidents are often fatal but avoided sharing further details. This suggests that a combination of trauma, normalisation of risk and limited expectation of preventive or compensatory measures is at play.

## 4.3 Health conditions

Musculoskeletal complaints, particularly low back pain, are very common and clearly associated with the physical demands and awkward postures involved in mining. Several miners reported knowing people with chronic mercury intoxication, describing the symptoms in a way that closely matches classic clinical assessments. This indicates a high level of community awareness of this type of occupational poisoning, but little effective prevention.

Chronic non-communicable diseases, especially hypertension and diabetes, were also mentioned. Many miners reported having these conditions but with poor treatment adherence and follow-up, mainly due to difficulty accessing regular medical care and medications. There appears to be a notable prevalence of obesity, which is paradoxical given the overall poverty and constrained access to food. The local diet includes frequent consumption of fish prepared in traditional ways. However, daily consumption of a local sugarcane-based liquor called viche and high intake of sugary beverages were repeatedly mentioned. Combined with limited access to safe drinking water, this contributes to an increased cardiometabolic risk profile (obesity, hypertension, diabetes) in a population that, despite living in a water-rich environment, often does not have reliable access to potable water.

In urban Tadó, there is access to piped water, but this is not consistently the case in surrounding villages and rural communities. Detailed household-level assessments of housing and sanitation were not conducted, but both testimonies and general observations suggest that basic services remain inadequate, particularly outside the municipal centre.

## 4.4 Mercury?

In Colombia, mercury use in ASM was officially outlawed following implementation of Law 1658/2013, Decree 2133/2016 and Law 1892/2018. But despite these moves – and reinforcing points already raised about the ambiguity of the legal framework in place for ASM in Colombia – some local authorities with territorial control have allegedly permitted the use of mercury in the sector.[15]

Interestingly, 93% of the people interviewed believe that mercury is not necessary for mining gold. Some acknowledged knowing about it but not using it ("I know about it but do not use it", "Do not use it", "Do not know about mercury" and "Do not use mercury because it is illegal"), while others are reluctant to use it because of its toxicity ("It is toxic and do not use it", "I know about the toxic effect of mercury" and "Mercury is a poison") and/or do not believe it is needed to produce gold ("I do not currently use mercury, used it 20 years ago, and no longer use it", and "It is no longer necessary because it [i.e. gold] can be extracted in other ways"). All respondents conceded that they knew about alternatives to mercury, making such claims as "Currently it [i.e. gold mining] can be done without the use of mercury", "In the community, all gold is extracted without mercury; they use a process of gravity for extraction", "Extraction is done by gravity" and "Use of ratchet and magnetic means".

What could the next steps in Colombia look like when it comes to addressing these occupational health and safety concerns? While most interviewees certainly appeared aware of these challenges, Colombia seems further away than Brazil in its quest to formalise ASM. Although the bureaucracy around permitting is likely to unravel at some point, the current state of ASM makes targeted support interventions on the occupational health and safety front challenging. In the interim, the hope is that survey work will engage the relevant government authorities.

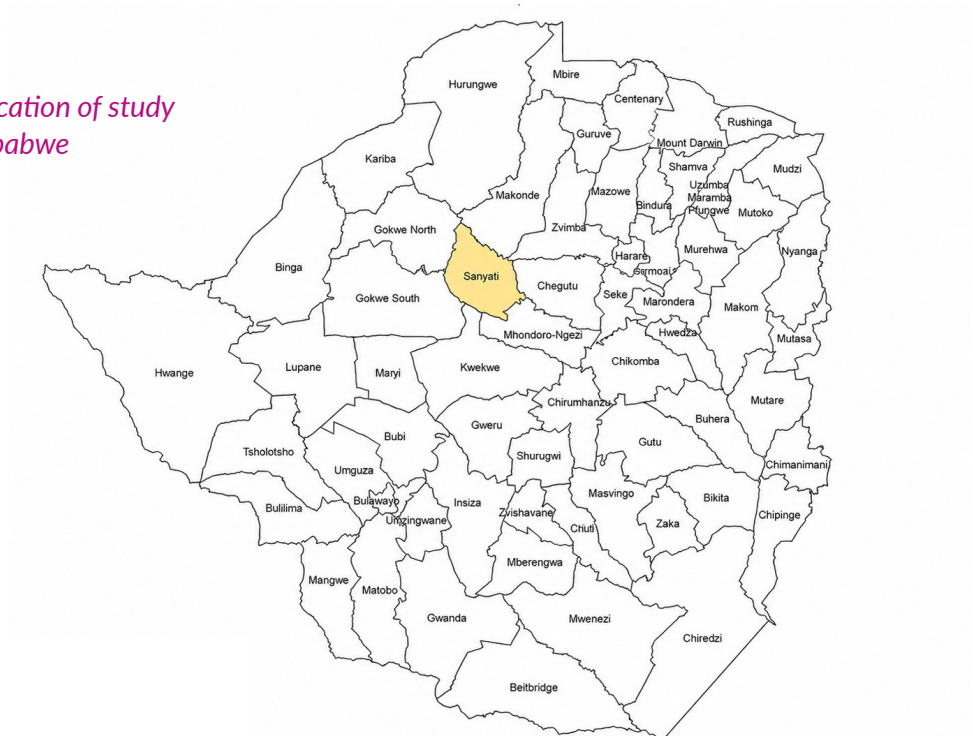
15. Vélez-Torres, I., Vanegas, D. (2022). Contentious environmental governance in polluted gold mining geographies: The case of La Toma, Colombia. World Development 157:105953; Kaufmann, C.J. (2024). The politics of toxicity governance in Colombian gold mining. Journal of Political Ecology 31(1):391–410.

# 5. Zimbabwe

## 5.1 Methodology and context

In Zimbabwe, data were collected from ASM operators in Kadoma in Sanyati District. Kadoma is situated within the Great Dyke, which is rich in gold, chrome, nickel and platinum. Interviews were conducted with 171 miners at two clinics in Kadoma, in areas which were previously populated by licensed mines.

*Figure 4: Location of study sites in Zimbabwe*




Most of the ASM activity in Kadoma is linked to the extraction of gold; all but one interviewee was engaged in small-scale gold mining. Most interviewees reside very close to the sites where they work. They hail from all corners of the country and typically work in small groups numbering between three and five people. Interviewees have 'claims' which were legally registered and were working in underground mines, using predominantly basic mining tools. The activities observed included excavation of ore, crushing and gold extraction using very basic processes. Convincing people to adopt the appropriate safety preventive measures is a challenge in these areas. **Table 4** provides a breakdown of the regulations and licences relevant to ASM in Zimbabwe.

## 5.2 Findings

### 5.2.1 General

The individuals interviewed in Zimbabwe are fairly well educated (124 of 188 people completed secondary schooling) and, for the most part, have been engaged in ASM for some time (on average, 8.68 years). Perhaps one of the more interesting findings from the data concerns licences: specifically, despite providing some security of tenure, they appear not to have had much of an impact on the lives of miners. Most of the interviewees claimed to be working under a licence (82.5%) yet continue to live quite precariously.

## Table 4: An overview of regulations relevant to ASM in Zimbabwe

| Relevant Laws for ASM | Details of Licensing / Formalisation Process for ASM | Major Barriers to Formalisation | Main Health and Safety Regulations for ASM |
|---|---|---|---|
| Mines and Minerals Act [Chapter 21:05]: This is the primary piece of legislation governing mining licences and mineral rights in Zimbabwe.<br><br>Environmental Management Act (Chapter 20:27) of 2002: This act regulates environmental management and protection, ensuring sustainable use of natural resources. | Types of licences:<br><br>- Prospecting Licence: Issued to permanent residents, valid for two years, and renewable. Allows prospecting and searching for minerals.<br><br>- Mining Lease: Issued by the Mining Affairs Board, allows mining operations.<br><br>- Special Mining Lease: Issued by the president, requires a minimum investment of US$100 million, and valid for up to 25 years.<br><br>Environmental Impact Assessment (EIA) certificate from the Environmental Management Agency (EMA). | Lack of formalisation frameworks: Absence of tailored frameworks leaves ASM operations criminalised and unsupported.<br><br>Inappropriate policies: Rigid regulations fail to align with the sector's diverse socio-economic realities.<br><br>Weak enforcement.<br><br>Costly and complex licensing requirements.<br><br>Limited access to finance: ASM operators struggle to obtain loans due to lack of collateral and poor bankable feasibility study outcomes.<br><br>Lack of access to land: Limited availability of land with significant ore grades hinders ASM operations.<br><br>Lengthy and complicated procedures discourage formalisation. | Occupational Safety and Health Act (Chapter 29:17): Sets out comprehensive regulations to prevent workplace accidents, illnesses and fatalities.<br><br>Mines and Minerals Act [Chapter 21:05]: Regulates mining licences and mineral rights.<br><br>Environmental Management Act (Chapter 20:27) of 2002: Ensures environmental management and protection.<br><br>Statutory Instrument (S.I.) 109: Mining (Management and Safety) Regulations: Guides safety standards and enforcement. |

*Plate 3: Typical pit in Kadoma*

*Plate 4: Makeshift winch at a pit in Kadoma*

Most of the miners interviewed in Zimbabwe – licensed and unlicensed – are closely aligned with the 'poverty-driven' type of operator. While specific responses vary, when asked "Why do you mine?", all but four of the 189 miners interviewed implied it was crucial to their survival. Responses included "To earn a living", "Poverty", "For Survival", "Farming inputs obtained from mining", "That's the only job", "Am poor, I have nothing" and "To provide for my family". There was a hint of desperation in respondents' voices. The four exceptions were "Looking for money", "To look for money", "That's the job I enjoy doing" and "There is a lot of money". These responses are more aligned with the 'get-rich quick' type of operator.

Why are these findings significant? The broad implication is that desperation is likely to lead to miners taking more risks. On a positive note, only 36% of interviewees (68 individuals) reported being involved in a mine-related accident, and, of these, only five and seven indicated that they were "severe" and "very severe", respectively. It is especially surprising given the hazardous work conditions in which the miners interviewed are working (Plate 3 and Plate 4).

Interviewees generally displayed a discernible level of awareness of occupational health and safety concerns in the ASM sector, which has likely contributed to the low percentage of serious accidents at sites. Sixty-six per cent identified pit collapse as the "most serious risk" at mine sites, followed by falls (42%), accidents linked to machine use (32.8%) and crushing (30%). Seventy-nine per cent claimed that they had never been diagnosed with a disease related to mining; those who did reported coughing, chest pains, headaches, asthma and silicosis. Compared with the sites visited in Brazil and Colombia, the average distance between these miners' sites and the closest health facility is far less, at 5.63 km.

### 5.2.2 Mercury

All 189 respondents acknowledged that mercury was important to gold mining. They hinted at mercury's effectiveness in extracting gold from ore, saying "It's important to capture fine gold", "It's the one that captures gold", "Fine gold" and "Important for sampling to separate gold". When quizzed about their knowledge of alternatives, individuals suggested that there were none. Interviewees made claims such as "Mercury makes gold extraction possible", "Because it is the only way to produce gold", "It's the only substance used when producing gold" and "It is not possible because mercury is the only thing that makes extraction of gold to be possible".

Eighty per cent of interviewees shared the view that miners could not continue to extract gold without mercury, although 61% did concede to having some knowledge of potential alternatives. Examples identified include metal detectors, heap leaching and shaking tables. The concern, however, is that close to 80% of interviewees sell their gold locally, which means their mobility is limited and exposure to elemental mercury emissions is a constant threat. A dependency on mercury has proved crippling for Zimbabwe's ASM operators, including those interviewed, because the government recently passed a law that bans its use near rivers. If caught, individuals must pay a hefty fine and could be jailed for up to 12 months. The Government of Zimbabwe has ratified the *Minamata Convention on Mercury*[16] but has not provided a timeline for phasing out mercury's use in the ASM sector. There is no explicit ban on importation of mercury and its use at ASM sites in the country because gold is its largest export, accounting for US$2.14 billion in 2020 alone. The country's ASM sector accounts for 60% of this production.[17]

16. The Minamata Convention on Mercury is a treaty that came into force on 16 August 2017. A country that has ratified the Minamata Convention on Mercury is required to produce a National Action Plan, in which details must be shared on how the host government intends on minimising – and, where possible, eradicating – the use of mercury in the sector. See 'Minamata Convention on Mercury', (Accessed 4 February 2026).
17. 'Zimbabwe slow in implementing UN Minamata Convention to stop using toxic mercury', (Accessed 3 March 2026); 'A push for gold leaves a toxic legacy in Zimbabwe', (Accessed 1 March).
18. 'A push for gold leaves a toxic legacy in Zimbabwe', (Accessed 1 March).
19. 'Zimbabwe slow in implementing UN Minamata Convention to stop using toxic mercury', (Accessed 3 March 2026); 'A push for gold leaves a toxic legacy in Zimbabwe', (Accessed 1 March).
20. Spiegel, S.J. (2015). Shifting Formalization Policies and Recentralizing Power: The Case of Zimbabwe's Artisanal Gold Mining Sector. Society & Natural Resources 28(5):543–558.

Moving forward, a dependency on gold for export makes a blanket ban on mercury use at ASM sites in Zimbabwe unrealistic. The main task moving forward, therefore, is regulating its use effectively. At present, an estimated 500,000 artisanal miners operate without a licence in Zimbabwe.[18] Individuals must apply to the Ministry of Mines and Mining Development for their titles, but the application procedure is costly and burdensome. The process can be summarised as follows:

1. Securing a Prospecting License (from a provincial mining office)
2. Carrying out claim pegging, and registration (US$150+ for a 10-hectare block), a process that involves identifying land (manual search and obtaining GPS coordinates), registering with the Registrar of Companies, and securing approvals from the Environmental Management Agency (EMA)
3. Pegging the claim and registering with the Provincial Mining Director within 30 days
4. Submitting a Prospecting License, prospecting notice, discovery notice and site map
5. Obtaining an EIA certificate, registering with ZIMRA for taxes, and complying with occupational health and safety regulations

Mining claims are only valid for 12 months, although they are renewable.[19] But the EIA certificate can cost thousands of dollars[20] and there are no dedicated health and safety regulations in place for ASM, which makes compliance "with occupational health and safety regulations" near impossible.

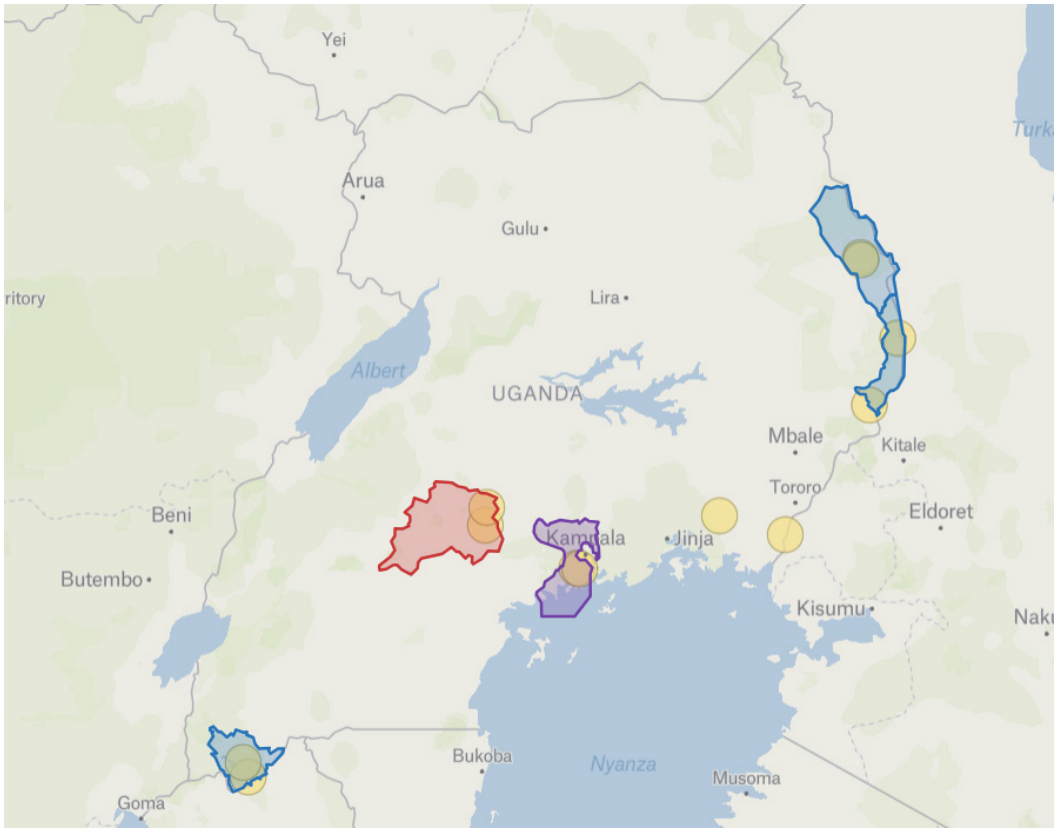
The resulting persistent informality makes regulation of ASM exceedingly challenging in Zimbabwe. Occupational health and safety research carried out at ASM sites – such as the work carried out as part of this project – is nevertheless valuable. As one of the first countries in sub-Saharan Africa to legalise ASM, Zimbabwe is in rare company when it comes to administering technical assistance to the sector. Even in the absence of dedicated occupational health and safety regulations for ASM, there is a history of industry bodies and NGOs working with the country's government to engage the sector's operators. A targeted programme on occupational health and safety could be launched if it was embedded in the relevant ministry and complementary donor-funded interventions.

# 6. Uganda

## 6.1 Methodology and fieldwork

In Uganda, a cross-sectional mixed-methods study was conducted across five districts: Kabale, Wakiso, Kasanda, Amudat and Moroto (Figure 4). Of the 49 miners interviewed (31.37%), most were engaged in the extraction of gold, while others were mining marble (25.5%), and wolframite and tungsten (23.5%). At all five sites, informal ASM is widespread.

*Figure 5: Locations of study sites in Uganda*




The quantitative data collected were analysed using Stata 14. Chi-square and logistic regression tests were performed to determine associations and risk between occupational exposure and health outcomes. Qualitative data were collected through 12 focus group discussions and nine key informant interviews exploring lived experiences and risk perceptions among ASM workers and community stakeholders.

21. U.G.A.A.S.M. www.ugaasm.org (Accessed 2 February 2026).

## 6.2 Findings

### 6.2.1 General observations

Kasanda hosts dense clusters of artisanal gold mining characterised by open pits and extensive manual labour, with workers relying on hoes, spades and pans. Women and young people dominate ore washing and soil processing, often along water points. Basic safety infrastructure (PPE, first aid, signage) is largely absent. Operations here are predominantly informal, although the Mubende United Miners Assembly (MUMA) acquired a licence in June 2025. The MUWOGOMA (Mubende Women Gold Miners Association) cooperative also has a licence and is registered under the Uganda Association of Artisanal & Small Scale Miners (U.G.A.A.S.M.),[21] an umbrella body of 158 ASM operator associations in Uganda.

Most of the country's miners, however, struggle to obtain licences due to high costs, limited awareness of legalisation pathways and a lack of trust in regulatory authorities (Table 5). Informality is reinforced by land tenure complexity, where mining occurs on privately owned land without formal agreements. Gold mining in Kasanda expanded rapidly after its (i.e. gold) discovery in the mid-2000s, driven by rural poverty, declining agricultural returns and youth unemployment. The sector evolved faster than regulatory frameworks, further entrenching informality.

In Amudat District, the artisanal and small-scale gold mine sites are scattered, remote and minimally supervised. They are located close to homesteads and grazing areas, which increases exposure of non-miners, foremost women and children, to dust, mercury and hazards associated with open pits. Weak district presence and geographic remoteness limit regulatory enforcement. Traditional authority often supersedes formal regulation. The gold mining activity here is a relatively recent phenomenon and linked to cross-border movements.

In Kabale District, iron ore extraction is small in scale but physically demanding. Activities include stone breaking, lifting heavy loads and manual transportation. Sites are located near farms and wetlands, with visible environmental degradation. These operations are semi-informal: some sites had licences, which have since expired, while others had secured permission from the local authorities. Regulatory ambiguity persists regarding small-scale iron ore extraction. Officials at the Ministry of Energy and Mineral Development claim they are working towards registering these operators, although when the team conducted the research, these plans were still in their initial stages. Kabale has a long history of iron ore extraction that goes back to the colonial period. As mechanised mining declined, however, artisanal and small-scale operations intensified, generating revenue that supported local communities.

In Moroto District, small-scale marble mining is widespread. There are quarries and stone-cutting activities featuring, predominantly, manual methods of extraction. Operations here are mostly informal, despite there being larger commercial concessions nearby. Artisanal miners often operate on the margins of licensed concessions. Marble mining has grown as infrastructure in the area has improved and local construction trades have expanded. Artisanal marble extraction is now viewed as a survival strategy in Moroto District, following livestock losses and climate shocks.

In Wakiso District, peri-urban stone quarrying supplies local construction markets. Workers operate in deep pits with poor slope stabilisation at sites that are informal or partially formal. The local government has allowed some operations to function, even though they do not comply with occupational health and safety standards and environmental regulations. The expansion of stone quarrying is being fuelled by rapid urbanisation around the country capital of Kampala. It has become an important source of livelihood for landless young people and women.

### Table 5: Regulations relevant to ASM in Uganda[22]

| Relevant Laws and Licence for ASM | Details of Licensing / Formalisation Process for ASM | Major Barriers to Formalisation | Main Health and Safety Regulations for ASM |
|---|---|---|---|
| **Licences**<br>Artisanal Mining Licence (AML)<br>Small Scale Mining Licence (SML)<br>Mineral Processing Licence (MPL)<br>Other permits include movement permits and an Environmental Certificate<br>**Laws**<br>Mining and Minerals Act Cap. 159<br>The Mining and Minerals (Licensing) Regulations, 2023<br>Mining and Minerals (Export Levy on Refined Gold) Regulations 2023<br>National Environment Act Cap 181<br>National Climate Change Act, Cap. 182<br>Occupational Safety and Health Act Cap. 231<br>Workers Compensation Act Cap. 233 | Artisanal Mining Licence (AML)<br>- The Mining and Minerals Act, 2022 (Clauses 96–104)<br>- Mineral licensing procedures and requirements<br>Small Scale Mining Licence (SML)<br>- The Mining and Minerals Act, 2022 (Clauses 85–94)<br>- Mineral licensing procedures and requirements<br>Cooperatives<br>- Cooperative Societies Act Cap. 112. See Part II on Registration<br>Associations (community-based organisations at sub-county or district local government level)<br>- Non-Governmental Organisations Act, 2016 | **Financial and Economic**<br>- High compliance costs and taxation fear<br>- Limited access to finance<br>- Exploitative market chains (middlemen financing)<br>**Legal and Administrative**<br>- Complex and costly procedures due to overlapping mandates<br>- Weak institutional capacity and coordination<br>- Lack of awareness of laws | Occupational Safety and Health Act Cap. 231<br>Minamata Convention on Mercury, 2017 |

### 6.2.2 General findings

More than 70% of the study population relies on tools such as hoes, hammers, spades and pangas; only 4.1% of interviewees reported using mechanised tools. Observational findings corroborated these claims, revealing an absence of PPE at 80% of sites visited, poor ventilation in underground pits, and limited access to safe water and sanitation. Qualitative interviews revealed that there is significant exposure to contaminated water during manual washing, carrying, and sorting activities, and frequent musculoskeletal pain and respiratory distress linked to prolonged dust exposure. A significant association was observed between reported disease diagnosis and district ($\chi^2$=14.13, p=0.003) and disease diagnosis and mineral type ($\chi^2$=14.86, p=0.002).

Most of the miners interviewed fall into the 'poverty-driven' category of operator. Ninety-two per cent of respondents reported using their earnings from ASM to cover household expenses, 75% on their children's school fees and 75% to support their family farms. Only 10% claimed they invest in other ventures,

22. Refined from information provided by Mr Asiimwe Kenneth Jeovanne, Personal Communication, February 2026.

confirming that these miners have very little disposable income. This likely explains why 96% of respondents view revenue from ASM as supplementary and insufficient to support them and their families. They provided responses such as "It is very little", "Only caters for food", "I get small money yet I have a lot", "I need plus paying school fees", "Not enough at all because am planning to develop myself" and "I have so many family expenditure including school fees and my husband is working there as miners but he drinks all the money". All interviewees expressed that they were driven to ASM out of desperation ("To get money", "Breaking stones to get money" and "To earn a living, to get school fees for my kids").

Interviewees seemed aware of serious risks in the ASM sector. They identified falls (71%), pit collapse (45%), complications linked to crushing (66%) and dangers linked to machine use (37.25%) as the "most serious risks" at ASM sites. Close to 69% identified "other" as well, a list that included asphyxiation, malaria linked to poor hygiene (stagnant waterbodies) and HIV/AIDS. The closest health facility is located, on average, 3.75 km away, which is closer than in any of the other study locations. This bodes well for the interviewees, because 61% claimed to have been diagnosed with a disease linked to mining, and 84% have reportedly been involved in a (mine-related) accident.

It would appear that many of the health-related risks faced by small-scale miners in Uganda have a lot to do with the labour structures at sites and circumstances facing operators. The following interview extracts capture this:

> *We enter the pit knowing it can collapse. But if we don't work, our children don't eat.*
> *[Male miner, Kasanda]*

> *This explains why 83% accident prevalence is normalised rather than seen as preventable.*
> *[Male miner, Kasanda]*

> *Children help after school or when there is no money for food.*
> *[Community leader, Moroto]*

Roughly one third of interviewees were engaged in small-scale gold mining. All conceded that mercury was important ("Used to collect gold together", "Very important, no gold without it" and "Mercury is used to collect gold together"). Close to half of these miners indicated that they could not continue gold mining without mercury.

In summary, on the one hand, from the data gathered, ASM sites in Uganda support countless livelihoods. Recognising this in policy is worthwhile because the occupational health and safety risks, and environmental challenges facing individuals operating at the study sites, though systemic, are correctable and preventable.

On the other hand, informality at the study sites is being fuelled by structural barriers, not an unwillingness to comply, as the authorities may believe. There is strong community buy-in for interventions when support is accessible. The Mining and Minerals (Artisanal Mining) Regulations, 2025 heavily relies on provisions contained in the 2019 National Environment Act. For any licence to be issued to a small-scale miner, therefore, a comprehensive Environmental and Social Impact Assessment (ESIA) must be submitted to the Directorate of Geological Survey and Mines (DGSM).

The problem with this is the bureaucracy: the law demands that an artisanal miner must undertake the same ESIA as a multinational must conduct, despite only being permitted to work to a depth of 10 metres. The entire procedure can cost an operator up to US$25,000; not surprisingly, few people in Uganda have licences.

Reference is made to health and safety under the Mining and Minerals (Artisanal Mining) Regulations, 2025 but under a large-scale regime. It states that "A holder of an artisanal mining licence shall":

**a.** Observe good mining practices, health and safety rules and protection of the environment during mining operations in accordance with the Mining and Minerals Act, the National Environment Act, the Occupational Safety and Health Act and any other applicable law; and

**b.** Conduct rehabilitation, reclamation and restoration of mined areas in accordance with the Mining and Minerals Act, and the National Environment Act and any other applicable law.

Achieving best practice occupational health and safety at ASM sites will remain elusive in Uganda until there is a viable route to formalisation.

# 7. Concluding remarks

This report has shared findings on occupational health and safety concerns at ASM sites, drawing on fieldwork conducted in Brazil, Colombia, Zimbabwe and Uganda. The findings reveal that there are health and safety-related risks associated with activities but that the sector's persistent informality and lack of regulation are the main reasons why they are not receiving the attention they deserve. At each of the study sites, miners demonstrated a sound understanding of the occupational health and safety risks associated with ASM. Their continued pursuit of mine work despite its dangers, however, is governed more by their precarious economic circumstances. Until their situations change, these miners are unlikely to alter their practices.

None of the four study countries has specific occupational health and safety regulations and policies in place for ASM. At this stage, given the sector's proliferating informality, it would be counterintuitive to develop these unless there is renewed commitment to formalising the sector. Without legalisation, the ability to address specific aspects of the sector's operations – in this case, occupational health and safety concerns – is limited. Moving forward, it is therefore instructive to 'locate' occupational health and safety concerns in ASM within broader national policy dialogues centred on formalising the sector. Doing so in Brazil, Colombia, Zimbabwe and Uganda is likely to galvanise a more cohesive response from host governments.

# Next steps

The research highlighted in this report fully explores the common occupational health and safety challenges faced by ASM workers. As a result of this research and the challenges of the issues it raises, SOM has launched a 3-year Phase 2 Implementation Project, funded by NEBOSH's social purpose programme. The Phase 2 will be undertaken with the partners who contributed to the research in Brazil, Colombia, Uganda and Zimbabwe. It will also be supported by Professor Gavin Hilson and consultants, OK International.

This report informed project design for Phase 2. It highlighted a strong interest among ASM, cooperatives and local stakeholders in developing practical and contextually relevant health and safety support. Building on this report and its findings, Phase 2 will focus on delivering targeted occupational health and safety interventions through established ASM cooperatives and associations in the four partner countries.

The Phase 2 project is two-fold:

1. Development and dissemination of contextual Information, Education and Communication (IEC) materials. These will be created locally, and in collaboration with OK International, to strengthen and evaluate changes in knowledge, behaviour and practices among the miners. The project plan to deliver this is through a sustainable peer-to-peer training model, and to introduce formal qualifications to further support this.
2. Develop advocacy campaign and policy engagement with national and international stakeholders, for strengthened occupational health protection for ASM workers.

By linking the evidence generated in Phase 1 with practical action on the ground, Phase 2 provides a unique opportunity to translate research findings into measurable improvements in the occupational health of ASM miners and their communities, whilst creating a foundation for longer-term change and stronger occupational health and safety within ASM.

This research has also informed a related project funded by NEBOSH's social purpose programme - for occupational health and safety training for ASM workers in India. This project was launched in 2026 through a collaboration between the SOM and St John's Medical College, Karnataka, using insights generated through this report, alongside country-specific evidence and stakeholder input from India. This ensures that training content reflects both the common occupational risks identified across ASM communities and the specific social, regulatory and operational realities of the Indian ASM context.

# Appendix 1: Survey Instrument

(translated into Portuguese for the Brazil component and into Spanish for the Colombia component of the research)

*My name is x from x. I am conducting a research study among artisanal and small-scale miners in x.*

*This research study is titled 'Investigating the burden of occupational diseases and injuries, and occupational risk exposure profiles among artisanal and small-scale miners (ASMs) in x'. The purpose of this survey is to broaden our understanding of the occupational health risks in artisanal and small-scale mining in x. It also seeks to gather details of the context which exposes these individuals to occupational health. I am inviting you to complete this questionnaire as part of the research. Please note:*

- *If you consent to participating in this research, you must sign the attached consent form.*
- *Participation in this research is entirely voluntary and anonymous.*

| **Demographic information** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Gender (tick one)** | | **2. Marital status (tick one)** | | | | **3. No. of children** | **4. No of children in school** | **5. Miner's education level (tick one)** | | | | **6. Number of years mining** |
| M | F | Married | Single | Divorced | Widowed | | | None | Primary | Secondary | Tertiary | |
| | | | | | | | | | | | | |

| **7. Mineral(s) mined** | **8. District you are mining** | **9. Are you staying with your family at the mine?** |
|---|---|---|
| | | |

| **General mining information** | | | | |
|---|---|---|---|---|
| **10. What is your role in the mine?** *Miner* *Processor* *Trader* *Other (Please specify)* | | | | |
| **11. Why do you work in the mine?** | | | | |
| **12. Is this site** **licensed unlicensed?** | | **If unlicensed, are there plans for this site to secure a permit?** **Yes** **No** | | |
| **13. Do you consider yourself** *poor* *average* *wealthy* **compared with people in your village/town?** | | | | |
| **14a. What tools do you use in mining?** | | **14b. Who paid for these tools and how?** *Self* *Sponsor* *Family* *Other* *(Please circle)* | | |

| 16. How far is the closest health clinic/hospital in terms of distance or time? | 17. Have you ever been diagnosed with a disease related to mining?<br>Yes ☐ No ☐<br>If yes, state the disease: |
|---|---|

**18. How many times have you been involved in a mining accident?**

1 ☐ 2–5 ☐ More than 5 ☐ If yes,, was the accident: *negligible* *minor* *moderate* *severe* *very severe?*

**19. Are you experiencing any health problems now?**

Yes ☐ No ☐ If yes, please list them, including any symptoms you are experiencing or have recently experienced in the past six months.

**20. Have you ever received health information on health hazards related to mining, their effects and how to manage them, such as chemical hazards including dust and smoke, heat, cold, water, noise, vibration, back strain, mental stress, and infections (e.g. malaria, diarrhoea, HIV)?**

Yes ☐ No ☐

**21. Is alcohol and substance use a major problem in your mining area?**

Yes ☐ No ☐

**22. Does your family have any illnesses caused by the mine?**

Yes ☐ No ☐ If yes, which diseases?

**Specific cohort: Gold**

**G1. How important is mercury to mining?**

**G2. Do you think miners can continue mining without mercury?** Yes ☐ No ☐

*Please explain your answer.*

**G3. Do you know of ways to mine gold without using mercury?** Yes ☐ No ☐

*Please explain your answer.*

**G4. What training has the government/association provided for mercury?**

*Please provide details.*

**G5. Where do you sell your gold?**

Locally ☐ Regionally ☐ In the capital city ☐ Other ☐

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