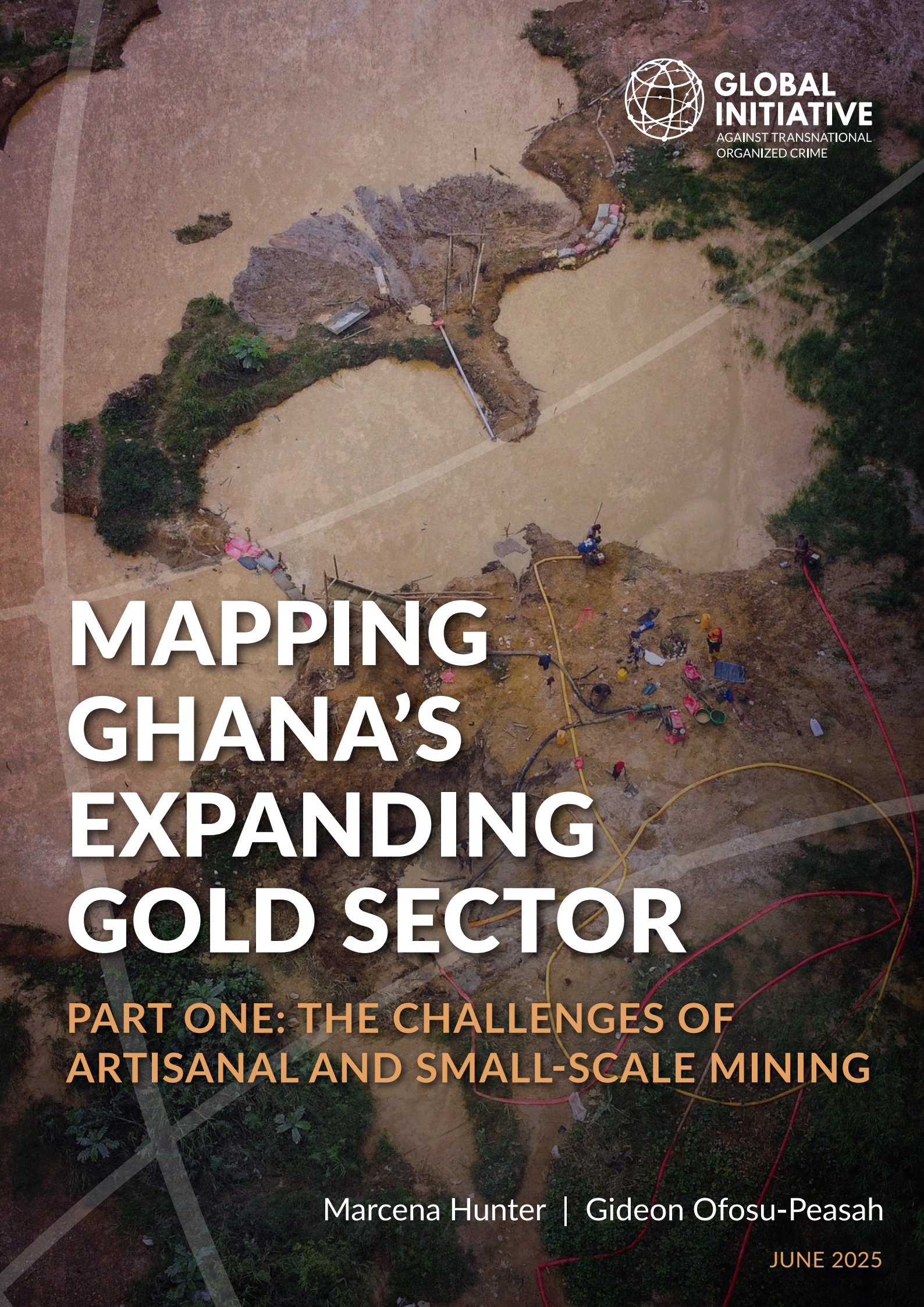

GLOBAL INITIATIVE
AGAINST TRANSNATIONAL ORGANIZED CRIME

MAPPING GHANA'S EXPANDING GOLD SECTOR

PART ONE: THE CHALLENGES OF ARTISANAL AND SMALL-SCALE MINING

Marcena Hunter | Gideon Ofosu-Peasah

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CONTENTS

EXECUTIVE SUMMARY

Ghana boasts a storied gold mining history stretching back centuries, and the country remains a globally significant producer today. According to the World Gold Council, Ghana was the largest African gold producer and sixth largest global producer as of December 2022.[1] Artisanal and small-scale gold mining (ASGM) plays an important role, accounting for a sizeable portion of the country's overall gold production. ASGM is an economic driver across the country and an important source of livelihood, especially in rural regions. In 2020, national data as reported by the Minerals Commission of Ghana recorded small-scale mining yielded 36 tonnes of gold.[2] However, the true scale of the ASGM sector is likely to be much larger than official data suggests. Unlicensed ASGM, widely referred to as 'galamsey' in Ghana (literally 'gather them and sell'), accounts for the majority of ASGM extraction in the country. Since only a small percentage of artisanal gold miners operate in full compliance with legal and regulatory frameworks, the complete extent of gold production is not captured by official data.

Swissaid, a non-governmental organization (NGO), estimated that 24 to 30 tonnes of artisanal and small-scale gold production went undeclared in Ghana in 2022 (equating to a value of between US$1.39 billion and US$1.74 billion based on market prices at the end of 2022).[3]

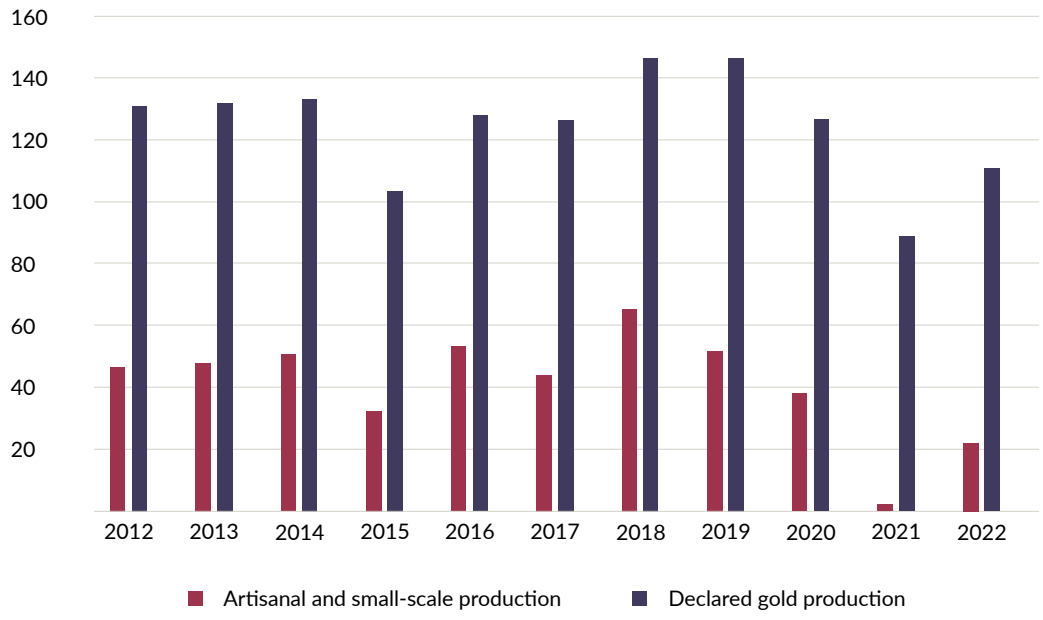

FIGURE 1 Gold production in Ghana, 2012–2022 (in tonnes).

SOURCE: Swissaid[4]

Informality in the gold sector, in addition to the attractiveness of gold as a profitable commodity and monetary vehicle, renders the sector vulnerable to criminal exploitation. Criminal infiltration of ASGM results in multiple undesirable outcomes (notably exacerbation of environmental harms, undermining the rule of law and increasing security risks), while also hampering efforts to improve the conduct of ASGM. Criminal exploitation of the gold sector is a major obstacle to efforts to formalize ASGM and realize its full development potential.

While development of Ghana's gold sector (and criminal exploitation therein) has been a key long-term theme, the pace of change in ASGM has accelerated in various ways in recent years. These changes range from the increasing adoption of new technologies and mining and processing methods to shifting power dynamics in illicit networks connected to the gold sector, alongside the market entry of new illicit actors and transnational networks. ASGM in Ghana has significantly expanded in scale and is becoming increasingly mechanized and technologically sophisticated. This includes the use of mercury amalgamation and cyanide leaching techniques and the deployment of heavy equipment, including excavators. The size and impact of 'small-scale' operations are therefore rapidly increasing in terms of land area, geographic distribution, gold output and environmental effects.

The government has taken several steps to tackle criminality in the gold sector and to support the formalization of ASGM operators. However, the national response has also been encumbered by vested interests, capacity limitations and inadequate political will.[5]

Recognizing the evolving nature of the sector and the need for evidence-based responses, there is a pressing need not only to update knowledge on illicit activity and actors in Ghana's gold sector, but also to develop methodologies that enable stronger monitoring of the sector. The Global Initiative Against Transnational Organized Crime (GI-TOC)'s extractives team has therefore undertaken research in Ghana to map illicit gold mining, supply chains, illicit financial flows and criminal networks. This research serves to strengthen programming around combating natural resource crimes and to reduce transnational criminal organizations' profiteering from gold mining and trade.

This is the first of two reports on Ghana's gold sector. This first report focuses on gold mining and processing, while the second report focuses on the politico-criminal economy of gold supply chains and financial networks. In this first report, the analysis centres on two geographically salient (albeit contrasting) case studies – the Western region and the Savannah region. The Western region is a long-established gold mining centre, while the Savannah region is an emerging hotspot. To a lesser degree, this report also focuses on the Upper West region, where artisanal and small-scale extraction is also significant. This study maps the expansion of ASGM in Ghana through various methods, including flow accumulation analysis, radar interferometry and computer vision models. Additionally, building footprint detection is employed in monitoring ASGM expansion.

Definitions

Artisanal and small-scale gold mining (ASGM): There is no consensus on the definition of ASGM. Artisanal mining refers to mining operations that are carried out manually by individuals or small groups with little or no mechanization. Artisanal mining is typically subsistence-oriented, with miners extracting minerals to sell or trade locally. Small-scale mining is carried out on a bigger scale than artisanal mining but involves less intensive operations than large-scale mining. Small-scale mining is usually carried out by individuals, small groups, or small companies using machinery, but with limited investment. While small-scale mining is often more structured, requiring greater financial investments and resulting in larger production than artisanal mining, it often still lacks comprehensive regulation and oversight.

Doré: Gold doré is an alloy made of gold and small amounts of other metals, such as silver. It is produced during the refining of gold ore or scrap gold. There are wide variations in how much gold this alloy contains, with the pure gold content often ranging from 50% to 80%. Gold doré is refined further to increase the gold purity, ahead of the production of gold bars or bullion. It is impossible for gold bullion to be purely gold. As such, to be considered 24 carat (the highest carat rating for gold) gold bullion must achieve a purity of 99% or more.

Galamsey: Derived from the phrase 'gather them and sell', galamsey is a local Ghanaian term that refers to small-scale gold mining activities in Ghana, conducted without authorization or adherence to environmental and safety regulations.

Legal mining: Legal mining refers to mining activities that are conducted in compliance with the laws and regulations of the country or region where the mining is taking place. This includes obtaining the necessary permits, following environmental regulations and adhering to labour laws.

Legitimate ASM: Legitimate ASM refers to artisanal and small-scale operations that follow laws, and thus are also classed as legal. When legal frameworks are not enforced, or in the absence of a framework, legitimacy is determined by assessing the good faith efforts of ASM miners to operate legally and their efforts to formalize where opportunities become available.

Informal ASM: Informal ASM refers to operations that do not have the requisite official state licences and permits but do have a social licence to operate through social and cultural norms. This can include rights granted by traditional authorities, such as chiefs.

Unlicensed ASM: Unlicensed ASM is not explicitly forbidden but is carried out without a mining licence or any other permits required by the state.

Illegal mining: Illegal mining is explicitly forbidden by the law. For example, ASGM operations which are explicitly prohibited can include mining on large-scale mining concessions and in protected areas, such as national parks, and when ASGM contributes to conflict and human rights abuses. Under the Minerals and Mining Act of 2006 (Act 703), in Ghana any small-scale mining operation that lacks a licensed concession, involves foreign participation or employs individuals below the age of 18 is deemed illegal. However, in practice, determining the legal status of an ASGM operation can be complex and relies on compliance with various regulations.

These definitions reflect a combination of academic research, policy frameworks developed by international organizations such as the United Nations and the Organisation for Economic Co-operation and Development (OECD), as well as definitions and classifications used by national governments and mining industry associations.[6]

Methodology

This research is the product of over three years of researching and monitoring of Ghana's gold sector. A multifaceted research methodology was used to investigate, map and analyze ASGM activities and associated actors, systems and flows. The research focused on criminal exploitations and vulnerabilities in the sector and sought to identify research methods applicable for ongoing monitoring and to identify trends and potential future developments in the sector. An iterative approach was used, with the research methods feeding into each other, including a literature review; remote sensing and spatial data analysis; key informant interviews; surveys of mine site staff, gold processors and gold traders; and geolocation of gold shops and processing facilities.

Remote sensing technologies have increasingly been used to map the scale and spread of ASGM. Where it can be used, spatial data analysis using remote sensing technologies provides valuable insights and has significant potential moving forward. However, the potential success of their application depends on various factors such as the environment and type of ground cover, the type of mining being carried out, and the availability of quality training data and imagery with minimal cloud cover. To optimize its value, spatial data needs to be complemented with field data confirmation and expert analysis, including knowledge of supply chains and market dynamics, to build robust methods that can be used to support mapping of activity and supply chains.

Focus areas for research were selected based on levels of known mining activity, changing dynamics that had not been captured in existing research, and links to illicit gold markets and illicit financial flows. The selection of the focus areas was informed by a literature review, national geological survey data and existing remote sensing mapping of mining activity. This was supplemented by interviews with key informants and the knowledge of the research team, including the team at the University of Mines and Technology (UMaT) in Tarkwa in the Western region. Fieldwork then fed back into the process, enabling adjustments and adaptations to be made.

Following the initial selection, the Upper West, Savannah and Western regions were decided on as focus areas for more in-depth research. The Western region was selected over the other regions due to the intensity of ASGM activity, changing dynamics in the region and its importance in national gold supply chains. In-depth research focused on the Western region (Wassa Akropong and Asankragua, situated in the Wassa Amenfi East and Amenfi West districts respectively) and the Savannah region (specifically, the Bole district). The Western region of Ghana is a significant hotspot for illegal mining, with substantial involvement of foreign nationals and several research initiatives conducted there. However, these research efforts often lack the utilization of remote sensing and spatial data analysis in mixed research methods for mapping illicit gold mining and supply chains.

Given the similarities between the Western region and other regions in southern Ghana, the insights and understanding garnered from focusing in-depth research in the Western region could inform knowledge and future research in some of the other regions. Other regions that are also major gold producers considered for in-depth investigations included the Ashanti, Central and Eastern regions. While the Ashanti region was not included as a focus region for satellite imagery analysis, given the importance of the Ashanti region as a gold producer and the presence of gold trading hubs, interviews and visits to gold buying offices were conducted in the region.

Scoping field research was then conducted in the focus regions to further define the case study areas. During the scoping phase, it was determined that the intensity of mining and volume of gold being produced in the Upper West region did not warrant in-depth investigation because ASGM

was occurring at a much smaller scale, with far lower estimated production and trade volumes. Also, due to the terrain, land use, land cover and type of mining activity (arid and underground), mining activity would be difficult to identify using remote sensing technology. While in-depth research was not conducted in the Upper West region, data collected in the region informed the study, particularly in mapping and analyzing cross-border flows.

In-depth research in the focus regions comprised surveys, field visits and key informant interviews. Fieldwork, including interviews with key informants, industry associations, law enforcement, gold miners and buyers, took place in Accra in July and August 2021 and in Tema in March 2023. Interviews were carried out in the Western region in October 2021, including in Takoradi, Tarkwa, Nsuaem, Wassa Akropong, Wassa Nkakaa and Asankragua. In January and February 2022, interviews were conducted

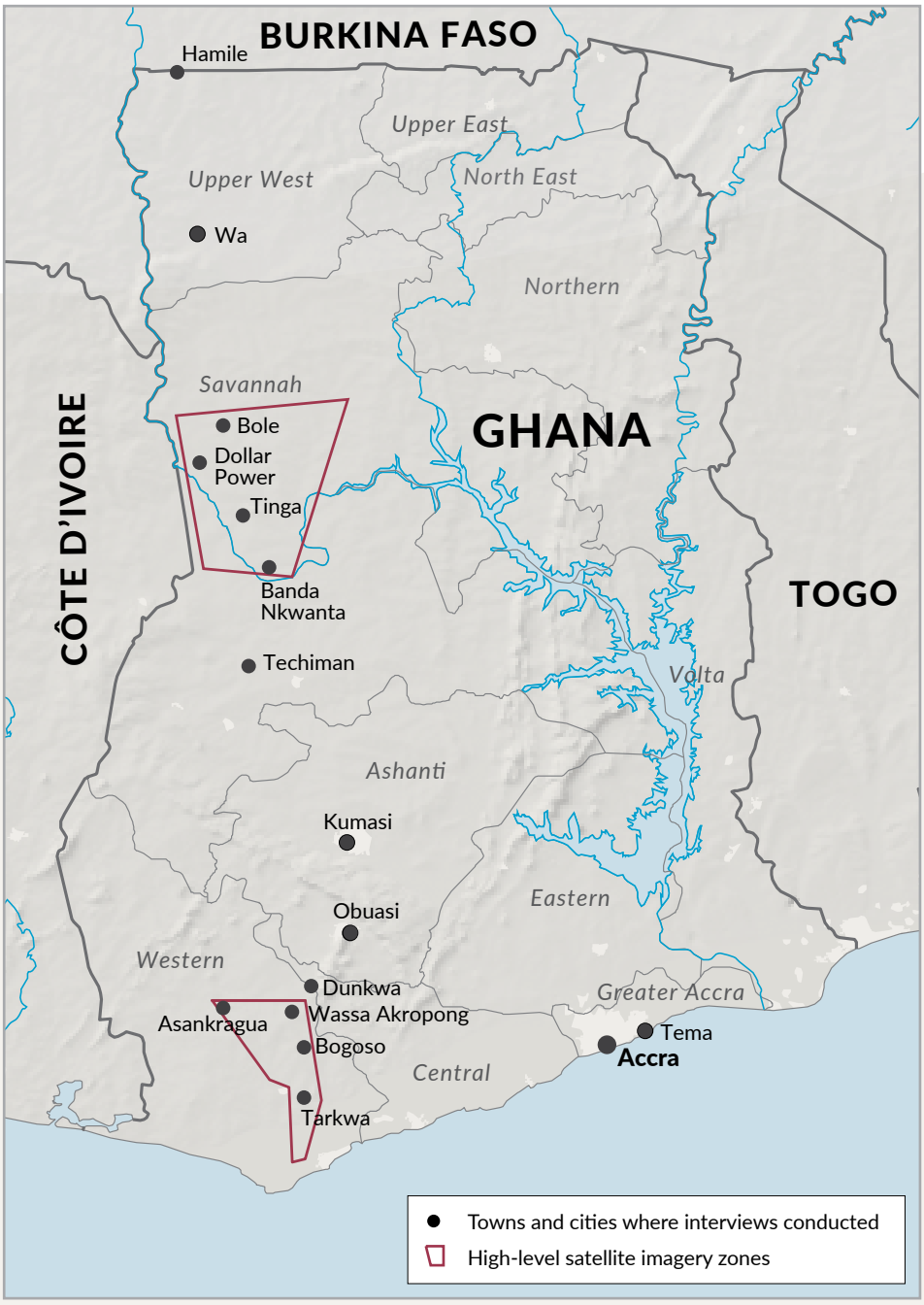

FIGURE 2 Ghana, showing research locations.

Excavated pits for illegal gold mining dot Ghana's Western region and have caused severe environmental damage, notably deforestation.
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in the Upper West region, covering Dorimon, Hamile, Kpaalamuna and Wa, as well as in the Savannah region, covering Tinga, Dakrupe, Banda Nkwanta, Dollar Power and Bole. Fieldwork in Obuasi (Ashanti region), Dunkwa (Central region) and Techiman (Bono East region) took place in May 2022.

Field surveys were also conducted across various areas, starting with towns in the Western region. This included Bogoso Junction-Tarkwa, Nsuaem, Tarkwa, Fanti Mines, Abooso, Bogoso, Wassa Akropong and Gyappa in November and December 2022. Surveys were also carried out in the Ashanti region (Dunkwa, Obuasi and Akrokoli) and the Savannah region (Bole, Banda Nkwanta, Tinga, Dakrupe and Dollar Power) in December 2022. Surveys were conducted at 51 processing and extraction sites and 57 gold shops, and among 300 mine site workers. This research has been further informed by additional field visits by the GI-TOC to the Savannah and Upper West regions in 2023 and 2024 under other research initiatives.

Key findings

- The introduction of investment and technology, often by foreign nationals, has a significant impact on mining activities and gold supply chains and financial flows. The growing use of cyanide processing is an important trend to monitor, reshaping processing activities, gold supply chains and financial flows in the region. In Ghana, foreign nationals are the most significant players injecting money and technology into unlicensed mining operations and the gold trade markets. Adding to the complexity, there are increasing reports of foreign networks linked to European criminal groups, in addition to those already present, seeking to engage in illicit activity and exploit Ghana's gold.[7]

- The future of Ghana's gold sector remains intricately tied to evolving power dynamics and the competition for control of (and rents from) the sector. In the lead-up to the December 2024 elections, competition between political groups vying for control intensified, with each party seeking to leverage the country's lucrative gold sector to bolster their electoral prospects. Separately, tensions over community mining schemes are pitting the state against traditional chiefs who wield significant influence at the local level in some areas.
- Methodological innovations, in particular remote sensing technologies, help assess the spread, intensity and impacts of mining activity. Remote sensing refers to the process of acquiring information about an object or phenomenon without making physical contact with it. Satellite imagery and remote sensing technologies enable the monitoring of these changes, providing insights into the dynamics and trends of economic activity over time. However, it is important to complement remote sensing with on-the-ground research methods.
- There is a need for multifaceted, innovative and dynamic responses to curb criminality and build on existing efforts to support the sector's development potential. This requires a strong understanding of the complex, largely secretive webs of activities, actors, supply chains and financial flows in the gold sector. It is also critical to recognize that the mining sector and gold markets are constantly changing. This is especially true for illicit actors and markets that quickly and dynamically adapt to changing mining, market and regulatory dynamics, enabling them to remain active and maximize profits. Ongoing investigation and analysis, alongside the development of research tools and methods, are therefore required to inform policy and programme design.

SCALE AND SPREAD OF ASGM

Ghana's ASGM sector is a dynamic landscape characterized by significant economic activity and regulatory challenges. As of March 2023, the country had 767 active small-scale gold mining leases, according to data derived from the Minerals Commission, the primary Ghanaian government body regulating the ASGM sector.[8] Yet the vast majority of operations remain unlicensed, with notable regions of operation including Western, Ashanti, Central and the emerging Savannah region.[9] The sector plays a crucial role in local economies, providing livelihood opportunities for many Ghanaians while simultaneously presenting environmental, regulatory and social challenges.

Overview

In Ghana, small-scale mining is limited to a concession not exceeding 25 acres (101 171 square metres) and a small-scale mining licence applicant must be a Ghanaian citizen who is at least 18 years old. A small-scale mining licence is valid for five years and may be renewed on expiry.[10] The primary legislation governing Ghana's gold mining sector is the Minerals and Mining Act 2006 (Act 703). Artisanal mining is subsumed under small-scale mining, thus while Act 703 only refers to small-scale mining it also includes artisanal operators. The Act has been revised multiple times, including amendments in 2015 that significantly increased penalties for illegal mining, including for foreign nationals engaged in illegal mining and citizens who employ or work with foreigners in illegal mining operations.[11] This reflected growing concerns regarding foreign national involvement in informal mining activities. Further amendments in 2019 broadened the definition of illegal mining to include all forms of mining operations that lack a licence or valid authority, and tightened laws on the use of excavators and other equipment, while also restricting mining in (or along the banks of) natural bodies of water.[12]

ASGM is conducted across the Ghanaian gold belt, shown in Figure 3.[13] Ghana's Western and Ashanti regions are historically prominent gold-producing regions and remain ASGM hotspots. There are also new ASGM hotspots emerging elsewhere, including in the Savannah region and the Eastern region. Miners' association representatives reported that the Eastern region is becoming a more popular ASGM centre because gold can be found at shallower depths and is easier to reach than gold deposits in the Western and Ashanti regions.[14]

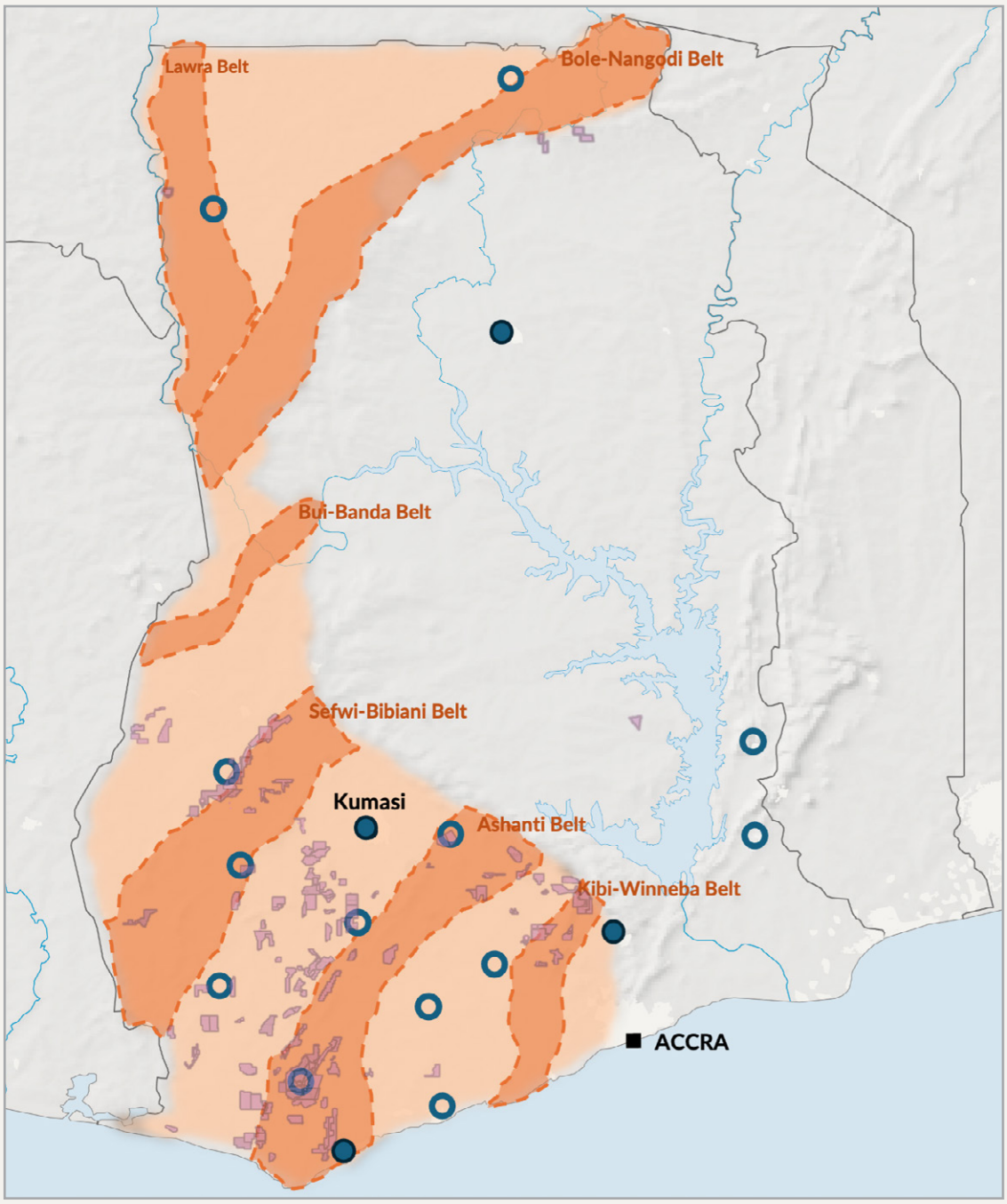


FIGURE 3 Gold mining concessions and the Ghanaian gold belt.

SOURCE: Mining Cadastre Administration System;[15] Elias T Ayuk and Ngozi F Unuigbe (eds.), *New Frontiers in Natural Resources Management in Africa: Effective Tools for the Implementation of Sustainable Development Goals*, Routledge, 2024.

Gold deposits are classified as alluvial, colluvial or hard rock, which determines the mining and processing methods used to extract gold from ore (see the box below). In the Western region, alluvial and colluvial mining are predominant, while underground mining is more common in the Savannah region. Alluvial and colluvial mining are far more visible in satellite imagery than hard rock/underground mining, meaning that satellite imagery is more effective in the Western region than in the Savannah region. Regardless of the type of deposit, it is very difficult to estimate production volumes at gold mines. Production varies greatly by mine size and location; large swings in production can also be recorded at any one mine. As such, identifying and estimating the amount of gold flowing through trade hubs can be a better indicator of ASGM production volumes.

Mineral deposit types and mining techniques

Alluvial deposits are formed by the concentration of moving particles by gravity (called a placer deposit) and by water action, usually through a river or stream.[16] Shallow alluvial extraction takes place in valleys and low-lying areas. These deposits are found at depths of up to a maximum of 3 metres. Deep alluvial mining is conducted on the banks of major rivers, which in Ghana include the Ankobora (located in the country's south-west), Pra (south-central Ghana), Tano (in Bono East region) and Offin (a tributary of the Pra River located in the Ashanti region). Deep alluvial mining involves digging a pit, often between 7 and 12 metres deep, to access gold-bearing gravel found in soft rock. Gold is extracted by using rudimentary or semi-mechanized tools.

Hard rock mining, usually carried out in mine shafts or open pits, involves extracting ore from deep-seated reefs or ones close to the surface. Hard rock mining often involves the use of explosives or mechanized (or at least semi-mechanized) tools and techniques. ■

Many miners are Ghanaians from the immediate locality and region. A significant number of miners also come from other parts of Ghana, attracted to the mineral-rich areas. Foreign nationals also migrate to ASGM hotspots in Ghana from other parts of West Africa, particularly Burkina Faso. Foreign nationals from outside Africa, especially Chinese nationals, are also known to operate in Ghana's ASGM sector. Reports of an increased presence of European actors need substantiating with stronger evidence. As discussed below, foreign nationals hold a variety of positions in the ASGM sector, ranging from diggers to ore processors, investors or providers of engineering services.

Women in the ASGM sector

There is little quantitative data on women in Ghana's ASGM sector. However, it is common to see women providing ancillary services to ASGM, such as selling food, water or energy drinks at mine sites. Anecdotal evidence suggests that the direct engagement of women in ASGM varies by region. Women are much more visible in ASGM activities in the Savannah region and other parts of northern Ghana, while it is rare to see women directly engaged in ASGM in the Western region. Many women will mine during the lean season (August–February) and farm during the rainy season (March–July), while others manage grocery shops or other small businesses.[17]

Where women are directly involved in ASGM, they are usually head loaders (those who carry ore) or pounders (those who crush or grind the ore into fine particle size), water bearers, washers of

recovered gold or ore buyers/processors. Earnings come from payment for grinding rocks and gold extracted from the ore (including by using mercury). In specific areas of the Savannah region, women sell their tailings (leftover materials from the processing of ore) to cyanide leaching operations; they also sometimes subcontract processing. The roles outlined above can earn around 200–500 Ghanaian cedi (GHS) per week (equivalent to US$24.18–US$60.44 at the time of research).[18] For comparison, the daily minimum wage in Ghana as of January 2022 was GHS13.53 (US$1.64).[19]

It is widely acknowledged that women face discrimination and marginalization in the ASGM sector across West Africa. Women often face exclusion from higher-paying roles in the ASGM sector, such as supervisory positions or direct involvement in ore excavation and extraction, which typically offer double the earnings.[20] Securing funding for mining operations is also especially difficult for women, who traditionally have less access to (and control over) capital. The gender desk officers of the Minerals Commission in Ghana shared instances in which women missed out on the opportunity to own a concession because they did not have readily available capital or funding to secure land or concessions. According to a representative of Women in Mining Ghana, an NGO, 'formalization has brought some benefits to women in ASGM in Ghana, [but] it has not addressed the underlying structural barriers that limit their access to land and mining rights.' These challenges are exacerbated by the presence of criminal actors, who are reported to perpetuate traditional and societal gender inequalities that denigrate and deprioritize women.[21]

Sex trafficking: an underappreciated risk

In mining communities across Ghana there is a worrying increase in the sexual exploitation of women in contexts that constitute trafficking.[22] Traffickers use the promise of decent work to entice women and girls to Ghana (often from Nigeria) and force them into commercial sex work to cover astronomical debts for travel, lodging and documents.[23] The women and girls are often brought into the country outside formal entry points and/or using false identities.

GI-TOC interviews with sexually exploited women revealed stories of girls being brought to Ghana and forced into sex work in order to repay immense transport debts, and of women being exploited in towns near mine sites (the latter sometimes held incommunicado by female managers or proprietors).[24] Methods used to control the women and girls include threatening to tell their families back home about the nature of their employment or threatening to put a curse on them or their families. Women involved in the sex industry are sometimes arrested during sweeps at brothels by state security forces because their services are patronized by miners who operate illegally.[25]

A shelter used for sex work near an artisanal gold mining site.
Photo: GI-TOC

In Ghana, this is an underappreciated risk that urgently requires greater attention and resources to protect women, prevent future sex trafficking and prosecute offenders. ■

Use of explosives

An increasing concern in ASGM is the unauthorized use of explosives at mine sites. The Minerals and Mining Act 2006 and the Minerals and Mining (Explosives) Regulations 2021 (LI 2177) allow small-scale miners to use explosives with ministerial approval, but such approval is seldom sought.[26] Explosives are obtained from various sources including leakage from large-scale mines and quarries; they are often used illegally and without proper security precautions, resulting in accidents in which miners have been badly injured or killed. Authorized dealers and mining or quarry companies sometimes intentionally buy more explosives than they need, with the goal of reselling the surplus on the illegal market for a significant profit. Fraud is sometimes used to procure explosives. Investigations have also uncovered the use of illicit Chinese-branded explosives in Chinese-controlled quarries in Ghana.[27]

In January 2022, a truck carrying explosives for large-scale gold mining collided with a motorcycle at Appiatse, a village near Bogoso, resulting in a devastating explosion that claimed 13 lives, injured many more and caused extensive damage. According to a government press release, the explosives were sourced from Maxam Ghana Limited, a Ghanaian explosives plant, which was found to have violated multiple regulatory standards, including in the manufacturing, storage and transportation of explosives for mining or civil works.[28]

Substantial growth in ASGM across West Africa and the Sahel has prompted a significant increase in demand for explosives in ASGM zones across the region. Explosives are smuggled out of Ghana, where the mining industry serves as an important point of origin for the illicit explosives trade across the region. For example, in 2020, some arrests were made of people smuggling explosives from Ghana to Burkina Faso in Operation Conquered Fist, an anti-terrorism joint operation by police and the military.[29] Alongside smuggling to Burkina Faso, explosives are trafficked from Ghana into neighbouring Côte d'Ivoire and Togo, and then onwards to the wider region, including Mali, Guinea, Liberia and Niger.[30] The Elubo border crossing with Côte d'Ivoire in the Western region has been identified as a key transit point for explosives being trafficked out of Ghana.[31] Various methods are used to smuggle explosives, including commercial transport vehicles and trucks transporting goods. Traffickers sometimes hide explosives among legitimate goods to avoid detection or with other contraband goods in hidden compartments and fake fuel tanks in cargo vehicles.[32]

The supply of explosives from Ghana has implications for regional security. Explosives and explosives equipment from Ghana have been used to build improvised explosive devices (IEDs) in Burkina Faso, Mali and Niger; more recently, this phenomenon has reached Benin, Côte d'Ivoire and Togo, according to investigations by the Small Arms Survey.[33] Products such as electric initiators that are manufactured for the mining sector are the most easily identifiable commercial items making their way into IED production in Mali, where they have been documented in caches and during post-blast investigations. Two companies that distribute explosives through Ghana are also the major legal suppliers of explosive materials to Mali. The Small Arms Survey reports that these items are likely diverted from the legal supply chain in Ghana and trafficked into Mali. While Ghana has not been significantly affected by IED use, concerns are growing due to expanding insurgencies to the north in Burkina Faso and elsewhere.[34]

Western region

The Western region is a major ASGM hub and most such operations there are unlicensed. The Western region has a population of roughly 2 million people and a diverse economy.[35] While about 70% of the population is engaged in agriculture, other economic activities include mining, oil and gas extraction, tourism, fishing, livestock farming, cocoa processing, timber processing and palm oil processing.[36]

Satellite imagery shows the significant expansion of ASGM in this region between 2015 and 2021, as well as the growth of urban areas in ASGM hotspots (see figures 4 and 5).[37]

Determining the legal status of mining operations (whether they hold a licence and are operating in accordance with the licence and other regulatory requirements) requires individual site visits. However, satellite imagery shows substantial mining activity in areas outside licensed mining concessions, or within concessions that only hold exploration licences rather than exploitation licences. This indicates that a large portion of ASGM is operating without proper licences.

When satellite imagery of ASGM expansion is overlaid with Ghana's mining cadastral map it visualizes how much ASGM is taking place outside mining concessions, thus presumably constituting unlicensed activity. However, even ASGM taking place within a concession can amount to unlicensed activity. Examples include an outside party mining illegally on the land, extraction taking place at a concession designated only for exploration, or the owner failing to comply with environmental or health regulations. In the Western region, the urban growth in Wassa Akropong and Asankragua, both local gold trade hubs, is notable. The explosion in ASGM activity in the Western region is attributed in part to the influence of Chinese foreign nationals, who are credited with introducing and increasing the availability of more advanced technology, machines, and mining and processing techniques.

The ASGM expansion around Asankragua, although not as intense as that around Wassa Akropong, is notable because it is a newer ASGM hotspot and a gold trade hub that had not previously been highlighted in research on ASGM in the Western region. Reasons for Asankragua's emergence could include the relatively recent arrival of foreign nationals and the more remote location. Predictive computer learning models indicate that there is significant potential for additional mining in the area surrounding Asankragua, making it a high-risk area for increased unlicensed ASGM in the future.

Illegal gold mining has led to the destruction of cocoa plantations in the Western region, undermining communities' livelihoods. © *Francis Kokoroko/Reuters*

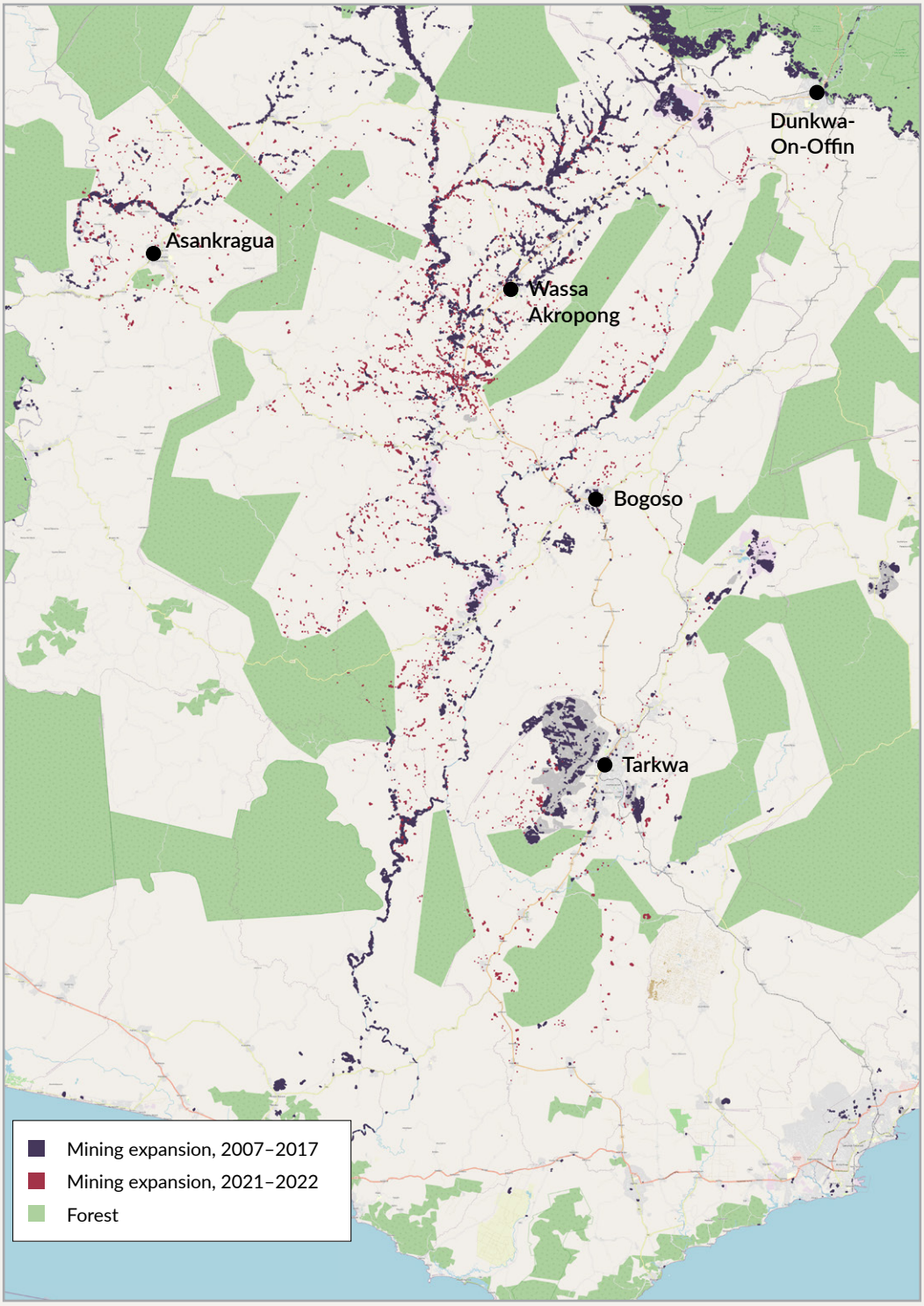


FIGURE 4 Satellite imagery analysis showing ASGM expansion in the Western region, 2007–2017 and 2021–2022.

SOURCE: Analysis of survey and satellite data, 2023. Data collection, analysis and visualization by Peter Scarth.

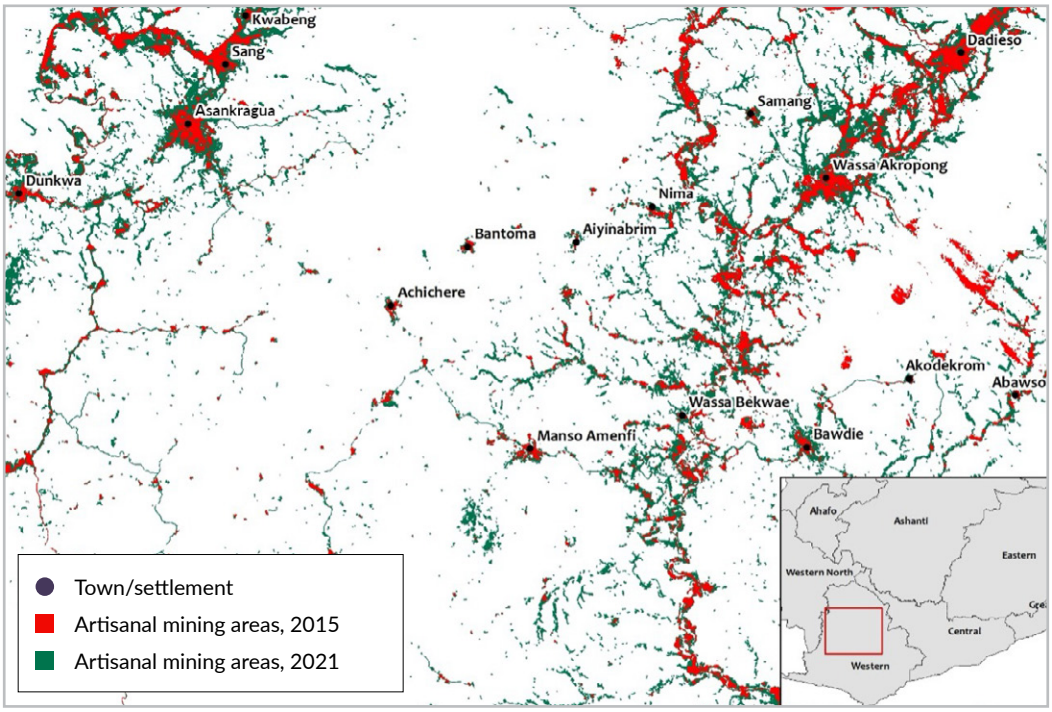


FIGURE 5 Satellite imagery analysis of ASGM in the Western region from 2015 to 2021 (accuracy: 70%–79%).

SOURCE: Analysis of survey and satellite data, 2023. Data collection, analysis and visualization by Eric Stemn and Gideon Vunase.

To illustrate the collection and analysis of satellite imagery, images of locations near Abooso are shown in Figure 6. It is important to repeat computer modelling wherever possible to improve results. Different models have different levels of accuracy and ASGM is not always detected. This is also why it's important to conduct 'ground-truthing' (verifying satellite imagery analysis by making visits on the ground) where possible. The images also visualize the immense environmental impact of unregulated ASGM, which has significant implications for water turbidity and deforestation among other environmental harms. Figure 6 also illustrates how satellite imagery analysis can be employed to investigate specific locations. While much of the imagery here is shown at a higher level, more zoomed in satellite imagery can be used to investigate specific locations and operations (including cyanide processing facilities, a technique we will cover a little later in this report).

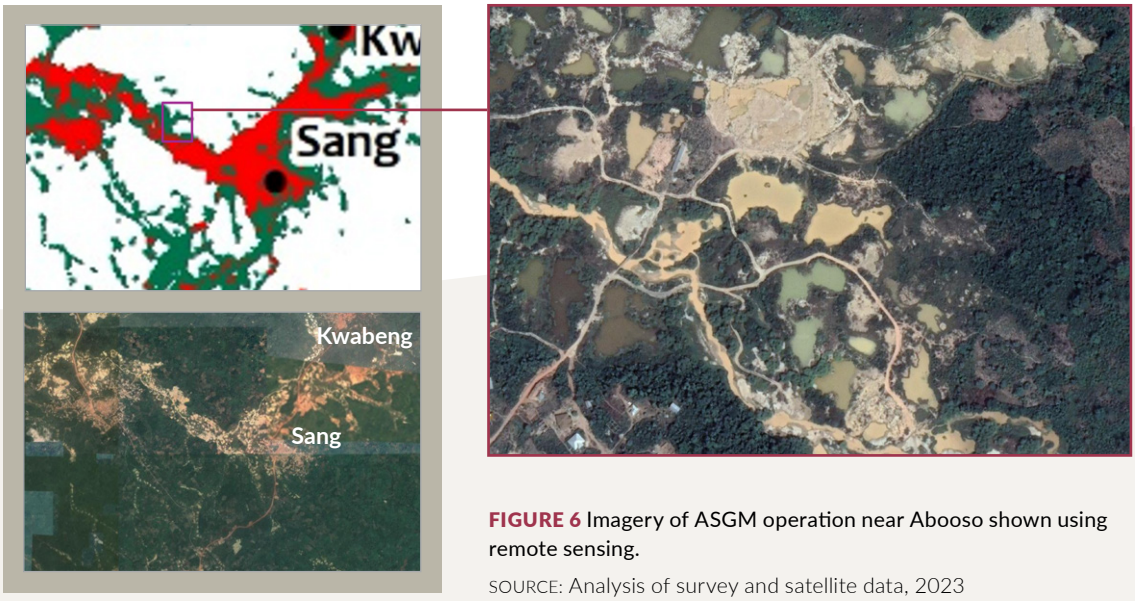


FIGURE 6 Imagery of ASGM operation near Abooso shown using remote sensing.

SOURCE: Analysis of survey and satellite data, 2023

Measuring forest loss

Forest loss serves as a growing indicator for assessing the extent and expansion of ASGM in forested regions. Although global monitoring products frequently lack the precision needed to directly attribute changes to mining activities, locally calibrated tools can effectively pinpoint deforestation associated with mining, as demonstrated in Figure 7, which shows significant changes in the Western region case study area. However, this technique has obvious geographic limitations; it is not effective in arid regions or areas without significant forest or vegetation cover, such as the Savannah region, due to the canopy not being as dense. Furthermore, because trees do not grow back immediately after mining has ceased, it is difficult to know if a mining site is active in a deforested area. When areas are converted to other uses after mining has ceased, it can make the interpretation of the local environment difficult, thus also highlighting the need for field validation to complement remote sensing. For these reasons, additional computer vision models are being actively developed to provide more robust change detection techniques, including those which consider changes in the areas surrounding mines to draw inferences and approaches which combine multiple datasets. The latter includes synthetic aperture radar, which uses radio waves to detect changes in landscape (surface deformation) and underground features. ■

In the Western region, because colluvial mining is the most common type of ASGM, there is a correlation between alluvial ASGM expansion and flow accumulation paths, which are natural pathways or routes along which water accumulates and flows.[38] Alluvial mining tends to follow valley floodplains. Thus, flow accumulation analysis, which is built by modelling the natural flow of water over the land surface to the floodplains associated with gold bearing deposits,[39] can be used to help interpret downstream changes that can be the result of alluvial mining. Flow accumulation analysis can also help to predict where mining might move to in the future. The expansion of ASGM and flow

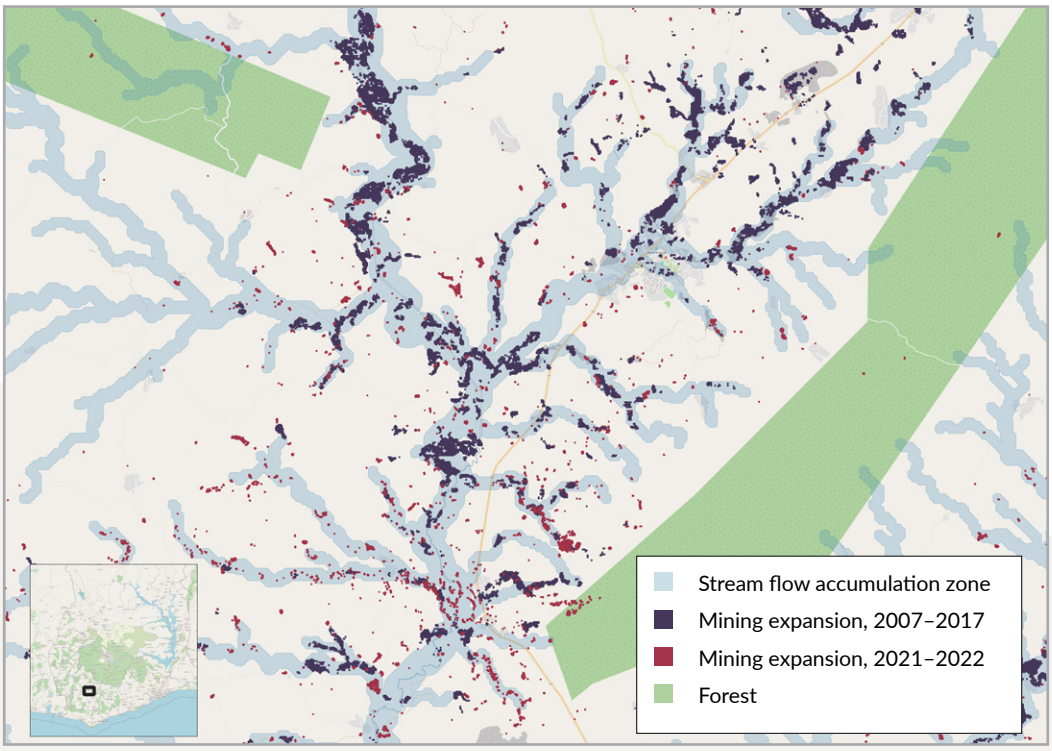


FIGURE 7 ASGM expansion and flow accumulation paths using satellite imagery analysis.

SOURCE: Analysis of survey and satellite data, 2023. Data collection, analysis and visualization by Peter Scarth.

accumulation in the Western region are shown in Figure 7. This is a significant advance, illustrating how remote sensing has the potential not only to show where ASGM has occurred, but also where it may expand in the future. This enables proactive action, as opposed to purely reactive behaviour, as potential ASGM expansion can be predicted and preventive action against illicit activity taken where necessary, for example by establishing a community mining area in the location.

Remote sensing has the potential not only to show where ASGM has occurred, but also where it may expand in the future.

Savannah region

The increase in gold mining in the Savannah region is a more recent trend, constituting a major uptick in the last 10 years. Only 18% of mine sites surveyed in this region were more than 10 years old at the time surveys were conducted.[40] In comparison, about a third of sites in the Western region are more than 10 years old. Compared to the Western region, the Savannah is sparsely populated (roughly 650 000 inhabitants as of December 2021) and suffers from infrastructure deficits and higher poverty levels.[41] Over 90% of the population is engaged in agriculture and there are limited job opportunities elsewhere. Within this context, ASGM is proving an important economic activity.

There are only a handful of licensed ASGM operations in the Savannah region. Apart from the villages of Dakrupe and Tinga, which hold community mining licences, all other forms of ASGM in this region (the vast majority) were unlicensed as of April 2024. The arid geography and mine sites that often consist only of shaft or tunnel entrances (small-diameter vertical shafts) in the Savannah region make it much more challenging to identify the scale and spread of ASGM solely using remote sensing technologies. Also, because mining in this region is mostly hard rock mining, mining locations are more heavily dictated by geological gold mineral occurrences and do not correlate to flow accumulation models. As such, mapped mining is much smaller than in the Western region, and it is likely that it fails to capture a significant portion of real mining activity.

ASGM in the Savannah region is more likely to be conducted by informal cooperatives or groups than in the Western region, where a higher proportion of ASGM sites are controlled by individuals. Usually, the licence is entrusted to several key families within the community. Due to a lack of geological prospecting, ASGM miners do not have sufficient information to reliably predict the location of gold deposits or estimate production levels. Some traditional practitioners rely on methods such as interpreting signs from nature – like withered trees – or spiritual practices to predict mineral deposits. Additionally, some mining operations still use historical trenches dug by prospecting companies or individuals during colonial times to predict mineral deposits. Community mining is constrained by significant delays in securing community mining licences. Community members reported that it took two years for the Dakrupe community mining licence to be processed.[42]

The Dollar Power area – a community with 3 000 inhabitants located on the border with Côte d'Ivoire – is a unique and remote unlicensed ASGM hotspot.[43] Gold miners in the area reported that mining began in Dollar Power after a Ghanaian went to mine in Côte d'Ivoire and realized that gold deposits were also likely to be found on the Ghanaian side of the border.[44] A small number of Ghanaians started relocating to the area in 2005 to profit from the gold riches and stop Ivorians from exploiting these deposits, which were mined and controlled until 2013 by former Ivorian rebels loyal to former President Laurent Gbagbo. Conflict between these disbanded rebels and Ghanaians resulted in the

expulsion of the rebels from the land. Since 2023, there has been a shift from the previously thriving Dollar Power area to sites like Cloth and Signakura, driven by the belief that these locations are richer in gold.[45] Mining operations at sites like Dollar Power and Banda Nkwanta (Patre mine site) encroach upon the buffer zones of the Bui National Park, the third-largest wildlife protection area in Ghana.

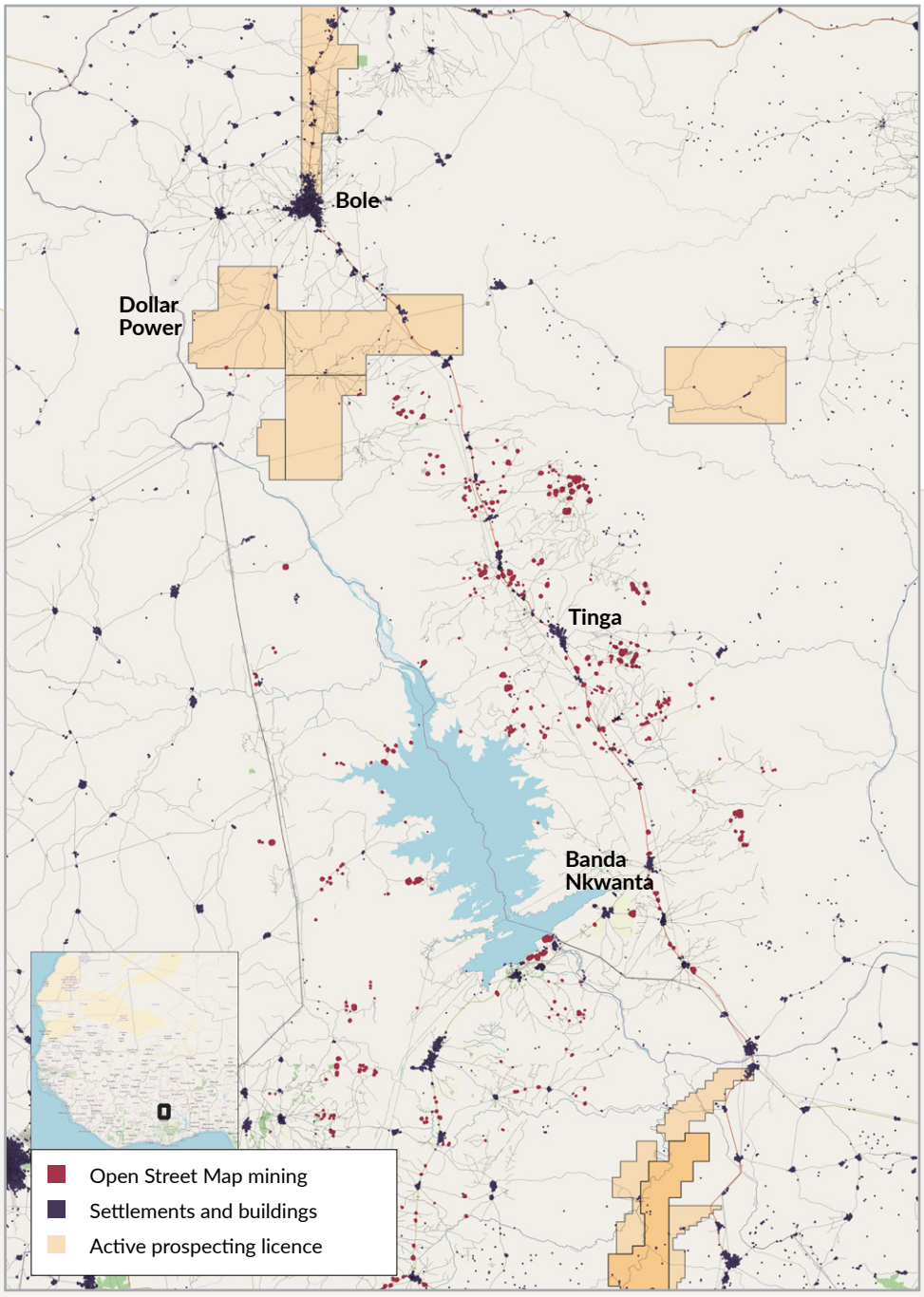


FIGURE 8 ASGM scale and spread in the Savannah case study area.

SOURCE: Analysis of survey and satellite data, 2023. Data collection, analysis and visualization by Peter Scarth.

DRIVERS AND ENABLERS OF UNLICENSED ASGM

ASGM in Ghana is deeply entangled in a complex web of political and traditional power dynamics. Corruption plays a central role in perpetuating unlicensed mining activities, with political elites, local chiefs and government officials often implicated in supporting and profiting from illegal mining operations. These systemic challenges not only undermine formal regulatory processes, but also create intricate networks of illicit economic participation that span both local communities and national political circles.

Livelihoods

The ASGM sector is an important source of livelihoods, especially in rural areas of Ghana where there are limited other options and high levels of youth unemployment. This is reflected in GI-TOC survey data. Unemployment was cited by 45% of respondents as a reason they began mining for gold, while 22% of survey respondents reported that they started gold mining to supplement their income.

The gold sector also offers higher incomes than other sectors. One gold buyer reported that the urge to earn a better living motivates people to go into ASGM.[46] This is also reflected in survey data, with roughly half of respondents reporting they earned more than GHS2 000 (about US$233) per month. While respondents largely held managerial roles and thus earned relatively high incomes for the sector, this rate is significantly more attractive compared to the government's Net Living Wage (after income taxes and pension deductions) of GHS1 703 (US$237), although it falls short of the Gross Living Wage of GHS2 112 (US$294) reported in June 2022.[47] Average incomes for informal jobs in the Savannah region and other northern regions are much lower than in the southern part of the country. However, even in the Western region most jobs do not pay as well as gold mining.[48] For example, in the Western region the lowest salary within the ASGM sector reported by survey respondents was GHS1 700 (US$223) per month, which is roughly the same as the salary of a trained teacher who holds a diploma.[49] Landowners are also attracted to the potential profits of the gold sector. For instance, a farmer might lease out mineral-rich land to miners for money or a share of the profit, which often outweighs profits from farming.[50]

The relatively high incomes in ASGM represent a significant factor in alternative livelihood projects largely failing to succeed. Studies have observed that individuals attracted to illicit economic activities

tend to have a higher risk tolerance, and that traditional income generation and livelihood programmes might not appeal to them.[51]

ASGM livelihoods are projected to increase in importance, serving as an economic safety net as other traditional livelihood options, particularly agriculture and livestock rearing, come under threat, including from climate change. For example, in the Savannah region's Bole district, most miners worked as farmers (mainly planting yam and grains) but shifted to mining when their farms were destroyed by nomadic or semi-nomadic cattle herders. Herders, upon entering communities, often bribe local authorities – such as chiefs, youth leaders and assemblymen (elected local government representatives) – to secure their presence. Their practice of night grazing frequently results in the destruction of farmers' crops.[52]

ASGM communities benefit from the investment of mining profits in the local economy. Profits from gold mining, licensed and unlicensed, are often invested into real estate (including rental properties and hotels), fuel stations, transport businesses (including car rentals) and retail fuel stations; some local profit also finds its way back into ASGM.[53] Survey data collected for this report indicates that miners mostly spend mining profits on existing property, new real estate construction, establishing grocery stores, cars, motorbikes, entertainment and alcohol.

Profits from ASGM (licensed and unlicensed) can also be channelled back into the community. In the Savannah region, the local mining committee and individual miners have channelled a portion of gold proceeds into building classroom blocks, a police post, an ambulance garage, a clinic, mosques and accommodation for teachers. Profits from ASGM have also been invested in improving housing for residents. Until seven years ago, residents in Banda Nkwanta (a small town in the Bole district), lived in thatched houses, but many now reside in brick-and-mortar houses with good roofing.[54] More broadly, ASGM has also boosted miners' quality of life, enabling them to fund personal milestones like getting married.

Many miners who work in ASGM operate without licences because the barriers to obtaining legal mining permits and meeting other legal requirements are viewed as too onerous, expensive, or lengthy, especially when individuals possess limited funds or other available resources. To be effective – and to avoid counterproductive consequences – interventions must acknowledge the importance of ASGM for livelihoods and economic development. This has largely taken the form of seeking to formalize the ASGM sector. Formalization can be understood as 'a process that seeks to integrate the ASGM sector into the formal economy, society and regulatory system'. It is an essential element in increasing resilience to (and combating) criminal exploitation of the gold sector.[55]

Influence of Chinese nationals

Foreign nationals have played a key role in the introduction of and increased access to new technologies, equipment and chemicals, often sourced from their home countries. Yet, non-Ghanaians are prohibited by law from engaging in small-scale mining, which is exclusively reserved for Ghanaian citizens above the age of 18 who have been duly licensed to operate.[56] The presence and impact of Chinese nationals in the Ghanaian ASGM sector are especially notable.[57] For example, a Chinese national sentenced to four and a half years in prison for illegal gold mining was dubbed the 'galamsey queen' by the Ghanaian press.[58] Chinese nationals have played a pivotal role in the mechanization of Ghana's ASGM sector. This has a significant effect on the scale of mining activity, volume of production and impacts on environment, health and communities.[59]

Machinery and mining

The importation and introduction of major machinery (and parts) by Chinese nationals has been a major driver of the sector's mechanization. Key machinery includes Chinese-made diesel-powered rock crushers (mostly assembled locally in Ghana by Chinese entrepreneurs),[60] excavators and trommel machines (cylindrical drum-like pieces of equipment often used to separate and classify different sizes of materials, such as ore, gravel and sand).[61] The Hunan, a Chinese network that formed the key initial foreign mining contingent in Ghana, introduced the changfa, a diesel-powered crushing machine that grinds gold-bearing rocks into powder, allowing gold particles to be extracted through washing.[62]

Chinese nationals have established machine shops that sell and maintain machinery for gold mining, including water pumps for pits.[63] Ghanaian miners are reported to purchase mining machinery from Chinese nationals or to hire the machinery on credit, which is later repaid once gold is found. Alternatively, Chinese nationals reportedly allow locals to use machines free of charge and later assess if a concession is rich enough to take gold as payment.[64]

While improved technology and equipment increases gold production volumes and economic returns, it also results in greater environmental and health damage when not properly managed and regulated. Changfa engines, imported from China, are primarily used in land operations but floating platforms can also be equipped with these engines, which unlicensed miners frequently use to dredge water bodies. These boats consist of barrels connected by steel frames, with the engines mounted on a

A diesel-powered rock crusher (left) and wet pan mill (right) of Chinese origin. Both machines are commonly used in the Western region. *Photos: GI-TOC*

A floating platform equipped with changfa engines imported from China. These highly mechanized systems are exerting very damaging impacts on the environment. *Photos: GI-TOC*

wooden platform that supports the structure and allows it to float. On top of the platform are compartments designed for washing the sand excavated from the river.[65] The impact of highly mechanized processing on the environment, particularly river systems, is incredibly harmful and has been described as 'ruthless'.[66] The waste from this process is discarded back into the river, resulting in increased turbidity in many water bodies, loss of aquatic life, and contaminated drinking water.

Chinese nationals also own ASGM operations. Given that it is illegal in Ghana for foreign nationals to engage in ASGM, Chinese nationals work with Ghanaian nationals who serve as a front for their activities and as an intermediary between them, the local community and authorities.[67] Ghanaian nationals who are front men for illegal operations owned by Chinese nationals are reported to be paid very well for their services and their loyalty.[68] The partnerships are so profitable that influential community and traditional leaders and land-owning clans and families are reported to provide access to land and allow illegal mining by Chinese nationals. Additionally, Ghanaian locals will invite Chinese nationals to invest in mining operations or to provide machinery for a portion of the profits.[69] Locals also lead Chinese nationals into rural areas in search of mineral-rich land.[70] Local community leaders such as chiefs, assemblymen, district chief executives and other politicians also allegedly protect foreign nationals who are engaged in illegal mining.[71]

Yet the economic benefits of unlicensed mining by Chinese nationals are not distributed widely. Chinese mining operations tend to hire only a small number of local people, instead bringing in Chinese nationals to operate machinery, provide security and run the businesses.[72]

Chinese professionals are also hired to provide consulting or training and support services to assist in using and fixing mining equipment such as submersible pumps, trommels and excavators.[73] It is legal to provide such services and ASGM operators have reported that knowledge-sharing and the introduction of more advanced equipment have significantly benefited operations. However, the provision of these consultancy services to unlicensed ASGM sites is illegal. It is also reported to be a cover for ASGM operations that are owned by Chinese nationals. When Chinese nationals are found on mining sites, they claim they are training Ghanaians how to operate excavators in a bid to avoid being arrested, according to one Ghanaian government official.[74]

The presence of mining operations owned or operated by Chinese nationals has had negative outcomes for communities in some instances. One interviewee noted that Chinese nationals often leave behind degraded and unusable sites after their mining activities. This situation arises when miners fail to undertake necessary land reclamation, leaving sites with exposed earth and uncovered pits that fill with water to form dangerous ponds. This is dangerous for local communities, especially children, as well as for livestock.[75]

Conflict between Chinese-owned mining operations and communities has at times reportedly resulted in violence and deaths.[76] For example, according to November 2022 news reports, three Chinese nationals were arrested for the murder of a small-scale miner in Bonsa in the Western region.[77] Also, in August 2023, four individuals were allegedly shot by Chinese miners at Banaso, near Enchi, in the Western North region,[78] and in October 2024, two locals were reported to be shot during clashes with Chinese nationals involved in illegal small-scale mining in Daboase, located in the Wassa East district of the Western region.

Role of Chinese nationals

The largest group in terms of Chinese engagement in ASGM in Ghana is the Shanglin gang, named after the county in southern China's Guangxi province from which most of its members hail. Shanglin is generally regarded as a poor area and the population is largely Zhuang, China's largest ethnic minority. There is a tradition of alluvial gold mining in Shanglin county, and many generations have worked in the sector. The Shanglin presence in Ghana can be traced to the late 1990s, likely driven in part by increased government regulation in China which pushed mining entrepreneurs to look for opportunities abroad. The movement of Shanglin residents to Ghana appears to have picked up pace after 2006, when rumours spread online that those mining gold in the African country were 'getting rich overnight'.[79] Estimates of the total number of Shanglin residents in Ghana at the height of this rush vary considerably, but most estimates were in the tens of thousands.

Professional roles and status are reportedly fluid within the group. Bosses usually pay for their workers to travel abroad. However, if a worker saves enough money, he may try to become a boss himself and open his own mine. On the other hand, if a project fails and a boss loses most of his assets, he may decide to work for someone else.[80]

However, financing for mining activities in Ghana is reported to mainly come from other regions in China. Media reporting and research indicates that mining activities in Ghana have 'generally been financed by individuals or small groups of Chinese nationals',[81] mainly from Zhejiang and Fujian provinces. These provinces are both considered prosperous and are associated with financial networks, both licit and illicit. Fujian, for example, is 'driving a new wave of investment' across Africa as a whole, supported by home region diasporic links in the same way that Shanglin networks facilitate international mining.[82]

Presence across Ghana

There is a visible presence of Chinese nationals in the ASGM sector in the Western region, including a significant presence in Wassa Akropong, Asankragua and Obuasi, which are all unlicensed ASGM hotspots. An increasing number of Ghanaians work closely with Chinese nationals operating in the mining sector; Ghanaians are also increasingly speaking Mandarin and local lawyers are assisting Chinese nationals in obtaining residency.[83] Chinese nationals are actively involved in running casinos, restaurants and supermarkets in Wassa Akropong. Chinese-operated casinos allegedly help facilitate illegal financial flows (notably, illegal gold trading and smuggling), as people move between the casinos and mining sites. Chinese nationals also run hotels and nightclubs.[84]

In 2022, there was a very limited presence of Chinese nationals in the Savannah region and there was no evidence of mining operations owned or managed by Chinese nationals. However, at the time gold traders reported that Chinese nationals were seeking to enter Bole, a prominent hub for gold mining in the Savannah region. Gold traders in the Upper West region reported that two out of the five shops selling mining equipment in Bole were owned by Chinese nationals.[85] It was also reported that Chinese nationals had approached local chiefs and mining committees for permission to mine on their lands, but their requests were declined due to concerns about environmental damage caused by Chinese mining activities and reports of poor working conditions and harsh treatment of Ghanaian workers by Chinese employers.[86]

However, dynamics have changed and there is a growing Chinese presence, which fuels illicit activity and contributes to environmental degradation. The Bole district has garnered attention due to the growth in the last two years of Chinese miners employing excavators for mining activities. Concerned community members encounter obstacles in seeking to curb illegal mining (and resultant environmental

harm) due to private armed security protecting widespread illegal mining by Chinese nationals in the Kalidu forest. The use of excavators exacerbates the negative environmental effects of ASGM, including by increasing the fragility of the area's ecosystems. Chinese mining sites are located in Jama, Tinga, Bole Bamboi, Jogboi and Babato, along the Black Volta, [87] a river that flows through Burkina Faso and into Lake Volta in Ghana.[88] Illegal mining activities and bribery of local chiefs to gain access to mining areas are allegedly financed by Chinese businesspeople.[89] Chinese investors also contribute money for the acquisition of mining and processing equipment.

The government has taken action to reduce the number of Chinese nationals active in the ASGM sector, but discrepancies in official reporting make it difficult to ascertain how many have been deported for their involvement in illegal ASGM activity. An inter-ministerial taskforce was set up in 2013 by Ghana's then President John Mahama to crack down on illegal miners, which led to the arrest and deportation of about 5 000 foreigners engaged in illegal mining.[90] The 2013 crackdown led to a significant reduction in Chinese nationals of Shanglin origin mining in Ghana, although they remained the most significant single group.[91] In 2014, China's foreign minister visited Ghana and pledged Beijing's support in tackling illegal small-scale mining.[92] However, according to the Ghana Immigration Service, between 2009 and August 2022 only 1 641 Chinese nationals involved in illegal mining in Ghana were arrested and repatriated, many of them (713) in 2013 alone.[93]

Despite the well-documented presence of Chinese nationals in Ghana's gold mining sector, little is known about associated financial flows or gold supply chains. Given the amount of gold they are thought to produce, it is likely that Chinese nationals are smuggling gold out of the country through Kotoka International Airport in the capital, Accra,[94] or through Ghana's seaports.[95] Yet, due to a lack of intelligence on the routes and modus operandi Chinese networks are using to smuggle gold out of Ghana, routes could not be confirmed.

Casinos: a money laundering risk

Casinos in Ghanaian mining areas pose a high risk of money laundering.[96] According to media reports, most of these establishments are owned by foreign nationals, particularly Chinese.[97] Details of officially registered casinos are available and Chinese language searches reveal casinos, both registered and unregistered, advertising on various platforms.[98] The cash-intensive nature of the casino sector, combined with weak implementation of anti-money laundering (AML) and counter-terrorism financing measures, makes it particularly vulnerable to illicit financial flows. There have been reported instances of criminals attempting to launder proceeds of crime through casinos in South Africa and Nigeria,[99] indicating a similar risk in Ghana. With Chinese nationals involved in both gold mining and casino operations, there is a high risk of overlaps between illicit financial flows from the extractives sector and gambling establishments.

Efforts to address these risks include revoking licences of non-compliant casinos, sensitizing staff and gaming operators on AML regulations and conducting crackdowns on unlicensed casinos,[100] especially in areas known for illegal mining activities involving Chinese nationals (such as Asankragua, Obuasi and Wassa Akropong).[101] However, despite regulatory efforts, the prevalence of casinos in mining hotspots continues to raise concerns about money laundering activities. ■

Corruption

Corruption is widely referenced by researchers and anti-corruption agencies such as the Office of the Special Prosecutor as an enabler of illegal mining activity in Ghana.[102] A rise in unlicensed ASGM has been attributed in part to the increasing participation of political elites in the sector who profit from taking stakes in unlicensed operations.[103] This can take the form of providing financial support to unlicensed ASGM operations in exchange for a portion of the profits.[104] For example, it is reportedly common practice for Metropolitan, Municipal and District Chief Executives (MMDCEs) to use the power of their office to profit from mining operations, including unlicensed operations. Political affiliations can also provide an access point for constituents to benefit, in the form of politicians and MMDCEs allowing loyalists to engage in illegal mining unencumbered.[105] These practices are not limited to the Western and Savannah regions; they reportedly take place across the country. For example, in the Upper West region, it is alleged that political actors, police officers, customs and security agents, chiefs and assemblymen are involved in unlicensed ASGM, some with links to bosses or larger financiers at the regional and national level.[106]

Land grabbing and corruption in the allocation of mining concessions by political actors is also reportedly prevalent.[107] Corruption in the allocation of concessions can also take place in industrial mining. For example, in 2018, a settlement was reached between Kinross Gold, a Canadian multinational that previously operated in Ghana, and the US Securities and Exchange Commission after the company failed to ensure its funds in Ghana and Mauritania were not being used to bribe government officials into speedily awarding mining concessions; Kinross agreed to pay a penalty of US$950 000.[108]

Delays in the licensing process create opportunities for corruption. Securing a licence in a timely manner is reported to depend on one's lobbying ability and the payment of extra-legal 'facilitation fees'. Some 35% of GI-TOC survey respondents reported that it took more than 12 months to secure a licence. One interviewee reported that facilitation fees can amount to 100% to 150% more than official licensing fees.[109] Due to the delays and expenses involved in procuring a legal mining licence, many miners forge ahead without the proper documentation and approvals.[110]

The corruption of security personnel also thwarts efforts to combat criminality in the ASGM sector. One interviewee described the 'constant' interference of 'big men', particularly politicians and local chiefs, in efforts by security personnel to clamp down on unlicensed mining activities.[111] One government official reported that if a Minerals Commission officer tries to close an illegal mining site, they will typically receive several calls from powerful individuals challenging the closure; moreover, officers who have closed mining sites have been transferred elsewhere.[112]

Enforcement operations against ASGM are clearly shaped by political interests and corruption. Operation Vanguard, a joint military–police operation launched in 2017 that ostensibly sought to end galamsey, provides a clear example.[113] A former member of Operation Vanguard reported that members of the operation were suspicious that top officials had been compromised because there were known illegal mining operations that were not included in military assignments. It was reported that some senior military officials take bribes from miners so illegal mining activities are not disrupted, and that Ghanaian nationals are sometimes pursued by authorities while foreign nationals (who can pay larger bribes) walk free.[114] A former officer who took part in Operation Vanguard recalled that during one scouting operation, the Criminal Investigations Department of the Ghana Police Service discovered that a senior colleague had been taking payments from owners of mining sites operating illegally in return for not shutting down those sites. The former officer recalled another incident in

which he and colleagues had to release excavators they had seized from an illegal ASGM site because the site belonged to a district chief executive.[115]

Prosecutors can also face challenges when seeking to prosecute individuals for engaging in illegal mining. For example, the former Operation Vanguard officer reported that in one incident a prosecutor who sought illegal mining charges against a foreign national was taken off the case. Furthermore, due to delays in court procedures, offenders are often released without charge.[116]

Traditional custodians of the land

Local chiefs play a crucial governance role in ASGM by regulating access to land. In many parts of Ghana, chiefs are the traditional custodians of the land, controlling access to and use of land under their purview. In the Savannah region and other northern parts of Ghana, including the Upper West region, traditional land tenure systems play a bigger role in land access than in the Western region.[117] To secure access to land and the right to mine, direct negotiations with chiefs, clans and land-owning families are required.[118] In the Savannah region, the chief has the power to constitute committees that oversee ASGM activities, maintain security and collect fees (including for himself, local royalty and sponsors).[119] For example, in Dollar Power, located in Bole on the border with Côte d'Ivoire, a local chief reportedly invested mining royalties into developmental projects in the area.[120] Committees are staffed by respected and trusted individuals appointed by the chiefs. Meanwhile, sub-committees supervise local exploration, including the use of metal detectors.[121]

When minerals are found, the prospector will inform the chief and become the owner of several pits.[122] A chief may demand payment from the prospector before allowing mining operations to begin.[123] The prospect of substantial profits reportedly makes chiefs favourable to gold mining; they even actively seek to entice people to mine on land they control. One interviewee indicated that chiefs prefer non-local prospectors because they are taxed at a higher rate than locals.[124] They erect barriers to check for proof of payment before granting access to mining sites. The sub-committee may also collect fees from gold buyers and processors. Sometimes the committee collects a portion of the ore produced rather than fees in the form of cash, with the chief receiving 10% of mined ore; this share

Artisanal and small-scale gold mining is an important source of income for many living in Ghana's rural areas. *© Francis Kokoroko/Reuters*

is then split among levy collectors, committee members, the chief and his relatives.[125] According to one interviewee, some chiefs prefer informal arrangements to formal licensing, because they fear that when mineral-rich areas are licensed, they will lose close control of the resources.[126]

Chiefs also stand accused of corruptly profiting from unlicensed ASGM.[127] Reflecting wider sentiment, one interviewee stated that chiefs are sometimes bribed with cars and money to turn a blind eye to illegal ASGM.[128] Other interviewees reported that the local chief's relatives and courtiers will demand additional fees, after formal fees are paid to traditional heads and pocketed without benefiting the community. Some traditional authorities are also allegedly involved in agreements with unlicensed miners whereby they directly receive a percentage for 'permission' to operate in their lands, which does not go through the committee system. Payments by foreign nationals, often through Ghanaian frontmen, are described as especially common. It is reported that chiefs may also lead negotiations with law enforcement and government officials, at times indirectly through trusted front men to hide their involvement in the dealings. Some traditional chiefs reportedly own excavators that they rent out to miners, or they own mine sites that they hire others to manage.[129]

However, a Community Mining Scheme is seeking to regulate and rein in chiefs' abilities to control and profit from ASGM on land they govern. Launched in July 2019 by the Minerals Commission,[130] this scheme aims to promote local community participation in ASGM as a means of creating jobs and improving livelihoods in mining communities, as well as improving the working conditions of miners and minimizing environmental degradation.[131] The areas are supervised by a Community Mining Oversight Committee. Community mining areas can be allocated on large-scale mining leases as part of a tributary system.[132] However, this is resulting in tension between state and traditional authorities, which is discussed later in this report (see the section titled 'Interventions and responses').

PROCESSING METHODS

Two main processing methods dominate gold extraction in the ASGM sector: mercury amalgamation and cyanide leaching. While mercury has historically been the most prevalent technique, there is a gradual shift towards cyanide leaching, which offers more efficient gold recovery but requires greater technical expertise and investment. This transition reflects the complex technological and economic dynamics of Ghana's ASGM sector, where processing techniques are intimately tied to environmental impacts, regulatory frameworks and economic opportunities.

Mercury

Mercury is widely used across Ghana to extract gold from ore. Some 77% of survey respondents speculated that 70% or more of mining operations used mercury.[133] In Ghana, the importation and sale of mercury is regulated by the Mercury Act 1989. The Act makes it legal to own and utilize mercury, but it also imposes fines on miners who do so without a permit. Through approved dealers, registered ASGM operators and licensed traders may lawfully buy and sell mercury. The Minerals and Mining Act of 2006 permits small-scale miners to buy mercury in quantities 'reasonably necessary for mining operations'. Additionally, the Mining and Mineral Regulations 2012 permit the use of mercury in ASGM if the individual in question uses a retort (a tool for removing mercury from gold sludge through vaporization) and obtains the written approval of the Chief Inspector of Mines.

Mercury, seen at a local gold buyer's shop, is used in extracting gold from ore. *Photos: GI-TOC*

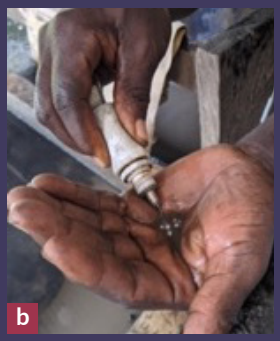
Mercury amalgamation

In Ghana, concentrate amalgamation is widely used for gold extraction, meaning mercury is used only on ore concentrate that contains the heaviest minerals and gold. The steps in concentrate amalgamation are shown below. An ore concentrate, commonly referred to as 'mud', is created by crushing rocks using a machine such as a diesel-powered engine or a wet pan mill (both described and shown above). In some cases, rocks may also be crushed manually.

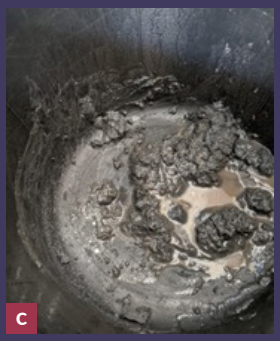
The ore is further concentrated through various techniques, such as using a sluice to capture the gold (image a). Because gold is heavier than other materials, it sinks to the bottom and is caught in a carpet which is washed to collect the gold-bearing mud (image a). The term 'tailings' refers to the leftover ore that is not processed using mercury (i.e. mud). Mercury (image b) is then added to the mud (image c). Mercury molecules bind to gold to form an amalgam (image d). When the amalgam is heated, mercury is vaporized, releasing mercury into the atmosphere where it risks being inhaled or condenses in the surrounding environment, which is harmful for human health and the wider environment. Gold in the form of 'sponge' is left over (image e). The sponge gold is then smelted (image f) to produce gold doré, which can then be traded (image g).

Gold processing using mercury

A sluice to capture concentrate, also known as 'mud'.

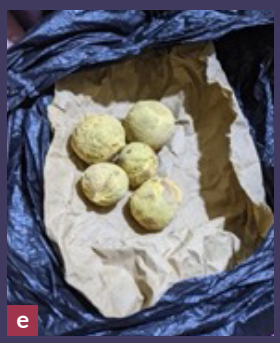


Mercury use at a mineral processing facility.

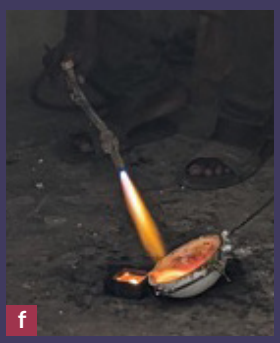


The mercury is mixed with ore concentrate.

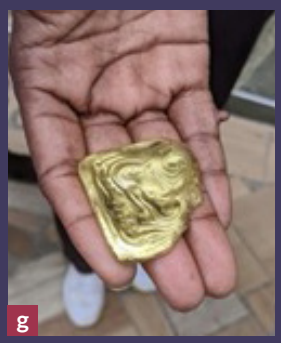
Concentrate and mercury are combined to form an amalgam ball, and processors use a cloth to remove excess water.



Sponge gold



Smelting



Gold doré

Photos: GI-TOC

While miners can obtain mercury under the current regulations legally,[134] in practice the vast majority is imported and traded illegally. There were mixed views on how far Ghana constituted a regional import hub. Some reports indicated that a large volume of mercury is smuggled directly into the country, while other interviews indicated that most mercury is smuggled into Ghana via Togo and Burkina Faso. However, there were anecdotal reports in other West African countries that mercury is supplied from Ghana, reinforcing claims that Ghana is a regional mercury import hub.[135]

In Ghana mercury is used in concentrate amalgamation. Concentrate amalgamation using mercury is a less harmful processing technique than whole ore amalgamation (when mercury is added to ore constituted of whole rocks and before it is crushed down into a sludge). Concentrate amalgamation requires a much smaller amount of mercury and results in little to no mercury going into the tailings.[136] This is important because when tailings containing mercury are processed using cyanide leaching techniques it creates methyl mercury, which is water soluble and generates even greater environmental and health harms. However, while concentrate amalgamation is not as harmful as whole ore amalgamation, it still has severe impacts, especially when mercury is vaporised in urban areas and homes.

An artisanal trader shows gold being prepared for smelting in Tarkwa, in Ghana's Western region. *© Reuters/Matthew Mpoke Bigg*

Cyanide

Over the past few years there has been a rise in cyanide processing of gold in Ghana. Cyanide leaching is more effective than mercury amalgamation at extracting gold from ore. One processor, who switched to cyanide leaching after observing others adopting the method, recounted, 'We realized what they were doing. Amalgamation only recovered 30% of the gold, so about 70% went back to the tailings.'[137]

Increased familiarity with this processing technique and improved gold recovery rates are spurring the spread of cyanide leaching in Ghana. However, leaching requires significantly more investment and technical skill than mercury amalgamation. In turn, this is impacting and reshaping gold production, supply chains and financial flows. The use of cyanide in ASGM operations is not expressly prohibited by national laws and regulations,[138] but the processes required for the legal use of cyanide are

often too arduous for many ASGM players. Thus, the supply and use of cyanide in ASGM is largely illicit. In practice, because cyanide leaching is more costly and time-intensive, it is more accessible to wealthier actors, including criminal actors who are then able to increase illicit profits and fortify illicit supply chains.

While it is likely that Burkinabés introduced cyanide leaching technology to others in West Africa, Ghanaians are increasingly conducting leaching operations.[139] Reflecting the spread of leaching from Ghana's northern borders with Burkina Faso, the technique was more established in the Savannah region than in the Western region. Cyanide processing has reportedly been ongoing in the Savannah region for longer, introduced between 2012 and 2016. Typically, the owner of tailings – often the pit owner or sponsor – has the option to sell them to a leaching operation (or to hire a leaching operation to process the tailings). Tailings are often not graded before being sold, especially in the Savannah region. Prices for a truckload of tailings amounting to 18 cubic metres can range from GHS1 000 to GHS4 000 (US$151 to US$606).[140]

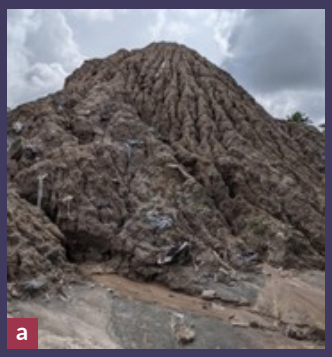
Cyanide leaching

Vat leaching is the most common type of leaching the research team saw in Ghana. To extract gold from ore using the vat leaching method, tailings (crushed ore; image a) are placed in a vessel, which could be a vat, large drum, tank or pool (image b). The vessel has a drain at the bottom and is lined with sand and/or filter materials. The crushed ore is put into the vessel and quicklime is added to the surface or mixed in with the ore. An alkaline cyanide solution is introduced by hoses to the top of the tanks. The cyanide solution dissolves the gold to form a 'pregnant' cyanide-gold solution that passes down through a drain and is pumped back around until the solution cannot leach (extract) more gold.[141]

Activated carbon or zinc strips/shavings are often used to recover gold from the pregnant leach solution (image c). The pregnant solution is passed through a series of tanks or columns containing activated carbon or zinc strip to recover gold from the solution. This cycle is repeated until most of the gold concentration dissolved in the solution has been recovered. The process can take four to 40 days, depending on the size and depth of the tanks and other factors.[142] Zinc precipitation (an alternative method to using activated carbon or zinc to recover gold from pregnant cyanide solutions in gold mining operations) is commonly used in Burkina Faso, and is also used in some cases in Ghana.[143]

Gold is stripped (i.e. extracted) from the loaded carbon or zinc by soaking it in an elution solution. Elution solutions typically contain chemicals such as sodium hydroxide or sodium cyanide. The elution solution helps to dissolve the gold from the carbon or zinc, allowing gold to be recovered in a concentrated form. Concentrated sulphuric acid is also used to separate the gold from other metals. In a process known as 'cooking' the gold, heat and pressure are also applied to extract gold. Finally, doré is produced by smelting the remaining gold ore in a furnace or using a torch burner.[144]

Gold processing using cyanide

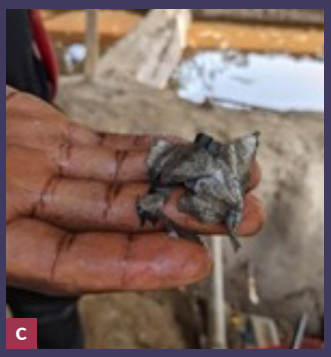


a

A tailing pile waiting for processing

b

Leaching pools



c

Activated carbon

d

An elution solution

e

A vat of cyanide

Photos: GI-TOC

In contrast, those aware of cyanide leaching in the Western region report that the processing technique has been adopted more recently (between 2017 and 2019).[145] The more recent uptake in cyanide leaching in the Western region is reflected in satellite imagery and field research, which indicate an increasing number of cyanide leaching facilities coming into operation from 2017. Within the Western region, cyanide leaching operations are clustered around the town of Abooso, just north-east of Tarkwa.

If properly handled, cyanide has little impact on the environment. However, when not safely managed, cyanide has the potential to cause significant environmental damage. Cyanide spills into water bodies, either through the surrounding ground surface or accidental spillage adjacent to (or directly into) water bodies, can be very dangerous. Safe handling of cyanide therefore offers a positive path away from mercury use. Cyanide processing is also more efficient than mercury amalgamation for extraction of gold from ore, thereby offering economic incentives to make the shift.[146] Thus, while cyanide leaching is a viable alternative to mercury processing, support for its adoption must be accompanied by stringent safety protocols.

Utilizing satellite imagery and field research, it is possible to map the expansion of cyanide leaching in the Western region from 2017 onwards. Figure 9 shows three images of the same location, with the image on the top from 2021 and the images on the bottom from 2022. Cyanide leaching facilities were also identified and mapped during fieldwork in 2023. Imagery of the same location was also collected and analyzed from 2017/18 and 2019. By triangulating the satellite imagery and fieldwork, it is possible to ascertain when individual cyanide leaching facilities were established (shown in Figure 9).

While the exact locations of cyanide leaching facilities are not shared here, the exercise demonstrates how satellite mapping can be used to pinpoint the location and scale of cyanide operations in a very precise manner, providing valuable information for policymakers, law enforcement and others seeking to improve regulation of the ASGM sector.

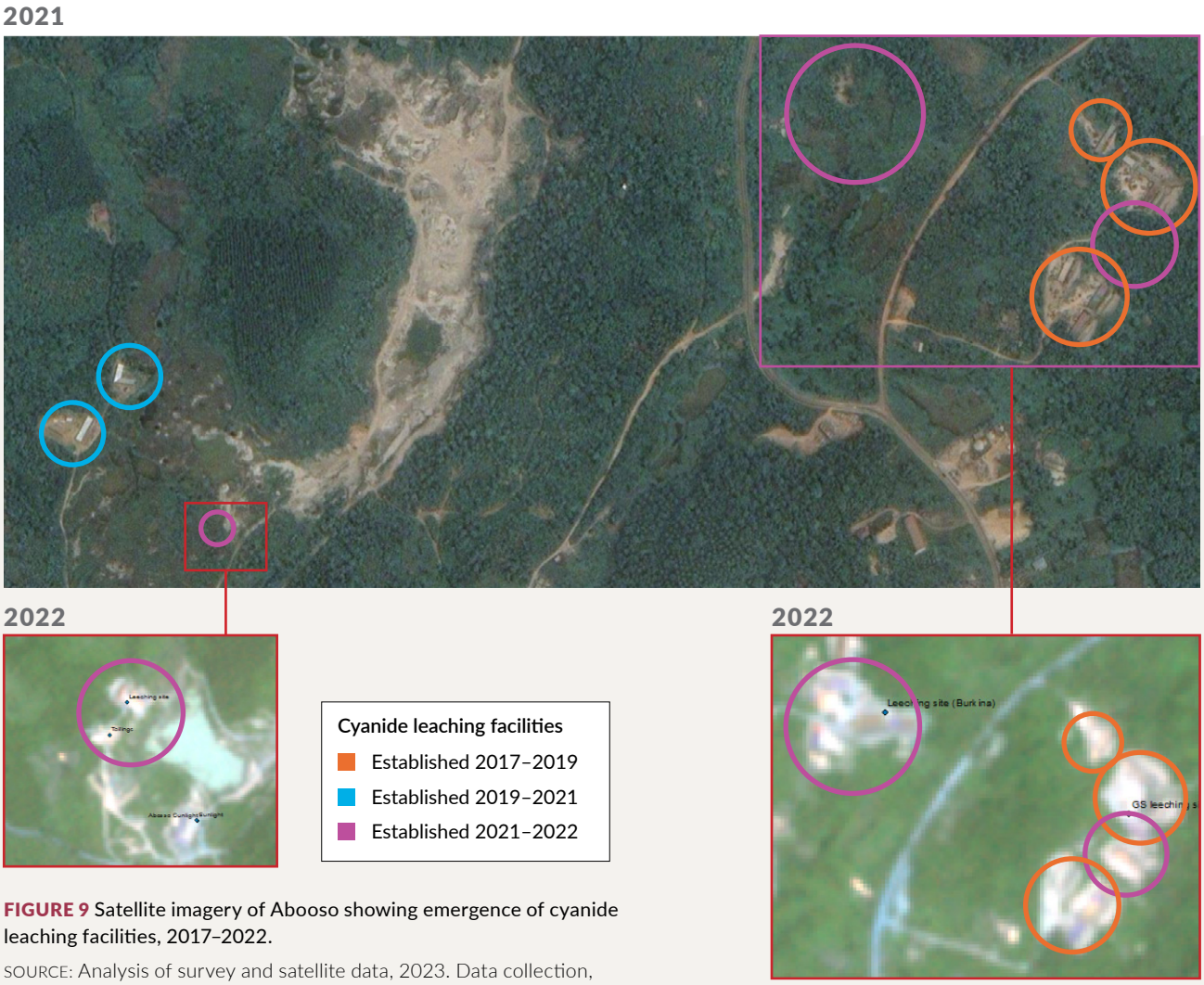


FIGURE 9 Satellite imagery of Abooso showing emergence of cyanide leaching facilities, 2017–2022.

SOURCE: Analysis of survey and satellite data, 2023. Data collection, analysis and visualization by Eric Stemn and Gideon Vunase.

INTERVENTIONS AND RESPONSES

There have been multiple and varied attempts to crack down on unlicensed gold mining in Ghana, driven by a recognition of the substantial environmental destruction, especially to waterways. However, such efforts have generated disparate and at times undesirable outcomes, with an adverse effect on livelihoods and increased criminality in the gold sector.

In November 2006, Operation Flush-Out was carried out nationwide. This operation was a military exercise geared towards ending the encroachment of illegal miners on legal mining sites and significant associated environmental damage. Although it occurred nearly two decades ago, the operation serves as a powerful reminder of the critical importance of integrating human rights considerations into any response to unlicensed ASGM. The United Nations Human Rights Council reported that during Operation Flush-Out 'hundreds of "galamseyers" were forcefully removed from the land they were working on', and 'an unknown number of "galamseyers" shot, beaten and maimed by members of the private and state security forces'.[147] It also reported that security contractors of mining companies assisted by armed police and soldiers conducted operations to arrest small-scale mining operators in the concessions of large-scale mining companies, which tended to be violent and bloody invasions of communities resulting in gross human rights violations.[148]

In early 2017, following widespread public outrage over massive environmental harms caused by excavators (mostly financed and provided by Chinese nationals) on land and water bodies in ASGM areas, the government established an inter-ministerial taskforce to combat foreign incursion into small-scale mining. In April 2017, the #StopGalamseyNow campaign was established after the Ghana Water Company Limited warned that water quality incidents caused by illegal ASGM had proliferated alarmingly and that the country was at risk of needing to import water for consumption by 2020 unless the practice was terminated.[149] The intense media campaign triggered the launch in 2017 of Operation Vanguard, the parameters of which were covered earlier in this report. In certain cases, mining equipment from illegitimate mining sites was removed and incinerated. The operation yielded mixed results, since legitimate small-scale mining firms owned by Ghanaians were also caught in the dragnet.

The #StopGalamseyNow campaign also resulted in a ban on all ASGM that was not lifted until December 2018.[150] The ban had wide-ranging impacts, albeit most of them unintended as there was no notable decrease in unlicensed ASGM.[151] While the number of foreign nationals involved in ASGM reportedly temporarily dropped during the galamsey ban, there were also adverse consequences for Ghanaian communities, including an increase in robberies in mining areas as individuals who previously

Public outrage over the environmental destruction caused by illegal gold mining led to the #StopGalamseyNow campaign in 2017. © *Nipah Dennis/AFP via Getty Images*

relied on ASGM were pushed to look for other means of survival. Many survey respondents also reported that the ban had deprived people of their livelihoods, to the point of making it difficult to feed their families.[152] In some cases, mine pits filled with water because miners could not continue to run the pumps that kept them dry, threatening the stability of underground mines (and their future use). The ban also resulted in an increase in illegal activity in some cases, as miners took drastic measures to hide activity,[153] and formerly licensed small-scale operators were left unable to sell their output. Miners who had secured financing were trapped in debt, pushing them to default on payments and turn to illicit gold markets.

Originally launched in April 2021, Operation Halt II, staffed by military personnel, sought to remove all persons and mining equipment engaged in ASGM from water bodies and forest reserves in the country. This operation ran alongside other measures taken by the Ministry of Mines, such as a designation of river bodies as red zones for mining (thereby making mining in the rivers illegal), a suspension of reconnaissance and prospecting activities in forest reserves (except in exceptional cases) and a ban on the manufacture, sale and use of Chinese diesel-powered engines. Planned additional actions included the procurement of speed boats to patrol the rivers and the recruitment of river guards.

While crackdowns on ASGM have featured heavily in Ghanaian policy efforts to regulate the sector, there has been a shift towards seeking to support the formalization of the sector through regulation. The Minerals Commission has set up district offices to offer technical extension services to miners and enhance supervision in the sector.[154] Among other roles, these officers are responsible for monitoring mining operations and providing essential advice and training to improve the efficiency of small-scale mining.[155] Small-scale mining committees have been established in all mining districts (83 in total) to oversee and monitor small-scale mining operations, including community mining schemes.[156] There have also been efforts to support the uptake and distribution of mercury-free processing technology.[157]

The establishment and regulation of community mining areas, launched in 2019, has not been without challenges. Community mining initiatives, while aiming to regulate ASGM, often undermine the traditional authority and economic control of chiefs and local leaders over areas where unlicensed mining occurs. These initiatives have threatened their ability to collect rents from ASGM operations on land they are responsible for. In other instances, the concept of community mining has been misappropriated by traditional leaders to legitimize unlicensed mining operations. One government official reported that due to confusion among district chief executives about the nuances of legislation, there were several cases where purported community mining initiatives were operating illegally because they had not secured the appropriate permits from the Minerals Commission.[158] There are also reports of foreign nationals (illegally) mining on community mining sites.[159]

This has strained relationships in various regions between key players, notably between chiefs, district assemblies and district mining committees or community mining oversight committees. Looking ahead, the potential extension of the Community Mining Scheme in the Savannah region, including to areas such as Dollar Power and its immediate surroundings, is expected to cause tensions, especially in places where formal governance structures are lacking. Sidelining established power structures also risks further eroding government legitimacy.

While community mining therefore holds great potential for furthering formalization efforts in Ghana, additional work is required to ensure authorities (state and traditional) understand the system and that community mining areas are properly regulated. These factors are crucial to ensuring that community mining schemes deliver the greatest benefit to Ghanaians and local communities (and to ensure that such initiatives are not misappropriated).

The establishment of a gender desk at the Mining Commission in 2019 was an important positive step in addressing the role of women in Ghana's mining sector. The Commission started a review of the Mineral and Mining Law, and the gender desk is actively engaged in this process to make it more gender sensitive. The Ghana Artisanal Small Scale Mining Framework of 2015–2023 is one of the few documents in the country's ASGM regulatory framework that clearly seeks to address gender equality and the inclusion of women in the sector. However, the gender-specific objective is allocated the lowest level of funding, with a total budget of GHS50 000 (about US$13 477 at 2015 exchange rates) (representing 0.2% of the framework's total budget). This highlights the degree to which enhanced prioritization is needed.[160]

In 2021, then President Nana Addo Dankwa Akufo-Addo launched the National Alternative Employment and Livelihood Programme. This initiative, themed 'Creating alternative jobs to illegal mining for sustainable national development', seeks to ensure that illegal miners who have been displaced by the activities of Operation Halt II are supplied with life's necessities, and to discourage them from reverting to illegal mining activities. In a speech, the president reaffirmed support for the Community Mining Scheme and made clear that: 'My government is not against small-scale mining. On the contrary, the government is in full support of responsible small-scale mining activities, as it provides an avenue for Ghanaians to participate in the mining industry.'[161]

CONCLUSION AND RECOMMENDATIONS

There is a long history of ASGM in Ghana, and with that a long history of Ghana's government seeking to regulate the sector. Curbing criminality in the gold sector is no easy task, and the government's efforts to do so ought to be commended. However, illicit activity remains a major challenge and continues to hinder formalization and environmental protection efforts. Consequently, there is a need for tailored responses that target key actors, financial flows and transit points in illicit gold supply chains. There is no single 'right' response to combating illicit gold markets and supporting the development of a responsible, sustainable ASGM sector. Instead, evidence-based responses that are multifaceted, innovative and dynamic are needed to curb criminality effectively and to realize the sector's full development potential.

To complement ongoing efforts by Ghana's government and other stakeholders in the gold sector, the below recommendations are made.[162]

Improve monitoring of the gold sector, including through greater investment in computer vision models. Policy and programmatic interventions must be well informed to produce positive and sustainable outcomes, and to avoid generating unintended negative consequences. Knowledge has a significant multiplier effect and is a necessary foundation to develop evidence-based policy and programming. This requires continual monitoring and analysis of the gold sector and associated networks, which are dynamic and constantly shifting. A strong knowledge base will empower stakeholders to channel their resources and political will into creating resilient, targeted policies and programmes for formalizing ASGM and tackling criminality and corruption in the gold sector. Strengthening the knowledge base should include investment and development in computer vision models, including spatial data and satellite imagery analysis. When complemented by fieldwork, these research methods and technologies can be an incredibly valuable source of data and analysis on gold mining, processing, trade and illicit networks.

Further investigation and analysis of the mining and trading activities and impacts of foreign nationals in Ghana's gold sector are needed. The influence and impacts of foreign nationals in the sector are very significant, but there remains a great deal of secrecy around their motives, activities and links to gold supply chains and financial flows, particularly surrounding Chinese actors. As such, targeted investigations into gold supply chains linked to mining and processing operations owned and controlled by Chinese nationals are needed. Such investigations would be valuable on a global scale, since the

phenomenon of Chinese entrepreneurs supporting unlicensed and illegal gold mining operations is a global trend.[163] Specific areas to monitor include those identified as at high risk of further unlicensed ASGM expansion. For example, the area around Asankragua should be closely monitored.

In addition, due to the constantly shifting nature of the gold sector, it is important to continue to monitor the dynamics of networks, including supply chains and illicit financial flows. For example, the uptake of cyanide leaching and reports of new networks entering Ghanaian gold markets (including allegations of European criminal groups gaining entry) should be monitored and investigated. Investigations into the production and transport of gold concentrate would also be valuable.

Adopt mining policies that are inclusive and development-focused. ASGM must be treated as a development challenge, and policy and project design must be inclusive. This requires direct engagement with ASGM stakeholders (such as miners and gold buyers) to build the relationships necessary for greater uptake. National frameworks that recognize ASGM as a legitimate economic activity, provide the legal and regulatory mechanisms for it to operate successfully, and offer developmental support are encouraged. Bureaucratic hurdles must also be reduced as much as possible. Short-term fiscal policies should incentivize ASGM miners and traders to enter and engage with the formal sector. While the ASGM sector has the potential to generate significant revenues for host states, this first requires creating clear incentives that increase the participation of both ASGM miners and gold buyers.

In addition to miners, engagement must also consider the interests of gold traders. The influential role of intermediary buyers and their relationships with mining communities have the potential to either enable or thwart the success of policy and programmatic interventions. Providing support to ASGM stakeholders, including both miners and gold traders, and incentivizing them to engage with the formal sector and development programmes will be critical to combating illicit mining and trade.

Invest in community mining schemes and other formalization efforts, while ensuring appropriate safeguards against criminality and corruption are in place. The Community Mining Scheme is an initiative that has the potential to deliver positive impacts and contribute to the development of communities. To support its success, sustainable investment in implementation is required, alongside the selection of appropriate locations for community mining areas. Miners will need to be sure that they can successfully mine sufficient gold in the chosen location. The government should therefore consider geological mapping options that benefit ASGM and are made available to ASGM miners. Geological assessments are a cost-effective way to empower ASGM operations to access formal financing options and to convince investors that meaningful returns are on offer.

When productive deposits are identified, there is a risk that they could be misappropriated, so it is important to prioritize development objectives and put sufficient safeguards in place to ensure the community mining areas are mined by (and ultimately benefit) community members. Also, given the significant risks of abuse of the scheme identified by this study, stringent regulation and strong safeguards against criminality and corruption are needed. The ownership of land that hosts community mining schemes (and associated rights) must also be clearly established; the structure and beneficial ownership (official and undeclared) of community mining schemes should likewise be scrutinized closely.

Increase coordination and cooperation. Due to the multifaceted nature of ASGM and illicit gold markets, a wide range of actors across government need to engage in the matter. Inclusive policy and programme responses require significant inter-agency coordination, both horizontally across different government agencies and vertically at different levels of government. A third element is diagonal coordination, which captures engagement with the private sector, civil society and the media.

An illegal artisanal miner inspects an excavated rock for traces of gold in the Prestea-Huni Valley municipal district in Ghana's Western region. © *Francis Kokoroko/Reuters*

It is important to recognize that the priorities of various stakeholders will not be perfectly aligned. Objectives may be mutually reinforcing in the long term, but short- and medium-term policies and programme interventions are likely to result in trade-offs: progress in some areas, setbacks in others. As such, policymakers need to be clear about goals and priorities, and coordination will require various groups to identify, address and collectively overcome any conflicting priorities.

Increase monitoring and regulation of cyanide and mercury use. The increasing use of cyanide leaching to extract gold from ore is an important trend to monitor in Ghana, including the impacts on gold supply chains (especially smuggling risks) and illicit financial flows. While there has been significant action on the issue of mercury usage and pollution in the ASGM sector, there is a gap when it comes to cyanide. Clearer legislative and regulatory guidance on the definition and use of chemicals in gold processing is needed. In developing regulations around the use of cyanide, it is important to recognize there are divergent views on its use in ASGM. Greater enforcement is also required, including inter-agency coordination and increasing the knowledge and capacity of regulatory actors to identify and seize illicit mercury and cyanide supplies. Demand also needs to be addressed. When supply and use of the chemicals are heavily restricted without also reducing demand, mercury and cyanide become valuable commodities on the black market. As such, supporting the introduction of less harmful processing methods and technology is valuable.

Combat (and increase resilience to) corruption in the gold sector. Responses must account for corruption and ensure appropriate safeguards are in place if policy and programme responses are to be effective. A multi-pronged anti-corruption approach aimed at both petty corruption and high-level corruption is required; one that includes technical, legal, institutional and operational counter-measures. International mechanisms and cooperation, such as the creation of beneficial ownership registries to prevent, prosecute and remedy grand corruption due to the failure to enforce existing laws, would also be valuable. Civil society and the media also have an important role to play in combating impunity by exposing corruption in the gold sector, increasing public awareness and mobilizing the public to hold government officials accountable. Advocacy by Ghanaian civil society and the media, which are adept at utilizing both traditional and digital platforms to amplify their efforts and ensure public oversight, have made an impact in the past.[164]

Adopt gender-sensitive programming. It is important to increase efforts to alleviate the challenges women face in the sector and to enable them to benefit fully from formalization of ASGM. There are various resources that can provide guidance to countries on developing gender-sensitive programming.[165] Such programmes could include setting aside government and donor funding dedicated to gender-sensitive initiatives, ensuring women have access to community mining areas (with the potential for dedicated spaces for women miners) and adapting licensing and mining concession policies and procedures to account for the unique challenges women face. This should extend to removing barriers to accessing to finance and easing financial requirements to support greater participation by women in mining.

There is also a need for greater investigation into sex trafficking risks linked to the ASGM sector, and for appropriate responses to protect women and girls.

Rethink alternative livelihood programmes. One of the greatest challenges to establishing sustainable alternative livelihoods is that the profits from illicit activity usually heavily outweigh those in the formal sector. Many miners also lack transferable skills that would enable them to move to other well-paid employment. Acknowledging the illicit character of some ASGM networks and their consequent implications is valuable in developing a more robust understanding of those involved and how best to draw them into other industries. For example, studies have observed that individuals attracted to illicit economic activities may have a higher risk tolerance, and that traditional employment generation and livelihood programmes might not appeal to them. Moreover, perception of available jobs and their connection to social identities, and notions of social justice and status, play an important role in the decisions people make about whether to pursue formal employment over engagement with illicit activities.[166]

While evidence of successful initiatives to establish alternatives to illicit economic activities is limited, the effectiveness of alternative livelihood interventions depends on political, socio-economic and cultural contexts, as well as the combination and sequencing of enforcement and alternative livelihood policies. To be successful, development efforts need to address all the structural drivers of why communities participate in illicit economies, such as poor access to legal markets, deficiencies in infrastructure, no access to legal microcredit and a lack of value-added chains.[167]

Alternative livelihood programmes should not only try to match the prices of the illicit commodity – often a losing game – but also to create employment opportunities that enhance social standing and provide a viable future. Alternative livelihoods need to be perceived as legitimate and equitable by community members, in particular young men, who are the dominant population engaged in ASGM. This requires engagement and selection by community members in accordance with their cultural and socio-economic values.[168] Combining training programmes with economic incentives – for example, capital inputs or cash transfers – may be more effective than vocational training alone.[169]

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