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on Mining, Minerals, Metals and
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IISD Head Office
111 Lombard Avenue
Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

iisd.org
@IISD_news

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It is devoted to optimizing the benefits of mining to achieve poverty reduction, inclusive growth, social development and environmental stewardship.

The IGF is focused on improving resource governance and decision making by governments working in the sector. It provides a number of services to members including: in-country assessments; capacity building and individualized technical assistance; guidance documents and conference which explore best practices and provide an opportunity to engage with industry and civil society.

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IGF / IISD Ottawa office
1100-220 Laurier Ave. W.
Ottawa, Ontario
Canada R3B 0T4

IGFMining.org
@IGFMining

SUMMARY

Artisanal and small-scale mining (ASM) has experienced explosive growth in recent years due to the rising value of mineral prices and the increasing difficulty of earning a living from agriculture and other rural activities. An estimated 40.5 million people were directly engaged in ASM in 2017, up from 30 million in 2014, 13 million in 1999 and 6 million in 1993. That compares with only 7 million people working in industrial mining in 2014.

ASM is generally pursued as a route out of poverty or as an activity to complement insufficient income, especially in communities where alternative employment is hard to come by. ASM is also a very diverse sector. Its main challenges vary from region to region—and often from site to site.

There is a perception that ASM is a "get-rich-quick" activity. This has misinformed legislation and extension programs and led to the application of one-size-fits-all policies. However, people working in ASM are far from the same. They range from those whose livelihoods rely on subsistence farming to skilled workers who migrated from urban areas in search of work.

Despite its low productivity, ASM is an important source of minerals and metals. It accounts for about 20 per cent of the global gold supply, 80 per cent of the global sapphire supply and 20 per cent of the global diamond supply. ASM is also a major producer of minerals indispensable for manufacturing popular electronic products, such as laptops and phones. For example, 26 per cent of global tantalum production and 25 per cent of tin comes from ASM.

ENVIRONMENT AND HEALTH AND SAFETY

ASM relies on a mostly unskilled workforce using rudimentary tools and techniques. Unsurprisingly, its environmental and health and safety practices tend to be very poor. For example, dust and fine particles resulting from blasting and drilling cause respiratory illnesses. It also degrades crops and farmlands, resulting in lost food production. Streams and rivers often become polluted near ASM sites, which makes water unsafe for drinking and can also affect fish stocks previously relied upon for food.

Artisanal and small-scale mining is also the source of the largest releases of mercury, estimated at 1,400 tonnes per year in 2011 according to the Minamata Convention.

Exposure to mercury can have serious health impacts, including irreversible brain damage. Mercury is also difficult to contain and can be toxic at even very small doses. It can be transported long distances by air or water, poisoning the soil and waterways, and eventually making its way into the food chain. In sub-Saharan Africa, most of these risks are borne by women.

ASM AND LARGE-SCALE MINING (LSM)

In many parts of the world, ASM and LSM operate in neighbouring—and sometimes on the same—concessions. As mineral governance frameworks tend to favour foreign direct investment by multinational companies over ASM, there are significant power imbalances and clashes over claims. However, their coexistence opens the potential for cooperation.

Current practices and debates about ASM–LSM relations include:

- Removing ASM from LSM concessions, which is unlikely to solve clashes over land in the long run
- Separating ASM and LSM by creating "ASM zones," with proven geological reserves
- Fostering cooperation between LSM and ASM operators through buy-back arrangements, technical assistance and support for formalization
- Promoting continued dialogue and communication between ASM and LSM, facilitated by governments

ALTERNATIVE LIVELIHOODS

Moving people straight out of ASM into other sectors is not a realistic strategy, as there are typically few other employment opportunities. Programs aiming to encourage more income-generating activities along the ASM supply chain——such as gemstone cutting and polishing—have shown positive results.

Agriculture and ASM need to be seen as complementary, as opposed to two activities that are fundamentally at odds. Many families turn to ASM to supplement their farming earnings and invest in farming and farm inputs.

CERTIFICATION SCHEMES

In recent years, ethical certification schemes and standards have been used to support formalization and to improve social and environmental practices in the sector.

Standards such as Fairmined and Fairtrade Gold aim to foster responsible ASM cooperatives, provide assurance of minimum standards of production, and support the sector's formalization and professionalization. In addition, "chain of custody" initiatives aim to ensure traceable supply chains from mine to market that are free from conflict and human rights abuses. They respond to the need of companies seeking to meet international regulations and/or voluntary codes and to ensure good business practices.

Despite signs of progress, there are concerns about these initiatives. Some argue they are not reaching the most marginalized communities in need of greatest support. Instead, they are believed to be empowering already licensed and relatively affluent cooperatives able to meet the requirements and costs of certification. There are also concerns about longer-term sustainability due to their reliance on Western markets and ethical consumption trends.

FORMALIZATION

In many countries, 70 to 80 per cent of small-scale miners are informal.

Informality brings along damaging socioeconomic, health and environmental impacts, which trap the majority of miners and communities in cycles of poverty and exclude them from legal protection and support.

Formalization has to be inclusive of miners' views and effective in monitoring and enforcing regulation. It needs:

- Legal frameworks that remove barriers to formalization and are supportive and accessible rather than punitive
- Streamlined licensing processes that make it easy, cost-effective and rewarding to obtain a licence
- Access to finance for miners, potentially using geological information as collateral for loans
- Technical and financial support to meet the licensing requirements and, once licensed, to continue to improve performance

TOWARDS SUSTAINABLE ASM: WHAT DO WE NEED TO GET THERE?

- Know-how: Building capacity through local institutional partnerships
- Organization: Encouraging miners to form cooperatives and associations
- Collaboration: Encouraging large-scale mining companies to support capacity building
- Capital: Using microcredits to lend to organized groups of miners and communities, supported by donors
- Technology and equipment: Improving miners' access to efficient and cleaner technologies

In numbers:

- 40 million people working in ASM in 2017
- 150 million depend on ASM across 80 countries in the global south
- 20 per cent of the global gold supply is produced by the ASM sector
- 80 per cent of the global sapphire supply and 20 per cent of the global diamond supply come from ASM
- 26 per cent of global tantalum production and 25 per cent of global tin production come from ASM
- 40–50 per cent of the ASM workforce in Africa are women
- 70–80 per cent of small-scale miners are informal

TABLE OF CONTENTS

1. GLOBAL TRENDS AND UPDATES ON KEY ASM NUMBERS

Artisanal and Small-Scale Mining (ASM) is recognized as a considerable source of revenue for millions of people in about 80 countries worldwide (World Gold Council, 2017; World Bank, 2013). ASM takes place in different parts of the world, mostly in the global South, i.e., sub-Saharan Africa, Asia, Oceania, Central and South America (Armah et al., 2016). The activity has been defined in different ways, and is often characterized in terms of the number of miners, the production capacity, the level of mechanization or capital investments (ILO, 1999; World Gold Council, 2017).

In 1993, about six million people were believed to be working in ASM. The International Labor Organization (ILO) revised this number to 13 million miners in 1999 (including women and children) and estimated that about 80 to 100 million people depend on this activity (ILO, 1999). In recent years, the number of people directly involved in ASM has more than doubled, reaching about 30 million people in 2014, because of the rising value of mineral prices and the increasing difficulty of earning a living from alternative activities like agriculture, among other reasons (García et al., 2015; Seccatore et al., 2014; Levin, 2014; Banchirigah & Hilson, 2010). This implies that more than 150 million people are indirectly dependent on ASM (Levin, 2014). As accounted on Artisanalmining.org (2017), a database where ASM estimates are regularly updated, direct ASM numbers might have reached (+/- 25 per cent) 40.1 million in 2017. Some sources estimate a much higher number, for example, up to 100 million ASM operators, compared to 7 million people working in industrial mining (World Bank, 2013). However, it is important to remember that there is a need to improve benchmarking and consistency in the field with national data, the need to disaggregate numbers by gender and to establish a criteria-based census of ASM operators.

The number of people involved in ASM differs across countries in Africa, Latin America and Asia. Most of the countries in Africa had 5-20 per cent of their populations directly depending on ASM in 2009; in Latin America 0.1-5 per cent and Asia 0.1-1 per cent. Most ASM operators are in Asia, with a total average of at least 10.6 million in 15 countries in 2014, mainly due to the extremely high number in China (nine million). This is followed by Africa, with a total average of at least 9.9 million ASM operators in 23 countries in 2014, and Latin America with a total average of at least 1.4 million ASM operators in 19 countries in 2014.

There are two African countries with an average of more than 1 million miners in 2014 (Democratic Republic of Congo [DRC] and Sudan) compared to one country in Asia (China) and none in Latin America.

There are four African countries with an average of 500,000 to 1,000,000 miners in 2014 (Ivory Coast, Ghana, Mali, and Tanzania), but none in Asia and Latin America.

The other countries where ASM activity involves on average at least 200,000 miners in 2014 are: Angola (200,000), Ethiopia (450,000), Guinea (250,000), Madagascar (450,000), Mozambique (200,000), Niger (365,000), Sierra Leone (300,000), Uganda (200,000), Zimbabwe (450,000), Pakistan (450,000), Philippines (325,000), Brazil (467,500), and Colombia (385,500).

Studies concerning African countries with ASM are the most complete—i.e., there are estimates on all but four countries that are known as having ASM operations. In Asia, 15 countries do not have estimates, although they are likely to have ASM activities; and in Latin America, the same issue concerns five countries. Hence, compared to Africa, the ASM population in Asia and Latin America remain relatively understudied.

The three regions have commonalities concerning ASM since it is a way of addressing poverty for many communities or a way to earn more for a living in combination with other activities such as agriculture. There are also regional differences between the three continents (Hentschel, 2003): "[I]n Africa, AIDS and sustainable community development are the key issues; in the Asia/Pacific region,

multicultural aspects and cultural rights predominate; while in the Latin American/Caribbean region, environment, indigenous rights and legal aspects are the key issues." There are also differences in terms of women's ASM participation. According to Hinton et al. (2003), there is generally fewer than 10 per cent of women directly participating in mining in Asia, between 10 and 20 per cent in Latin America, and between 40 and 50 per cent in Africa. In some regions, female miners can even represent 60 to 100 per cent of the ASM mining force; for example, in Guinea the rate is as high as 75 per cent (Hentschel, 2003, Hinton et al., 2003).

The motivations for child labour in ASM also vary depending on the region. According to Buxton (2013), children are commonly involved in Latin America as part of a "long ASM tradition"; whereas in Asia, there is less child labour due to the involvement of the private sector in ASM. . As in Latin America, in Africa children are also commonly involved in ASM, but more because of the poor socioeconomic context (e.g., civil war, conflicts, weak social institutions and government, forced labour) (Buxton, 2013). It is hence essential to understand the specificities of each ASM site.

ASM is believed to contribute 15–20 per cent of the global non-fuel mineral production, 18 per cent of Africa's gold, and almost all African gemstones except diamonds (ILO, 1999; Ledwaba & Nhlengetwa, 2015). It is an important source of revenue for miners, their communities and local governments, especially when the activity is focused on the mining of high-value minerals like gold, silver and gemstones. According to CIFOR (2009), gold and diamond mining account for more than half of the mineral exploitation globally, involving between six to nine million artisanal miners, i.e., about 60 per cent of all ASM activities in 2009. About 50 per cent of the total number of ASM operators work on gold extraction, contributing to 90 per cent of total employment (the remaining 10 per cent mainly came from large-scale gold mining) and generating between 12-15 per cent of global gold production (Levin, 2014).

According to the World Bank (2013), ASM accounts for about 20 per cent of the global gold supply, 80 per cent of the global sapphire supply, and 20 per cent of the global diamond supply. About 65 per cent of the world's diamond reserves are in Africa (CIFOR, 2009). Madagascar is one of the largest producers of sapphires, with about 50 per cent of the global supply in 2002—production relies heavily on artisanal mining, with about 500,000 people involved either on a full-time or part-time basis (Tilghman et al., 2005). The activity is, however, not limited to these minerals: according to Veiga et al. (2014), ASM operators work on more than 30 different sorts of minerals. For metals specifically, in 2009 ASM operators were estimated to account for about 26 per cent of global tantalum production, 25 per cent of global tin production, 6 per cent of tungsten, 4 per cent of iron ore, 3 per cent of lead, 1 per cent of zinc and 0.5 per cent of copper (Dorner et al., 2012). Most ASM production of tantalum is in Africa, particularly Central Africa where it is obtained from alluvial and soft rock deposits.

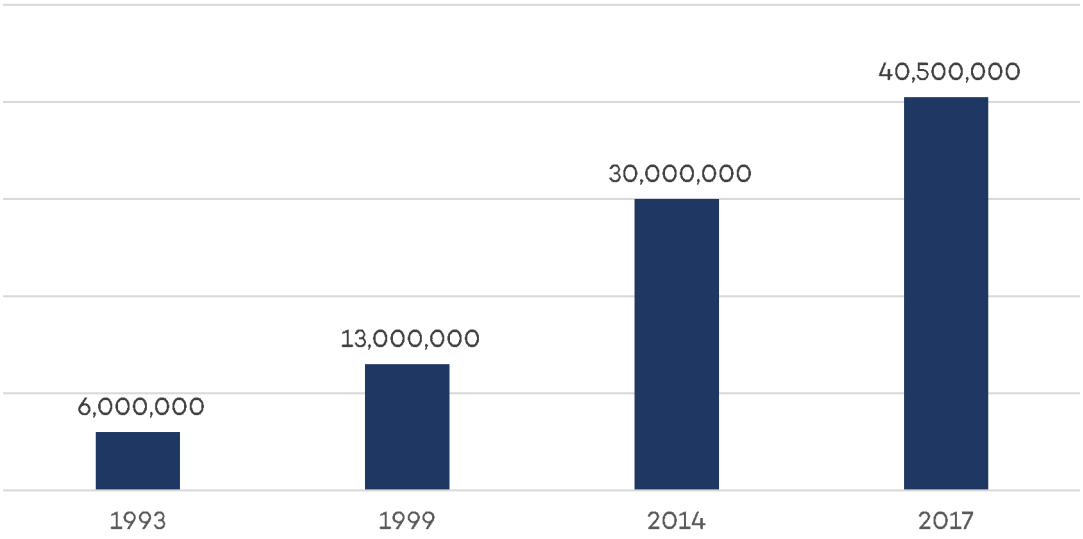


FIGURE 1. NUMBER OF ASM OPERATORS WORLDWIDE SHOWS THE GROWTH IN THE NUMBER OF ASM OPERATORS WORLDWIDE BETWEEN 1993 AND 2017.

Source: Author illustration based on ILO, 1999; Seccatore et al., 2014; Levin, 2014; artisanalmining.org, 2017

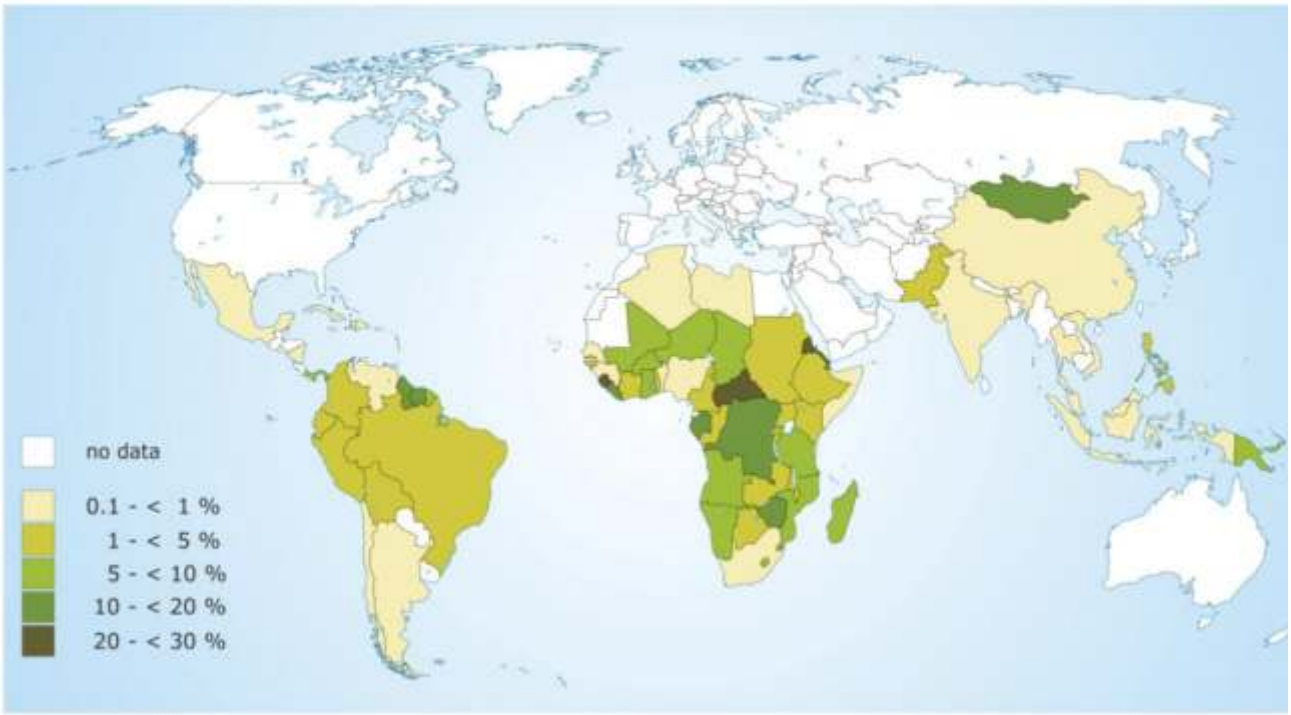


FIGURE 2. PERCENTAGE OF THE POPULATION DEPENDING ON ASM

Source: Dorner et al., 2012

2. ENVIRONMENT, HEALTH AND SAFETY IMPACTS AND REMEDIAL EFFORTS

Although each ASM site has specific characteristics, some common factors can aggravate the general environment, health and safety (EHS) impacts of the ASM activity. These include lack of mechanization, use of rudimentary techniques, low levels of occupational health and safety (OHS) practices, lack of skilled workforce, lack of social security and a lack of awareness about EHS issues.

The use of hazardous substances puts the health of miners and their communities at risk, through exposure to mercury, zinc vapour, cyanide, or other acids (Obiri et al., 2010). This is particularly significant for gold mining, where mercury is often used, and which is also seeing increasing cyanide use. Mercury can be inhaled, swallowed or absorbed through the skin, but the health consequences are usually not immediate (Armah et al., 2016). The inhalation of dust and fine particles due to blasting and drilling processes can cause respiratory diseases such as silicosis or pneumoconiosis to men, women and children that often accompany their parents (Armah et al., 2016). According to their findings, temporary or permanent hearing loss and speech interference can also be the consequence of a lack of safety protections to filter noise from equipment like drills or crushers. Most occupational health and safety risks in sub-Saharan Africa are borne by women, due to the division of tasks between male and female miners.

There are usually two ways to use mercury in artisanal and small-scale gold mining (ASGM): "whole ore amalgamation" (WOA) and "concentrate amalgamation" (United Nations Environment Programme [UNEP], 2012, p.14). WOA uses the most mercury since it is inefficient (usually capturing no more than 30 per cent of the gold) compared to concentrate amalgamation and releasing important quantities of mercury in the tailings.

The burning of the amalgam can take place on site and in processing centres, but also in the villages, for instance in the kitchen/houses/backyards of miners, putting their health and the health of their families and community at risk of mercury intoxication when no protection equipment is used (UNEP, 2012, p.12; GAHP, 2014; Spiegel et al., 2018). According to UNEP (2013a, 2013b), ASM activity emits about 1,400 tonnes of mercury per year and is the largest source of anthropogenic mercury emissions worldwide with about 727 tonnes per year. Among the countries where mercury is used in ASGM, Indonesia has seen the number of polluted sites rise in the past 20 years by about 50 per cent between 2010 and 2015 (Balifokus, 2015). The country hosts some of the most mercury-polluted sites in the world (Spiegel et al., 2018).

According to Pure Earth (2017), about 130 ASGM sites are sources of mercury contamination, particularly in Africa and Southeast Asia. Based on available estimates (Mercury Watch, 2017), four countries are the largest polluters of mercury from ASGM activities: Bolivia (120 tonnes/year), Brazil (105 tonnes/year), China (100 tonnes/year), and Burkina Faso (35 tonnes/year). However, it must be emphasized that no estimates are available for many other countries. Indonesia clearly appears to be one of the countries with the largest health issues related to mercury use, as well as Mongolia, Peru and Ecuador with 70,0000–150,000 people exposed to mercury contamination.

The least effective mercury practices (ratio of mercury consumed versus gold produced) can be observed in Africa, in Burkina Faso (ratio of about 1:70), Senegal (ratio of about 1:35), Sudan (ratio of about 1:20) and Ghana (ratio of about 1:17). Better practices can be found in Asia and Central America (Indonesia: 1:10, China: 1:10, Mexico: 1:10). The most effective practices are in South America, where Colombia and Brazil still have a ratio of about 1:5; however, all other countries are below this ratio.

Mercury contamination is more serious in some countries compared to others. This is the case for instance in Tanzania and Indonesia, which were defined as hotspots by Evers et al. (2013, pp 10–11). In the Matundasi and Makongolosi regions of Tanzania, the amalgamation process is conducted in the

open air with no safety or mercury recovery systems. Most of the contaminated water from sluicing and amalgamation is poured directly into the Lupa River and has environmental and health impacts for the people living in the Lake Rukwa area of South Tanzania. In Indonesia, several sites are of concern. In both countries, the level of mercury in human hair largely exceeded the U.S. Environmental Protection Agency (EPA) reference dose of 1.0 ppm (parts per million). A number of studies have shown urinary mercury concentrations in humans well above the 100 µg Hg/g-creatinine, a World Health Organization (WHO)-defined level above which the probability of developing classical neurological signs of mercury intoxication is high. In various cases such as Burkina Faso, for instance, these limits are exceeded in ASGM sites (Black et al., 2017).

The World Health Organization lists mercury among the top 10 chemicals of major public concern. Mercury poisoning causes problems in the brain and the nervous, digestive and immune systems, as well as in the lungs, kidneys, skin and eyes (UNEP, 2012; WHO, 2017). The symptoms of mercury poisoning include tremors, insomnia, memory loss, headaches, cognitive and motor dysfunctions, respiratory failures, psychotic reactions, and eventually death in case of severe intoxication (WHO, 2017; GAHP, 2014). People working in ASM and using mercury are the most directly and seriously affected populations since they are exposed to both occupational mercury poisoning and methylmercury poisoning through the food chain.

Cyanide is usually used in LSM operations, but is increasingly being used in ASGM because it can recover more gold than mercury amalgamation (EPA, 2017). In some cases, it is more effective and cost-effective, as shown in Ecuador (Veiga et al., 2009). In general, however, cyanidation is still more costly than mercury amalgamation for most ASGM sites, and requires more knowledge and technical training (Veiga et al., 2009). The use of cyanide to process tailings at processing centres is observed in countries like Brazil, China, Colombia, Ecuador, Mozambique, Nicaragua, Peru, Venezuela, Tanzania, Zimbabwe, and the Philippines (Veiga et al., 2014; Hilson & van der Vorst, 2002).

Cyanide can be used instead of mercury in a process called direct cyanidation (Spiegel et al., 2018) and is the safest way to use cyanide after the ore has been concentrated (EPA, 2017). However, cyanide is also a toxic hazardous substance, although it does not persist in the environment like mercury (GAHP, 2014; EPA, 2017). Unlike mercury, cyanide can be decomposed into less toxic forms and its effects are immediate and chronic, while mercury has long-term effect on EHS (Veiga et al., 2014).

Cyanide is not as common as mercury in ASGM since it usually requires more capital investments and skills, different business models, and its management is thus more complex (Spiegel et al., 2018). However, the number of processing plants where cyanide is used is rising in reaction to the international pressure for phasing out mercury use (Spiegel et al., 2018). According to Seccatore et al. (2014), Basu et al. (2015) and Malehase et al. (2017), South America is the region where the most environmentally friendly techniques are used in ASGM: other examples of good practices can be found in Central Asia and Central America. On the contrary, the practices that cause most damage to the environment are more common in Africa—with sub-Saharan Africa leading on mercury emissions—and East Asia (Basu et al. 2015; Malehase et al., 2016).

Efforts to address the EHS impact of ASM practices are grouped here into three main activities: technological alternatives, education/awareness raising, and national, international policies and programs. Among the most common technological alternatives to chemical usage in ASM, retorts and mercury-free concentration methods (such as gravity, panning, sluicing, shaking tables, spiral concentrators), have been subject to many studies and pilot projects, with greater or lesser success.

Technological alternatives and more environmentally friendly practices are among the cornerstones of tackling the issue of chemical usage in ASM. However, it should be noted that even though technical alternatives exist, they are not always applicable to ASM because of geological, socioeconomic, cultural and other site-specific issues.

One main barrier for mining communities in adopting cleaner technologies is cost-effectiveness, which means that the technology must increase the amount of minerals recovered and/or productivity (GAHP, 2014; Hinton et al., 2003). Also, ASM operators are usually risk averse and will not change their practices until the benefits have been clearly demonstrated to them (GAHP, 2014). Technological alternatives are more likely to be successful when introduced and implemented in organized mining communities in the form of cooperatives for instance, where investments in time and money may happen more easily.

Education and awareness raising on EHS issues in ASM is also important. However, to be effective they need to be feasible alternatives and related to the socioeconomic characteristics of the mining community, to understand better which technologies might or might not work (Spiegel et al., 2018). They should focus on contamination and how current bad practices are stigmatizing miners, as well as providing appropriate solutions to make a change. Regular and intensive training programs should be set up to educate miners and communities about the pros and cons of various technology alternatives. These programs need to be specified in legislation providing for enforcement and proper monitoring and evaluation. Forging partnerships with community organizations, civil society organizations and private sector will be crucial to successful implementation.

Governments have been working for several decades on reducing the EHS impacts of ASM, in particular the use of mercury. Some governments have banned mercury use in ASGM—or the ASGM activity itself—since the informality of the sector in some cases does not contribute to the creation of wealth for the country in the same way as large-scale mining (GAHP, 2014). But due to the large share of gold produced by ASGM, some approaches have instead focused on the formalization and regulation of the sector so that ASGM miners contribute to the wealth of the country by paying taxes while ensuring more environmentally friendly practices (GAHP, 2014). Such approaches, however, still need greater stakeholder involvement on site and investment in efficient technologies that align with the local context. With the rising number of ASM operators and the related EHS impacts correlated with the rise in the prices of minerals like gold, several national and international initiatives were introduced such as the Minamata Convention on Mercury.

Eliminating the use of mercury in all ASGM sites by forbidding the use of mercury or the ASM activity itself will not be effective—one recommendation may be that governments looking at eliminating mercury use in ASGM do it progressively (as in the case of Zimbabwe) (Spiegel et al., 2018). Indeed, such bans constitute a barrier for better environmental practices, since governmental bodies or external organizations (like NGOs and IGOs) have difficulty supporting ASM operators, since the activity is then considered illegal. In this context, as underlined by Seccatore et al. (2014), some governments—like Ecuador in 1991—have chosen to legalize ASM activity, so that miners can access safer technologies via national and international cooperation programs.

Beyond technologies and education, it is very important to consider the site-specific characteristics of ASGM and the needs of the mining community (bottom-up approaches) and engage directly and empathetically with miners and local stakeholders to build trust. Before developing new legislation, it is essential that policy-makers understand environmentally and locally attuned remedial activities.

3. ASM INTERFACE WITH LARGE-SCALE MINING

Increasingly, ASM activities are in contact with LSM operations, increasing the probability for conflict and clashes—as well as the potential opportunity for cooperation between the two. This is due to the growth of the ASM sector in rural, largely impoverished communities across the developing world over the past two decades, as well as the propensity for LSM companies to increasingly exploit marginal deposits. To meet demand, mining companies are exploring new frontiers and neglected resources that comprise lower-grade and hard-to-access deposits that were previously uneconomical to mine on a large scale due to the high levels of capitalization, technology and infrastructure required. These are also areas where, traditionally, artisanal and small-scale miners may already be present living and working near surface deposits. Furthermore, as new deposits are opened via exploration activities and roads they may attract small-scale miners to the area in rush-type situations (CASM, 2009: ICMM, 2009).

The instances where ASM and LSM activities have met have usually been marked by tension and conflict over land, access and control of mineral deposits, and the right to mine. In many countries the mineral governance framework favours foreign direct investment in the mining sector by multinational companies over local ASM concerns, leading to significant power imbalances and clashes over claims. Large-scale mining companies not only have a dominant position in the political and legal spheres, but also in terms of their significant financial resources and access to geological knowledge and sophisticated mining technologies: this gives them a great advantage over ASM firms when competing for the same claims.

Oftentimes extensive mining concessions are given over to large-scale mining companies without communities being informed or consulted. This leads to mining companies essentially arriving overnight and dispossessing informal small-scale miners of claims they believe to be rightfully theirs through customary land tenure systems and traditional laws—despite a lack of a permit or licence to mine under statutory law. This can create significant tension and conflict if the community and miners are not actively and meaningfully engaged prior to large-scale activities commencing, and due to the use of force and methods used to evict and police miners and communities. It can also lead to the encroachment of unlicensed and informal miners on to the concessions of large-scale mining companies (Chachage, 1995; Okoh, 2014; Hilson, 2002; Hilson & Yakovleva, 2007; Carstens & Hilson, 2009; Nyame & Blocher, 2010; Verbrugge, 2017).

Another area of interaction between the two is the way in which small-scale miners can act as "pathfinders" or "barefoot prospectors." During the exploration phase, junior mining companies will often follow small-scale miners in order to identify and search for potential new claims, only then to later evict them from the site once they have obtained a licence or place them in marginal parts of the concession where returns may be low and resources limited to a few years of mining (Carstens & Hilson, 2009; Luning, 2014).

Fundamentally, what all the challenges and conflict between LSM and ASM have in common is competition over limited land as well as overlapping concessions and poorly managed land-allocation programs (Siegel & Veiga, 2009). It has been argued that, starting with formalizing the sector, addressing power imbalances and supporting small-small miners to access claims that have geologically proven reserves, would help to improve relations between LSM and ASM and ameliorate instances of conflict (Hilson, 2013; Verbrugge, 2017).

Working with local communities is not only important to meet legal and voluntary requirements and ensure communities (including local small-scale miners) benefit, but increasingly it is also necessary to gain the social license to operate. However, in some cases Corporate Social Responsibility (CSR) has had negative impacts on ASM–LSM relations. Characterized by long histories of tension and mistrust as a result of years of poor communication and engagement, and failed promises, some CSR programs do little to benefit the local community and may instead act to fuel poor ASM–LSM relations. This is particularly the case when mining concessions change hands between different, discrete

mining companies multiple times over the course of a mining life cycle, and is particularly acute at the exploration phase.

Beyond CSR, it is also important to consider ways in which mining companies can contribute to the shared value of the local communities and businesses in which they operate. These can be through linkages to local input services and business, local content initiatives, ensuring they have a positive sustainable impact, and, if necessary finding ways to interact positively, dialogue, and work with ASM (Prieto-Carrón et al., 2006; Kemp, 2009; Ramdoo, 2013; Geipel, 2017).

There exist a number of potential governance and policy considerations, ranging from the complete separation of the two activities to finding ways in which the two can work together side by side. Given the highly heterogeneous, dynamic and diverse nature of ASM and the varied socio-political landscapes in which activities take place, such intervention would need to be assessed on a case-by-case basis. Any approach would be most effective by being embedded within an inclusive and holistic formalization program that prioritizes the socioeconomic development of ASM.

Four main governance and policy considerations regarding ASM–LSM interactions are outlined here.

A. SEPARATE ASM AND LSM BY DEMARCATING CONCESSIONS FOR ASM AND CREATING "ASM ZONES"

Given that the majority of tension and conflict between ASM and LSM is due to access to land and the imbalance of power between the two, it is argued that there is a need to demarcate specific areas for ASM activities with proven geological reserves. Furthermore, in order to be successful, ASM zones need to be located in areas that miners want to mine. Encouraging mining companies to shed unwanted or unused land as part of their concessions, and preventing exploration companies from speculating and selling land multiple times without breaking ground could help free up more areas for ASM activities and prevent illegal encroachments (Steinmüller, 2017; Hilson, 2017).

B. REMOVAL OF ASM FROM LSM CONCESSIONS

This is the least effective measure. Companies will often remove small-scale miners from their concessions by force, which is completely legal. However, it is unlikely to yield any meaningful solution in the long run given the way in which it is conducted and the fact that many informal miners may feel it is their land or that they have the right to mine there.

C. COOPERATING, INCORPORATING AND TRANSFORMING ARTISANAL AND SMALL-SCALE MINERS

There are numerous ways in which large-scale mining companies can work with small-scale miners, including by shedding and identifying land for ASM activities within their concessions and exploring the potential for tribute and buy-back arrangements, technical support, equipment leasing schemes, support formalization, and opportunities for small-scale miners to process and refine their ores, thus making them part of their supply chains (CASM, 2009). The mineral governance framework should effectively prioritize ASM and address power imbalances enabling small-scale miners to access high-value areas with proven geological reserves.

D. DIALOGUE BETWEEN ASM AND LSM

The process of consultations, sharing of information regarding concessions, and agreements between LSM and ASM should begin in the exploration phase and include all affected stakeholders. There is also a need for better information, understanding and awareness of customary and statutory laws and regulations that affect land for small-scale miners. Governments need to play a role in creating streamlined dialogue and communication channels between LSM and ASM, that outlast changes in ownership and licensing, and help small-scale miners to have a voice and air their grievances in effective ways that mitigate the potential for conflict (CASM, 2009; McQuilken & Hilson, 2016).

4. ALTERNATIVE LIVELIHOODS AND DIVERSIFICATION

There is a body of work looking at livelihood diversification in rural areas more broadly (and particularly in relation to agriculture) but without a focus on ASM. This provides good background context to the issue.

Hilson and Garforth (2012) argue that "agricultural poverty" (hardship induced by an over-dependency on farming for survival), has fuelled the rapid expansion of ASM operations throughout sub-Saharan Africa. They argue that the "get-rich-quick" perception of artisanal miners by policy-makers and donors has misinformed sector-specific legislation and extension programs. There is great diversity among those engaged in ASM operations. They range from skilled individuals who have migrated from urban areas in search of work due to redundancy in the private and public sectors, to those whose livelihoods are largely reliant on subsistence farming. This diversity is an important factor not often considered by policy-makers (Hilson & Garforth, 2012).

In 2005, Hilson and Potter (113) found that "a declining standard of living has not only attracted recent school graduates but has also persuaded a wide range of former professionals, semi-skilled labourers, and retrenched large-scale mine workers to relocate to the many rural reaches of the country where artisanal gold mining can be readily carried out." Similarly, Banchirigah (2008) claims that the numerous and diverse range of employment opportunities provided by the ASM sector—ranging from menial work such as digging, hauling, ore washing, to vending and bookkeeping positions—is one of the key drivers of its growth.

Attempting to move people straight out of ASM into other livelihoods is not a realistic approach given the lack of alternative employment opportunities and the fact that most alternative livelihood programs have not been successful. Value addition or beneficiation programs to encourage diversified income-generating activities as part of the ASM supply chain—rather than trying to divert miners into alternative livelihoods—have also shown promise.

According to Hilson (2016c), policies and institutions need to recognize and respond to the complementarities and linkages between agriculture and ASM rather than one or the other as alternatives. This is particularly the case in sub-Saharan Africa, where an "alternative livelihoods agenda" that focuses on moving people away from informal ASM to farming has been promoted. This agenda has failed to recognize that "a great number of these individuals are already involved in various agricultural activities" (Hilson 2016c, 557). Families turn to ASM to supplement their farming earnings and invest in farming and farm inputs in, for example, Ghana, Tanzania and Madagascar.

5. MINERAL CERTIFICATION SCHEMES FOR ASM

Over the past decade, a number of ethical mineral certification schemes that either directly target or include provisions for the ASM sector have been developed. Promoted by their designers as being development interventions with a potential to play a key role in formalization and addressing the negative social and environmental impacts of operations (Blackmore et al., 2013; Echavarria, 2014; IGF, 2017).

Two broad categories of certification initiatives have emerged. The first group comprises those that fall under the umbrella of Fair Trade, termed here as "ethical mineral certification schemes and standards." These are also aligned more closely with development and sustainability interventions in their efforts to foster responsible artisanal and small-scale mining cooperatives, provide assurances concerning minimum standards of production, and support the wider formalization of the sector, in the process addressing its associated negative socioeconomic and environment impacts.

The second group of certification schemes is made up primarily of "chain of custody" initiatives concerned with ensuring traceable and transparent supply chains from mine to market that are free from conflict and human rights abuses. These initiatives are borne largely out of the need for companies within global mineral supply chains to meet international regulations, voluntary codes and initiatives, and ensure good business practices.

The majority of certification activities that directly target ASM have been focused in Latin America—where the original Fairmined and Fairtrade Gold Standards (FFGS) (Maldar, 2011) were developed and piloted from 2009 to 2013—and sub-Saharan Africa, where the main focus has been in developing conflict-free, traceable and transparent supply chains and where both ARM and FLO are undertaking pilot schemes to scale up their certification initiatives.

Overall, progress has been made in terms of bringing these standards and mineral certification schemes to fruition in the first place; their contribution in reaching and raising the profile of marginalized ASM communities and their daily challenges to a global audience and consumers; helping to address the negative impacts of ASM activities through working with operators to become certified and the related benefits of doing so; and, ensuring a more responsible approach to sourcing minerals in conflict affected and high-risk areas (Levin, 2010; Blackmore et al., 2013; Childs, 2014a; Hilson & McQuilken, 2016). However, there are a number of concerns in the wider academic literature regarding the current implementation and future long-term potential of certification initiatives for the ASM sector.

Key considerations and refinements to maximize the potential of such certification initiatives in reaching as many artisanal and small-scale miners as possible and in their contribution to supporting the wider formalization of the sector include:

OVERCOMING ELITE CAPTURE, SELECTIVE EMPOWERMENT AND TARGETING "LOW-HANGING FRUIT"

There are concerns that certification initiatives are not reaching the "poorest of the poor"—the most marginalized ASM communities in need of greatest support—but targeting low-hanging fruit, and empowering a select group of already licensed and in some cases relatively affluent and highly organized mining cooperatives able to meet the criteria. This is due to the requirements and burdensome costs that mining communities have to meet in order to become certified which are deliberately stringent, mirroring the approach taken in agriculture.

To extend the benefits of certification, more needs to be done to address the fundamental and structural issues of informality. This can be through advocacy and dialogue with government, and to work with unlicensed, informal groups to help bring them into the legal domain where they may then be supported to become certified (Fridell, 2006; Hudson et al., 2013; Blackmore et al., 2013).

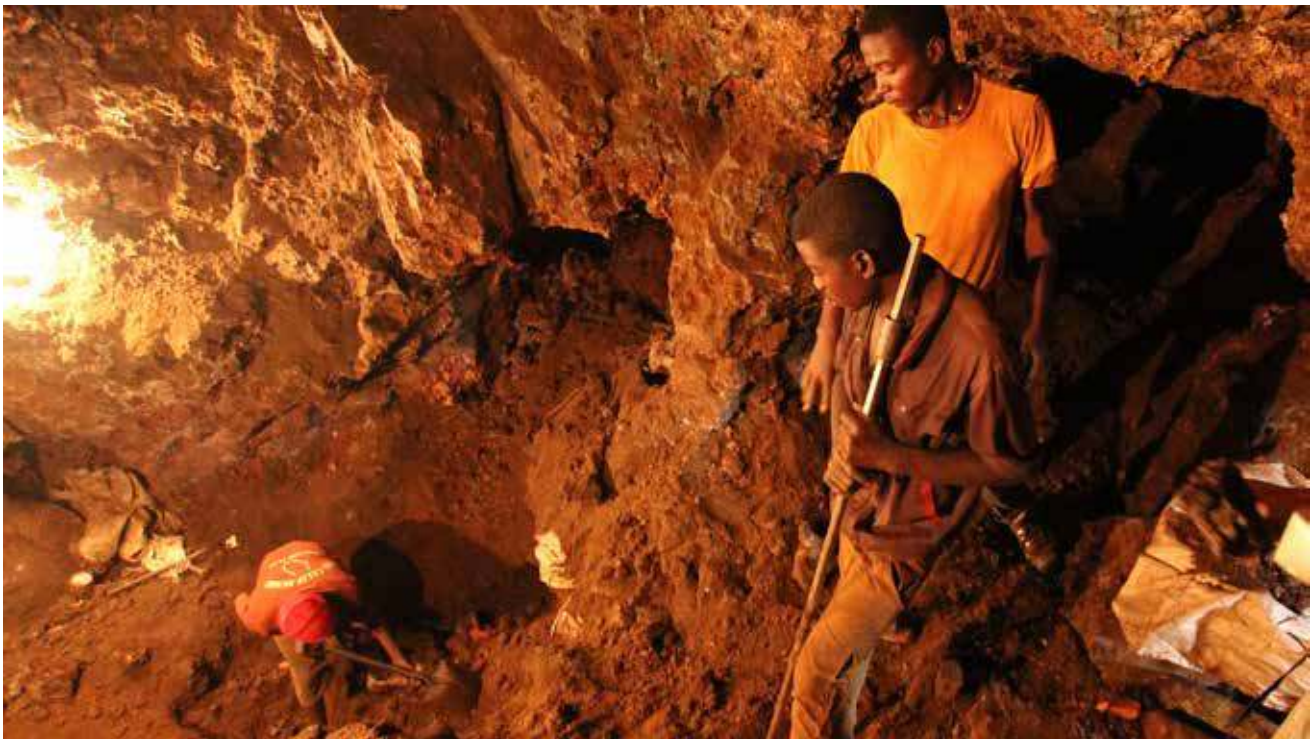
GREATER UNDERSTANDING OF THE COMPLEXITIES, FUNCTIONING, AND LOCAL DYNAMICS OF ASM

There is already evidence from FLO's pilot project that the differences in ASM operations as well as the social, cultural and economic conditions between Latin America—where the original Fairtrade and Fairmined Gold Standard were developed—and sub-Saharan Africa have been greatly underestimated, slowing both the progress and impact of their interventions (Keller et al., 2013; Hilson & McQuilken, 2016). Extending schemes to work with middlemen rather than cutting them completely out of supply chains could be a more bottom-up approach that keeps more value created by mining activities in-country and in local communities. A greater understanding of the functioning of ASM supply chains and the roles of the multiple actors within them is therefore needed. Furthermore, approaches to certification need to be adapted in order to take account of local dynamics and to avoid displacing legitimate market players.

LONG-TERM SUSTAINABILITY AND CONSUMER DEMAND

There are concerns regarding the longer-term sustainability and viability of fair trade mineral certification schemes due to their reliance on Western markets, ethical consumption, and catalytic bodies such as FLO. At present, most of the schemes are geared toward supplying the ethical jewellery market; however, there is no requirement for sustainable and ethically sourced minerals to come from ASM.

Certification should therefore be seen as a way to ensure supply chains are traceable and transparent and free from conflict. They should also raise awareness of the plight of small-scale miners and effect greater changes in society, provide a source of ethical minerals for the jewellery and electronics sector, and support a select number of miners and their communities to improve their position. Certification may complement formalization efforts in ASM, but it should not replace or be prioritized over wider formalization programs and policies. Until the more fundamental barriers to formalization are addressed, and the majority of miners are formalized, certification will remain limited in its ability to support large numbers of artisanal and small-scale miners in breaking free from the poverty trap.



6. ASM FORMALIZATION AND THE GLOBAL POLICY DEBATE

Globally, estimates suggest that in many countries 70 to 80 per cent of small-scale miners are informal (ILO, 1999) and in some countries these figures are even higher (EEITI, 2015). As a result of the sector's pervasive informality, a wide range of damaging socioeconomic, health and environmental impacts and development challenges has emerged, trapping the majority of miners' cycles of poverty and leading to community impoverishment (Hilson & Pardie, 2006).

Informality also leaves the sector open to corruption, embezzlement, and criminality and results in lost revenue for local and national governments. The position of the majority of miners operating informally, illegally and outside of formal governance frameworks means they are not afforded the benefits of legal protection, nor are miners or their communities able to access support services needed to address the negative "expressions of informality" leaving them out of reach of government (Hilson & Hilson, 2015).

Formalization is, therefore, more than just legalizing and regulating economic activities. It also concerns the activation, monitoring and enforcement of such regulations as well as the inclusion of marginalized miners in the process of developing, adapting and revising legal frameworks and support to meet such regulatory obligations in order for them to be effective.

A broad-based, integrated and inclusive approach to formalization needs to be taken, focused on the poverty-driven aspect of the sector. To be effective, formalization needs to address the following key areas:

SUPPORTIVE AND COMPREHENSIVE LEGAL FRAMEWORKS

The ASM sector is often a policy afterthought, and its largely poverty-driven characteristics are not accounted for (UNEP, 2013; Hilson & McQuilken, 2014). Legal frameworks therefore need to be adjusted to remove the barriers to formalization, be supportive and accessible rather than punitive, and account for the diversity of ASM operations.

STREAMLINED AND ACCESSIBLE LICENSING PROCESS

Despite many countries having a short time period (10 days to one month) to award licences upon receiving the application, the process of obtaining a licence can be a challenging, costly, time-consuming, and onerous task. Applicants are often required to travel long distances to regional and national government offices to obtain the necessary documentation and submit applications; in some cases, making informal payments to brokers and corrupt officials along the way. Nonetheless, they wait for up to several months or even a year to hear back and finally receive their paperwork due to the lengthy bureaucratic process involved, centralization of government, and overlapping or unconnected institutions at national and local levels.

These factors either preclude or discourage the majority of miners from obtaining a licence, making the process open only to an elite group who are often well connected and are able to navigate and afford it. The licensing process in many countries therefore needs to be streamlined in order to make it easy and rewarding to obtain a licence, and reduce the costs associated with doing so.

ACCESS TO GEOLOGICALLY PROSPECTED LAND

Demarcating geologically prospected areas specifically for ASM activities so that miners can access finance and support services by using the geological information as collateral for bank loans could help confine activities to specific areas and thus improve both the social and environmental impacts of ASM. The costs of geological prospecting are often high for governments. One way around this issue could be to ensure large-scale mining companies and prospectors are required to shed off

land deemed uneconomical for industrial mining but suitable for ASM, and to retain data for use by national geological survey departments.

TECHNICAL AND FINANCIAL SUPPORT

Artisanal and small-scale mining communities need technical and financial support to meet the requirements of obtaining a licence and, once licensed, to continue to improve the efficiency and impacts of activities.

Dialogue Between Government and ASM

To ensure that formalization efforts are aligned with realities on the ground it is essential that ASM miners are involved in the process of formalization. The development of ASM mining associations to establish a conduit for positive regular dialogue between government and miners is therefore needed, and miners need to be consulted on changes. More research with mining communities is also needed in order to understand the complexity and functioning of operations in host countries.

7. INITIATIVES AND STRATEGIES FOR SUSTAINABLE ASM

There have been various initiatives and interventions by key players, particularly governments, international bodies and the private sector through the following areas:

GEOLOGICAL DATA

There are limited examples of geological services being provided to ASM operators (or available in an accessible form), as government and donor attention in this area has tended to focus on LSM and attracting foreign investment (Huggins, Buss & Rutherford, 2017; Hilson & Maponga, 2004; Clifford 2011; Siwale & Siwale, 2017). Miners "are instead left independently to assess land, through costly consultants or unreliable basic prospecting" (Clifford 2011, p. 359).

According to Hilson and McQuilken (2014, p. 6), a number of African countries began providing assaying services for ASM operators in the 1990s, through funding from the World Bank and German Technical Cooperation (GTZ). For example, an assaying facility was installed in Tarkwa, Ghana; however, such analytical techniques were not suited to the targeted ordinary miners that lack the knowledge needed to adopt it.

Aryee, Ntibery, and Atorkui (2003, p. 138) mention an initiative in Ghana funded under the World Bank's Mining Sector Development and Environment Project (see EPC, 1994; World Bank, 1995) focused on "providing better geological information to small-scale miners through the assistance of geologists working in the field to delineate recoverable ore bodies on small-scale mining concessions."

Due to a focus on LSM investment, a number of donor projects have aimed to improve the efficiency and transparency of mining cadastre systems in Africa through the introduction of computerized and decentralized cadastres and GIS technologies (World Bank 2012b, 2012a; Ortega, Pugachevsky, & Walser 2009; CEEST 2009). For example, in 2015 the Australian government provided funding to the Minerals Commission of Ghana for a two-year project to develop a fully GIS-based computerized Mining Rights Cadastre system for processing, managing and monitoring mineral rights and licences in Ghana (Essabra-Mensah, 2015; Australian High Commission Ghana, 2015; GNA 2016). The online repository (web-based portal) was launched in July 2016 (Amadou, 2016), replacing the previous semi-computerized Mineral Rights Administration System and presenting two datasets: LSM and ASM licences (GNA, 2016).[1]

FlexiCadastre is a mining cadastre and mineral rights management system developed by the company Spatial Dimension, launched in 2003 after the company won a World Bank-funded project to implement a new computerized mining cadastre system for Mozambique (Spatial Dimension, 2015b). It has since implemented a number of World Bank Sustainable Management of Mineral Resources Projects (SMMRP). The system uses a web portal for data management and GIS technologies to facilitate the administration of mineral titles in multiple jurisdictions with the aim of improving stakeholder communications, reducing corruption and improving transparency (CEEST, 2009; Spatial Dimension, 2014). It can be used for both LSM and ASM (Spatial Dimension, 2013). Countries in Africa currently using the FlexiCadastre system include the Democratic Republic of Congo, Ethiopia, the Ivory Coast, Kenya, Liberia, Mozambique, Rwanda, Senegal, Tanzania, Uganda, and Zambia (Kolver, 2013; ArcGIS, 2014).

Some problems with accessing the system have been reported in regional offices. For example, in Tanzania, it was reported that the server is based in the capital city and very slow in regional areas; mining officers reported that it could take up to two hours to access the system and they could enter and search for one or two licences during this time (CEEST, 2009). In Nigeria, a similar system sponsored by the World Bank SMMRP (but developed by a different company) has also encountered

[1] According to Amadou (2016) the Minerals Commission had been attempting to implement a fully-fledged cadastre system since 1999.

various challenges, including the absence of supporting datasets and lack of system maintenance, as well as data entry issues such as duplication of entries and inconsistent spelling (Ozah et al., 2010). The lack of adequate and uninterrupted electricity supply also caused problems for the computerized system. These types of basic capacity and infrastructure challenges need to be considered when implementing technological strategies to improve the governance of ASM in developing countries.

CAPACITY BUILDING

Poor understanding of the makeup and dynamics of ASM communities has led to the design of many inappropriate technologies and support services (Hilson & Potter, 2003; Hilson, 2006; Banchirigah, 2008). Hilson and McQuilken (2014) criticize the technical support provided by donors through the 1980s and 1990s for their top-down approach, lack of knowledge of target populations and local context, as well short-term nature and lack of planning for ongoing funding and support to ensure the sustainability of interventions. This issue is not confined to that period and can still be seen in interventions today.

More recently, World Bank-funded initiatives in Tanzania—which include setting up new technical advisory services in existing state institutions like the Geological Surveys, national universities and vocational training institution—have been praised for focusing on local institutional partnerships (Fold, Jønsson & Yankson, 2014). Similarly, a recently established agreement in Ghana between the Minerals Commission, National Association and University of Mines and Technology (UMaT) and the Ghana National Association of Small Scale Miners (GNASSM) will develop a training program consisting of "six training modules aimed at teaching good practices in surveying, prospecting, mining, mineral extraction and environmental and safety management to small-scale miners in the nine mining Districts in the country" (Yeboah, 2015, n.p.).

Another relatively successful project was a three-year regional program run from 2013 to 2016 in Mali, Burkina Faso and Senegal through the Global Environment Facility (GEF) and UNIDO, focused on the transfer of mercury-free technologies (UNIDO, 2015; ARM, 2017). This program provided health education and technology training programs based on workshops, seminars and trainings, as well as assistance to mining communities to obtain Fairmined® Gold certification.

Encouraging miners to form cooperatives and associations is another well-praised initiative. It has the potential to aid successful capacity building and ultimately encourage formalization and more responsible mining practices, along with sharing of knowledge and resources).

There is some potential for large-scale mining companies to provide capacity building in the area of environmental management to the ASM sector, particularly when working with associations or cooperatives. Lombe (2003) provides some examples of successful cases of large-scale mining companies providing mentorship on best practices to artisanal and small-scale miners in South Africa and Zimbabwe. A further example is Bolivia, where the Coeur d'Alene Mines Corporation works via joint venture with organized ASM cooperatives representing 15,000 local artisanal miners (Pact, 2015).

ACCESS TO CAPITAL

MICROFINANCE (CREDIT AND SAVINGS)

Drawing on experience from the implementation of microcredit for ASM operators in the Yale mining camp in Talensi-Nabdam District, Northern Ghana, Hilson and Ackah-Baidoo (2011) recommend that the principles that made the Grameen Bank successful should be applied to ASM microcredit programs. These include social collateralization (i.e., money is lent to groups of people who are more likely to pay a loan than individuals); devolved responsibility to borrowers; and borrower discipline. Microfinance schemes in Tanzania have met with relative success as they have followed the Grameen

model, which encourages "individuals [to] unite and form 'trust groups' (typically, five–eight people who know each other) to borrow money or equipment collectively, and to hold each other accountable for repayments" ((Hilson & Ackah-Baidoo, 2011, p. 1195). Both Spiegel (2012) and Hilson and Ackah-Baidoo (2011, p. 1194) suggest that equipment loans could be a better alternative to cash to ensure that "finances dispensed are used to purchase the required technologies and not siphoned" (Hilson & Ackah-Baidoo, 2011, p. 1194).

GRANTS

A World Bank SMMRP run from 2004 to 2012 in Nigeria provided a total of 245 grants totalling roughly USD 9 million to 147 ASM cooperatives as well as 98 community entities, which included subprojects to enhance granite, sand, gravel and laterite quarrying (IEG, 2014b). Another World Bank SMMRP run in Uganda from 2003 to 2011 included a community grants scheme which provided grants to pilot safer and more efficient ASM practices. To receive a grant, miners had to form a group and be further trained in financial management and procurement (Sheldon et al., 2013). An unexpected consequence of the training and grants scheme was that it motivated several ASM associations to start Village Savings and Loan Associations that could provide small loans to members in times of need.

GOVERNMENT LOAN FACILITIES

Siegel and Veiga (2010) suggest that rather than focusing on grants, donors could assist in setting up user-friendly government loan facilities and carrying the risk. The authors provide examples of two successful government loan facilities for the ASM sector in Namibia and Mozambique. Tanzania has also taken steps through World Bank-financed initiatives to provide small-scale grants from a revolving fund and establish an equipment leasing scheme (Fold, Jønsson, & Yankson 2014). The Zimbabwe Government Mining Industry Loan Fund is another example of specially designed equipment loans and cash loans to ASM, which although short-lived was considered to be best practice (Spiegel, 2012).

ACCESS TO EQUIPMENT

One of the main bottlenecks for ASM operators is the lack of resources to be able to "replicate or adapt mining techniques." As a case in point, the Chinese presence in Ghana is strongly related to their advantage over access to both equipment and finance (Hilson, Hilson, & Adu-Darko, 2014).

UNECA (2002, p. 82) describes in detail specific best practice technologies in ASM, including for drilling, blasting, surface mining underground mining and processing (crushing, grinding, sizing, flotation and gravity concentration techniques) and provides the following list of success factors in the use of ASM equipment:

- Is simple in design and can be produced locally
- Uses accessories, e.g., grinding media that are readily available
- Is mobile and easy to install and operate
- Is powered by small diesel engines (diesel is available in most mining areas)
- Is cheap and can be afforded by individual miners
- Is efficient and has minimal environmental impacts
- Has low power consumption
- Utilizes selective mining techniques that allow focusing on particular types and grade of ore
- Applies methods that combine both manual and mechanized processing techniques.

HIRE PURCHASE LOAN SCHEMES

Attempts to improve artisanal mining technologies may be most effective if they encourage groups (rather than individuals) to collectively acquire new equipment through hire purchase loan schemes (Spiegel & Veiga, 2005).

Along with the assaying laboratory and processing plant set up in Tarkwa, Ghana, in the early 1990s, the Minerals Commission also set up equipment at other field sites, and had an equipment leasing scheme, whereby equipment manufactured in collaboration with local fabricators was made available on a sale or loan basis (UNECA 2002, p. 29; Hilson & McQuilken 2014, p. 6). The Global Mercury project also included a hire purchase scheme to assist miners to progressively buy a range of equipment.

CENTRALIZED PROCESSING CENTRES

Centralized processing centres are one way to reduce mercury emissions in ASM. The first processing centres were established in Ghana, Venezuela and Zimbabwe, by governments and other project donors. As well as providing processing facilities, the centres have served a role in the provision of information about environmental management (Hinton, Veiga, & Veiga, 2003). Unfortunately, they have faced a number of issues based in large part on a lack of prior research of their target beneficiaries. A centralized processing centre in Bolgatanga, Ghana, for example, was underutilized because it was too far away from the mining area and the equipment wasn't tailored to local geological conditions (Hilson, Hilson, & Pardie, 2007). In addition to the cost of transporting ores to processing centres, the centres require ongoing resources for labour, equipment, maintenance and administration (UNIDO, 2015).

The Government of Ghana has recently announced the five-year Multilateral Mining Integrated Project (MMIP), expected to cost USD 10 million dollars, which among, other activities, intends to set up a centralized processing plant that miners will be able to use for a fee (Citi News, 2017b; Asamoah, 2017).

There is certainly a sense that everyone wants to have the next "great idea" for fixing the "ASM problem," without drawing on lessons from the past. It appears that with technical support provided to ASM, the same ideas are cyclical, and there is a need for initiatives to build on previous knowledge and successes and failures.

LICENSING AND LAND-RELATED ISSUES

ASM is often supported by informal and customary land tenure systems (for example, because traditional authorities can gain financial benefits from the sector and thus give permission for ASM operators to work on their lands), which frequently conflict with formal land rights and licensing processes (Nyame & Blocher, 2010; Banchirigah, 2008; Hilson & Yakovleva, 2007). Conflicting land registration systems can cause additional complications and because of this, more attention needs to be given to understanding informal or customary land rights and their intersection with ASM (Spiegel & Veiga, 2010).

There are examples of artisanal and small-scale miners selling their ore (or even tailings) to LSM companies, who have the equipment necessary to extract it more efficiently. For example, in the Katanga province in the DRC, Pact has facilitated arrangements where an industrial producer buys from local ASM organizations operating on or around their concession.

Mitchell (2016) discusses the use of geographical information system (GIS) mapping to understand overlapping land use. This data is generally not made public or is accessible only by paying expensive fees. However, there is potential for broader use in resolving disputes over overlapping claims to land (including ASM). Mitchell mentions USAID's Mobile Application for Secure Tenure (MAST), which provided training, support and technology for Tanzanian landholders to map their (World Bank-promoted) Certificates of Customary Rights of Occupancy (CCROs) using mobile technology.

Others have attempted to use GIS data for mapping ASM activities. For example, Patel et al. (2016) identify areas of small-scale mining (SSM) activities using a classification of remotely sensed Landsat data to determine locations of spatial overlap between SSM and LSM concessions, in the context of conflict between LSM and ASM. More recently, a project based at the University of Adelaide and working in Burkina Faso and Mali is looking at optimizing potential land-use scenarios (including LSM, ASM and agriculture) using remote sensing data and mapping products (Ostendorf, Bolster, & Williams n.d.; personal communication, 2016).

Overall, there is still a lot of work to be done in many countries to improve the knowledge of communities and traditional authorities in terms of ASM licensing processes and land management.

ASM REGULATIONS AND POLICIES

O'Faircheallaigh and Corbett (2016) investigate policy and regulatory responses to ASM around the world using a heuristic model with two key variables: geographical scope (i.e., national or regional/local) and the extent to which policy and regulation is coercive or incentive-based. The authors conclude that regulation should be focused on the local or regional level to be effective, but have a level of central coordination. They also found that most regulations and policies for ASM tend to have a mix of incentives for miners to formalize (e.g., offering educational, technical, financial and infrastructure support, access to formal mining rights, and allocation of land for ASM), as well as coercive regulation and policies (e.g., military crackdowns or taskforces).

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