



Implications of credit constraint on the formalization of artisanal and small-scale mining (ASM) in sub-Saharan Africa

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Synopsis

Artisanal and small-scale mining (ASM) operations continue to grow across sub-Saharan Africa and serve as a source of livelihood to many rural communities. Owing to safety, health, environmental, and social concerns, the occupation has been regarded as a menace in several sub-Saharan African countries. Recent studies in the field of ASM prescribe formalization as a way to tame its excesses while enhancing its potential. This paper explores the concept of formalization as it relates to ASM and how it is being affected by the funding situation. The paper seeks to address the question as to whether formalization of artisanal mining operations can achieve the desired results in view of the lingering credit constraints in this mining subsector. It is recommended that, as a way of extending the scope of formalization, focus should be placed not only on access to credit in ASM but also towards optimizing the creditworthiness of ASM firms, with the goal of improving the viability of the operations.

Keywords

artisanal and small-scale mining, credit facilities, formalization.

Introduction

Artisanal and small-scale mining (ASM), which is characterized by low-tech, labour-intensive extraction and processing, has continued to grow in sub-Saharan Africa, serving as a source of livelihood to many communities. ASM activities are carried out by individuals, groups, families, or cooperatives with minimal or no mechanization, usually by those in the informal sector (Hentschel, Hruschka, and Priester, 2003), and involve in many instances illegal operations like the '*zama-zamas*' in South Africa and the '*galamsey*' in West Africa. Public commentary on ASM has largely been negative, dominated by reports of gold smuggling, money laundering, child labour, and links with organized crime (Planetgold, 2020a), poor safety and health, environmental pollution, and incidences of mercury and lead poisoning (Clement and Olaniyan, 2016; Owolabi and Opafunso, 2017; Hilson, Hilson, and Maconachie, 2018). Because of these aspects, mineral-rich countries around the world consider that ASM should be discouraged to create space for large-scale mining (LSM) companies (Cuvelier, 2019).

Nonetheless, the relevance of ASM is not in doubt. The occupation is attractive, especially for rural communities, for several reasons. One selling point is that it involves lower labour and technical costs. ASM operators can explore sites that are difficult for large mining companies to access and can excavate deposits with lower volumes (Geenen and Radley, 2014). The occupation plays key roles in opening up remote areas to development and can significantly reduce rural-urban migration (Hilson and McQuilken, 2014). It has been argued that local economies are primarily sustained by ASM and not LSM (Yankson and Gough, 2019). At the economic level, ASM contributes 15 to 20% of the global output of minerals and metals, in particular producing up to 20% of all diamonds, 20% of gold, and 80% of all sapphires (Buxton, 2013). The importance of ASM, especially for the sustenance of rural communities, explains its widespread proliferation across sub-Saharan Africa in recent history (See Table 1 for estimates of employment generated by ASM across the region).

ASM is usually practiced by people who are poor, and because the miners are mostly untrained, they sometimes do not realize that the methods they use for mining and processing of ores pose a great danger to their health and the environment. Most ASM operators would like to semi-mechanize to upgrade production capacities or develop new reserves. While there may be a reasonable concern

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Table I

Estimate of ASM employment showing minerals mined in selected sub-Saharan African countries (Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF), 2018)

| Country | Directly working in ASM | Estimated number of dependents | Main minerals mined by ASM |
|--------------------------|-------------------------|--------------------------------|------------------------------------|
| Angola | 150 000 | 900 000 | Diamonds |
| Burkina Faso | 200 000 | 1 000 000 | Gold |
| Central African Republic | 400 000 | 2 400 000 | Gold, diamonds |
| Chad | 100 000 | 600 000 | Gold |
| Côte D'ivoire | 100 000 | 600 000 | Gold, diamonds |
| DRC | 200 000 | 1 200 000 | Diamonds, gold, coltan |
| Eritrea | 400 000 | 2 400 000 | Gold |
| Ethiopia | 500 000 | 3 000 000 | Gold |
| Ghana | 1 100 000 | 4 400 000 | Gold, diamonds, sand |
| Guinea | 300 000 | 1 500 000 | Gold, diamonds |
| Liberia | 100 000 | 600 000 | Gold, diamonds |
| Madagascar | 500 000 | 2 500 000 | Coloured gemstones, gold |
| Malawi | 40 000 | - | Coloured gemstones, gold |
| Mali | 400 000 | 2 400 000 | Gold |
| Mozambique | 100 000 | 1 200 000 | Coloured gemstones, gold |
| Niger | 450 000 | 2 700 000 | Gold |
| Nigeria | 500 000 | 2 500 000 | Gold |
| South Africa | 20 000 | - | Gold |
| Sierra Leone | 300 000 | 1 800 000 | Gold, diamonds |
| South Sudan | 200 000 | 1 200 000 | Gold |
| Tanzania | 1 500 000 | 9 000 000 | Gold |
| Uganda | 150 000 | 900 000 | Gold |
| Zimbabwe | 500 000 | 3 000 000 | Gold, diamonds, coloured gemstones |

in some quarters that artisanal miners lack the skills required to operate better technology (as expressed in Saldarriaga-Isaza, Villegas-Palacio, and Arango, 2013), there are instances where they are quite knowledgeable in the use of technology and may have perhaps seen its use in neighbouring mine sites (Perks, 2016). Yet, without financial resources, they are forced to make do with what is readily available. Thus, in this case, the main bottleneck is the lack of resources to be able to adapt and replicate better mining techniques and equipment.

Given the potential of ASM, academic discussion as to the way forward has been largely on the formalization of the industry. Formalization, in this context, includes efforts to legalize ASM activities, where ASM is conducted on an illegal basis. It typically involves demanding that miners secure the required permits, in line with the law, and launching programmes which foster technical and/or financial support for licensed miners, among others (Hilson, 2020). There have been genuine attempts by governments across sub-Saharan Africa to formalize ASM operations (Siwale and Siwale, 2017). These efforts have yielded some progress, with widespread granting of licenses to artisanal and small-scale miners and reports of some governments designating and allocating mineralized land specifically for ASM operations (Fold, Jønsson, and Yankson, 2014). There are instances, as is the case in South Africa, where the ASM sector was profiled by the national government as an intervention to develop local economies. Nevertheless, the question of the viability and sustainability of ASM operations still persists (Perks, 2016; Planetgold, 2020a). Along this line, this article examines access to credit for ASM operations and its implication for attempts at formalization across sub-Saharan Africa.

This paper is a review of literature that covers selected articles on ASM in the past four decades, which is generally regarded as

the period of widespread proliferation of ASM operations in sub-Saharan Africa and across the developing world¹. Specifically, the review focuses on selected articles that discuss access to credit for artisanal miners² in relation to formalization of the ASM sector within the stated timeframe. Its purpose is to draw attention to the gap in the funding mechanism of ASM. This is achieved by first exploring the existing funding mechanisms for ASM, then using these lessons to discuss the need to expand the scope of formalization efforts to capture access to credit and enhance the ability of ASM operators to attract forming lending. Thus, the major themes in this paper include a review of the existing funding mechanism for ASM operations, implications of ASM credit constraint, the concept of formalization, access to credit, and discussion of the findings.

Existing funding mechanisms for ASM operations

A review of empirical findings on available funding for ASM activities indicates that the bulk of the operations are self-financed. They also obtain funding from other sources. The funding sources, their structure, benefits, and drawbacks are further explored below.

External informal financing

One of the most common sources of funding for artisanal mining across sub-Saharan Africa and other developing countries is what can be termed 'external informal financing'. It typically involves

¹This review paper forms the background to a doctoral research programme being carried out in the Mining Engineering Department at the University of Pretoria

²While different forms of classification are used in the literature, in this article, 'artisanal mining', 'small-scale mining', and 'artisanal and small-scale mining' (ASM) are all used interchangeably

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miners receiving funds for investment from external sponsors who have interest in the mineral to be mined. Mostly, these sponsors are buyers who provide investment capital to miners in exchange for an agreement that the miner will sell the mineral produced to them, usually below the market price.

Varying viewpoints have been expressed in the literature about external informal financing. The perception of its importance in sub-Saharan Africa seems to deviate from the view in some other developing countries. As an illustration, Verbrugge (2014) provides a positive impression based on his experience exploring informal financing arrangements in Southern Philippines. In this financing arrangement, described in the study as 'back-financing', the financier retains about two to three shares of the ore proceeds after deducting operational expenses and the landowner's share, then leaves the remaining share to the miner. Verbrugge (2014) argues that artisanal gold mining is a dangerous operation and miners may follow the veins of gold deeper into the earth, which increases the risks of flooding or collapse of the tunnel. At this point, the ability to continue with the operation usually depends on the availability of cash to provide reinforcement and other equipment. The intervention of external financiers therefore becomes very helpful. In this case study, it is further argued that the benefit of such arrangement is that the risks are shared among the participants in the investment, and this enables the miners to continue with their operation, focusing on the mining activities and not needing to worry about subsistence needs.

However, across sub-Saharan Africa, the findings of empirical studies on informal financing arrangements are rarely positive. For example, Perks (2016), who looked at informal financing arrangement in Tanzania and Rwanda, asserts that the way such finance and trade relations are structured usually leads to artisanal miners receiving less than the market value for their products. In this case study, it is argued that the absence of formal financing opportunities and technological support has pushed miners to adopt short-term mineral extraction strategies which rely on informal arrangements with outside financiers, traders, and sometimes large-scale mining companies in order to access the global mineral market.

Hilson and Ackah-Baidoo (2011) document how artisanal miners in Ghana rely on sponsors for loans to acquire crushers, pumps, and generators. These sponsors usually require high interest rates from the miners, in addition to the precondition that miners agree to sell their produce to the sponsors on 'inequitable terms'. There are instances where sponsors (who are also buyers) ask for a price cut of up to 10–15% less than the market rate (*ibid.*). Consequently, the report of the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (2018) asserts that the financiers, which the study described as 'power holders' in ASM, make the largest share of profit, while those doing the work on the ground barely make enough to survive. This led Perks (2016) to argue that such a form of capitalization prevents the miners from having the decision-making power to plan far into the future on their business. Fold *et al.*, (2014) used these lessons to justify why interventions downstream in the gold value chain, on access to mineral markets, could facilitate the formalization efforts upstream for artisanal miners.

The body of literature further discusses the potential for vested interests of financiers to subvert ASM formalization by governments and funding agencies such as the World Bank. Perks (2016) again illustrates how middlemen and financiers opposed technical and financial assistance by the World Bank to artisanal miners in Tanzania in 2014. These actors, who pre-finance a large

majority of the gold mines in the country, considered outside assistance as damaging to their monopoly on gold supplies from the artisanal mine sites.

While some documented cases expose the opportunistic tendencies of financiers to exploit the informal nature of ASM, there are instances where legitimate license-holders who are not able to acquire the funds needed to advance their operations willingly make way for artisanal miners on their concession areas, just so they can have access to the mineral to be mined. Based on experience in Uganda, Siegel and Veiga (2009) provide a tale of how a small-scale license holder who could not afford to employ a formal mining crew allowed 'illegal' miners to trespass on his concession area, while supporting them with tools and meals, with the agreement to purchase the gold they produce. The study argues that such a scenario underscores the flaw in formalization efforts where the licensee 'remains unable to access technical and financial resource(s) to advance his operation beyond the live-and-go-on artisanal stage' (Siegel and Veiga, 2009, p. 54).

Donor interventions

Another major source of funding for ASM operations is through grants by international and domestic donor agencies. Some of these grant schemes are carried out by the donor agency in collaboration with the host government. A typical example of such donor initiatives is the World Bank support in Nigeria, which has a budget of US\$120 million under the Sustainable Management of Mineral Resources Project (SMMRP), of which US\$10 million was earmarked for ASM (Oramah *et al.*, 2015). According to the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF, 2018), the SMMRP ran from 2004 to 2012 in Nigeria, provided 245 grants to 147 ASM cooperatives and 98 community entities, and included projects to enhance granite, gravel, sand, and laterite quarrying. A similar World Bank SMMRP scheme in Uganda is documented in IGF (2018), which ran from 2003 through 2011. To access this grant, miners only needed to form groups and be further trained on financial management and procurement. The IGF (2018) noted that the scheme motivated several ASM groups to start village savings and loans associations that could provide small loans to members in times of need (*e.g.* to pay children's school fees, build houses, *etc.*).

In Tanzania, Pedersen *et al.* (2019) examined a World Bank intervention programme, again through SMMRP, and identified its positive contributions. The donor intervention supported current efforts to upgrade the ASM industry, which also fits into the current resource nationalism agenda of the country. Some previous donor initiatives targeting ASM in Tanzania include the Global Mercury Project (GMP) and initiatives by domestic NGOs. It is noted that 'by systematically working with the state institutions that control the sector, the SMMRP has been by far the most far-reaching and potentially impactful support programme' (Pedersen *et al.*, 2019, p. 343). This argument underscores the role of the state in intervention programmes and why any such programme must be captured along the line of formalization.

It is noteworthy, that donor grant funding is helpful in the short term, but it usually fails to align with a business-led approach to develop sustainable long-term solutions. Additionally, as expressed in Siegel and Veiga (2009), donor interventions by international development agencies often come in the form of limited-term 'grants' and not 'loans'. It has been suggested that a more sustainable approach would be for development agencies to

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actually lend to miners as a way of addressing the capital shortfall. This can better enhance the viability of such operations. Another drawback is that competition for grants is very stiff. Thus, even when a miner manages to present every requirement, a grant is still not assured.

Government loan facilities

Siegel and Veiga (2009) drew evidence from Namibia and Mozambique on the implementation of government loan facilities to ASM. In Namibia, the government provided US\$92 million in loans through the Mineral Development Fund for projects, with emphasis on the sinking of shafts, exploration, and mine expansion. The loans were provided at low interest rates, with generous repayment periods and minimal bureaucratic overheads. The loan scheme has recorded a 92% repayment rate. A similar fund was provided in Mozambique which offered credit facilities, provided miners could show a mining license, feasibility study, plan for repayment, and proof of collateral (20% of the loan amount) (Siegel and Veiga, 2009). The key takeaway from these loan schemes is that they were relatively successful.

Planetgold (2020b) reports a similar loan scheme in Ghana, circa 2005, where the government provided loans to small-scale miners amounting to US\$500 000. The loan was provided through the government's Mineral Development Fund and coordinated by officials of the Minerals Commission, which is the country's major mining policy-making body. The loans were provided primarily to gold and salt miners. To access a loan, the miners were required to form cooperatives and were collectively bound by the terms of the loan. The loans were provided in the form of cash, tied to equipment and consumables, and beneficiaries were required to repay the loan in agreed instalments at a subsidized interest rate. Another feature of the scheme is that miners were required to share the mine machinery purchased such as crushers, pumps, and generators. Findings on the impact of the scheme are mixed. Nevertheless, a key takeaway is that the programme was relatively successful despite the initial teething problems, as borrowers agreed to the terms of the loan and the requirements in relation to repayment (Planetgold, 2020b).

There are recorded attempts in the literature of government loan interventions that were not so successful. An example is a South African government loan scheme to provide support for small-scale mining projects, managed by the National Steering Committee (NSC) under the supervision of the South Africa Department of Mineral Resources (DMR) – now the Department of Mineral Resources and Energy (DMRE). The funding structure was 90% loan, and applicants were required to source the remaining 10% themselves. The funds were provided for equipment purchases, operational costs, and for rehabilitation guarantees. Findings on the performance of the loan scheme indicate that borrowers were unable to repay their loans, and that led to the programme's cancellation in 2005 (*ibid.*). However, it was argued that one possible reason for the scheme's failure is that the bulk of the loans were provided to those in the industrial minerals sector, which has a relatively small profit margin. Perhaps interventions in small-scale gold mining, which has much higher profit margins, could have led to different outcomes. Another reason for the failure of the scheme was the inability of the DMR to monitor borrowers or pre-screen their applications (*ibid.*).

Apart from direct funding of ASM operations, there are documented cases in the literature where the state became involved in a section of the value chain of ASM mineral production

to enhance formalization efforts. An example of this scenario was reported by Fold, Jønsson, and Yankson (2014), where in 1990 the Tanzanian government (through the Bank of Tanzania) legalized the selling of gold to government-appointed banks. The state's policy aimed to reduce illegal trading and smuggling of gold in the country. With this policy, no questions were asked about the origin of the gold. Thus, the system became popular among ASM operators who suddenly had access to legal and locally available gold purchasers. Consequently, the official gold exports rose rapidly from just above a million US dollars in 1989 to more than 40 million US dollars in 1992, reflecting a significant reduction in illegal gold exports (Fold, Jønsson, and Yankson, 2014).

The observed limitation of government loans in the ASM industry is in its sustainability. Even when government loan schemes are successful, they are often short-lived. Also, the criteria set out for access to government loans sometimes place them out of reach for most artisanal miners.

Miners' cooperatives and village savings and loans associations

Mining cooperatives (sometimes called associative entrepreneurship) are local associations set up by miners to provide savings facilities and easy access to credit as a service for their members (Chaparro Avila, 2003). Mining cooperatives represents an alliance between individual interests to achieve collective benefits for all those involved. Alves, Ferreira, and Araújo (2019) asserted that alliance via cooperatives can be a key element in improving sustainability in the ASM sector. They argued that, as a business model, the use of cooperatives has not been fully explored in the mining sector compared with other sectors such as agriculture, health, credit, and consumerism. Some successful cases of cooperatives, however, have been documented. Perks (2016) reports a successful cooperative model adopted in Rwanda, where cooperatives are obliged to employ an administrator/accountant whose role is to formalize the cooperative's dealings and ensure better accountability of their financial resources. Under the term 'associative entrepreneurship', the collaboration between mining cooperatives and government regulating agency has produced some successes in Rwanda. The cooperatives are obliged by the government to pay social insurance and pensions to their members.

With the assistance of the state regulating agency, cooperatives have managed to hire the services of geologists to evaluate potential reserves (Perks, 2016). This underscores the potential of self-regulation in the ASM sector (Eniowo and Meyer, 2020). Saldarriaga-Isaza, Arango, and Villegas-Palacio (2015) therefore recommend that governments need to strengthen associative entrepreneurship as a way of formalizing the ASM industry.

Another initiative that is increasingly in use in some sub-Saharan African countries is that of village savings and loans associations (VSLAs). Reichel (2019) reports the results from a community-led savings and credit project implemented by the Canadian nongovernmental organization IMPACT in artisanal gold mining communities in the Democratic Republic of Congo (DRC). The scheme recorded very encouraging repayment rates (98%). More importantly, it is believed that such saving groups can contribute to local formalization efforts, since they can significantly increase the financial literacy of their members, which is one of the requirements for a formalized ASM operation. It must be noted, that VSLAs are not able to address all financial

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problems in ASM, e.g. major capital investment. However, they can contribute to cover the basic financial needs of miners, such as medical bills, children's school fees, food security, and housing needs, before banks or other formal lenders step in (*ibid.*).

Commercial bank loans

Despite the potential of ASM, the absence of formal bank investment in the sector is worrisome. The few recorded attempts to fund ASM operations through commercial bank loans usually have challenges. A typical illustration of this was an initiative to supply credit to emerald miners in Zambia, documented in Siwale and Siwale (2017). To access the fund, which was made available by the European Investment Bank (EIB), miners were required to provide bankable documents with requisite technical documents if their applications were to be considered. Siwale and Siwale (2017, p. 197) assert that 'due to the low educational levels among these miners, none were able to submit an application deemed acceptable to the EIB'. More appalling was that in this case, the technical assistance unit of the bank that was meant to assist loan applicants to design bankable documents required miners to pay 30% of the cost of designing the documents. Where applications for a loan were successful, miners were asked to pay the balance of 70%. In effect, artisanal miners could not afford these costs, and the project completely failed to fund any ASM operation.

Microfinance loans

To close the funding gap for artisanal miners, another reasonable option would be the creation of microfinance institutions specifically for artisanal mining operations, similar to the agricultural microfinance banks and other trade microcredit agencies in developing countries. Blore (2015) noted that, remarkably, only a few attempts have been made to create alternative financing networks specifically for artisanal mining, despite the rise of the microcredit movement. More recent literature, however, provides evidence of microcredit initiatives in sub-Saharan Africa that brings glimpses of hope for formal lending

in the industry. A typical example is the microfinance initiative used to support an equipment lending model based on a 'group sharing' arrangement, in the Bolgatanga and Tongo communities in Ghana. In this model, participants in a group rank their fellow group members according to their financial strength. This rank is used to determine who receives the loan first, and to elect a chairperson who coordinates the repayment. One useful feature of this financing arrangement is that the risk is shared across the group's members (Planetgold, 2020b).

While microfinance funding may be quite helpful as a funding option for ASM activities, the funding provided by such schemes is usually not enough to cater for efficiently mechanized small-scale mining operations. Thus, there is a need for ASM operations to be able to access commercial loans to acquire mining equipment in order to scale up their operation, improve their performance, and more importantly, ensure that their operation is safer and more environmental-friendly.

A snapshot of the major credit schemes used to fund artisanal and small-scale mining operation in selected sub-Saharan African countries and their successes and failures is shown in Table II.

Implications of ASM credit constraints

As shown, ASM operators usually suffer from a lack of access to formal lending, which fuels the perpetuity of the poverty in ASM operations on the one hand, and increases the adverse consequence for safety, health, and the environment on the other. It has been shown that the primary factor responsible for the problems caused by ASM is the inability of operators to obtain capital for investment to advance their operations (see Figure 1). This leads to the use of inadequate techniques for mining and processing, resulting in low recoveries and productivity and traps them into crude and inefficient mining and processing. A consequence of this is the poor health, safety, and environmental record attributed to the occupation (Barry, 1996). Richard Noetstaller, in his keynote address at a World Bank round table on ASM, asserts that 'most of the harmful effects of artisanal mining

Table II

Credit schemes used to fund ASM in selected sub-Saharan African countries (author's compilation)

| Authors | Credit scheme | Country | Remarks |
|----------------------------------------------------------------------------------------|------------------------------------------------|------------------------------------|--------------------------------------------------|
| Planetgold (2020b) | Government loan facilities | South Africa | Unsuccessful, borrowers were unable to repay |
| Siegel and Veiga (2009) | Government loan facilities | Namibia | Successful: 92% repayment rate recorded |
| Siegel and Veiga (2009) | Government loan facilities | Mozambique | Successful, but out of reach for most miners |
| Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (2018) | Government loan facilities | Zimbabwe | Successful, but short-lived |
| Planetgold (2020b) | Government loan facilities | Ghana | Successful, though had initial teething problems |
| Perks (2016) | Mining cooperatives | Rwanda | Successful |
| Reichel (2019) | Village savings and loans associations (VSLAs) | Democratic Republic of Congo (DRC) | Successful |
| World Bank (2012) | Donor grants - World Bank | Nigeria | Satisfactory |
| Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (2018) | Donor grants - World Bank | Uganda | Successful |
| Fold, Jønsson, and Yankson (2014) | Donor grants - World Bank | Tanzania | The scheme is just emerging. |
| Fold <i>et al.</i> (2014) | Informal finance | Ghana and Tanzania | Unfavourable to miners |
| Perks (2016) | Informal finance | Rwanda | Unfavourable to miners |
| Siwale and Siwale, (2017) | Commercial loan | Zambia | Unsuccessful |
| Planetgold (2020b) | Microfinance loan | Ghana | Successful |

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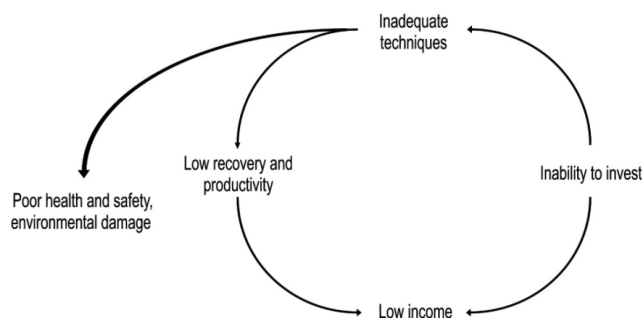


Figure 1—Negative circle affecting artisanal miners (Noetstaller, 1995)

is directly related to the technical and financial limitations typical for the subsector’ (Noetstaller, 1995, p. 5).

A typical illustration of the offshoot of the ASM poverty circle is that of tin ore (cassiterite) artisanal mining in Jos, Nigeria carried out by groups of community peasants using a local method of mining called *loto*³. Mallo (2011) examined *loto* mining and argued that miners using this technology lead a hard, insecure, unhealthy, and dangerous life while their earnings remain low. Each miner receives an average income of less than US\$1 a day, placing them squarely in the broad category of ‘absolute poverty’. Apart from that, the *loto* mining technique results in large-scale environmental degradation which adversely affects the land, waters, and other aspects of the ecosystem.

Noetstaller (1995) states that, given the crude processing techniques typically employed in ASM, usually only about 50% of the valuable minerals is recovered, the remainder being lost in the tailings and thus wasting non-renewable resources. This argument, among others, fuels the recent efforts to prioritize the issue of formalization of artisanal mining. What it involves, and why is important to do so, are discussed in the next section.

Formalization of ASM – The major discussions

The concept of formalization, for the development of informal economic activities, such as artisanal mining, has its origin in the study of Hernando de Soto, a Peruvian economist, who argued that property rights are the key to overcoming poverty in the developing world. He opined that the issue of formalization is ultimately about a clash between what can be termed the ‘mainstream legal economy’ and the ‘informal or extra-legal economy’ (De Soto, 2000). As much as 80% of economic activities are part of the informal (extra-legal) economy. Thus he argues that by not extending rights to the informal economy, government institutions are denying economic freedom to an overwhelming majority of the world’s population, who exist in a state of ‘legal apartheid’ (Siegel and Veiga, 2009). As a result, there is now a consensus among scholars that the foundation of intervention in ASM lies in formalization. Formalization, in the context of ASM, involves governments and other stakeholders demanding that ASM operators obtain necessary permits, in line with the law, with the goal of attracting support to their operations. The expected benefits that formalization would bring to the ASM industry, as documented in the literature, are discussed below.

Collateral security

It has been established that the lack of collateral security⁴, occasioned by the peasant nature of ASM operators, is a major impediment to formal lending in ASM (Eniowo and Meyer, 2020).

Thus, proponents of formalization argue that the acquisition of mineral properties benefits the miners by providing them with a form of collateral through which they could access support to upgrade their operations. They argue that poor people possess assets, but because these assets exist in the informal sector, they lack legal representation that can help generate adequate capital or value. It is therefore believed that formalization will give informal miners a face and more visibility that can bring about financial intervention from the state and financial organizations (Siwale and Siwale, 2017).

Access to mineralized land

Regarding access to land with mineral deposits, the issue discussed in the literature relates to how ASM operators could have easy and affordable access to mining licenses. Studies have documented instances where local populations and artisanal miners have discovered rich mineral deposits that ended up in the hands of large-scale mining companies (Hentschel, Hruschka, and Priester, 2002). Similarly, the regulatory bottlenecks involved in artisanal miners’ access to mining licenses are well documented (Siegel and Veiga, 2009). To tackle these challenges, in line with formalization, legislation for ASM ‘designated mining spaces’ has been recommended. Examples of this form of legislation can be seen in the DRC, Mali, Mozambique, and Tanzania (Mutemeri *et al.*, 2016; Corbett, O’Faircheallaigh, and Regan, 2017; Hilson *et al.*, 2021).

Attraction of credit

Proponents of formalization argue that it would provide the necessary exposure to ASM operations, which would help the operators to access formal lending. They argue that having informal mining formalized will give the miners more visibility, which can bring about financial intervention from the state and financial organizations (Eniowo and Meyer, 2020). Recently, attention has been placed on how to upgrade artisanal mining operations to a more sustainable form of small-scale mining enterprise (Marin *et al.*, 2016). The goal is to improve the artisanal miners’ access to formal lending, which is in line with the formalization drive. The relationship between access to credit and formalization will be further expanded in later sections of this paper.

Stemming the tide of clashes

More expediently, formalization presents an opportunity to abate the dangerous clashes between the informal and formal mining sectors. Informality breeds chaos. The clashes caused by illegal miners entering established large-scale mines make a case for the formalization of informal ASM. These intrusions are sometimes carried out violently. A reported case is a gold mine owned by AngloGold Ashanti in Ghana, which was overrun by thousands of illegal miners in 2016, and the mine was forced to evacuate employees (Jamasmie, 2016). Another reported case is an intrusion at the copper mine operated by Glencore in Congo,

³Loto mining involve group of community peasants numbering 10 to 15 who form clusters by separating themselves into groups consisting of those who extract the cassiterite and those who process it. The cycle of operation involve manual digging of pits to an average depth of 30 m and sluicing water over the ore, sun-drying it, and marketing the product.

⁴Collateral security is defined as an asset which a borrower is required to deposit with, or pledge to, a lender as a condition of obtaining a loan, which can be sold off if the borrower defaults on the loan (Pass, Lowes, and Davies, 2005).

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where 43 deaths, including those of several illegal miners who broke into the mine site, were caused by a landslide (*ibid.*).

The unsafe investment environment created by these clashes puts doubt in the mind of investors in several would-be mining destinations in Africa. Furthermore, as illegal miners operate without consideration for safety, there is usually a record of high casualties in their operations, which brings into question the issue of safety. A typical example is an accident that occurred in the shaft of an unused gold mine in South Africa in 2017 where over 30 illegal miners died in an explosion (Bloomberg, 2019). It has been argued that while effective policing of the ASM industry may sometimes be unavoidable, formalization presents a more sustainable solution and a win-win situation for policy-makers and artisanal miners in addressing the major conflicts linked to ASM. By capturing informal miners to the formal domain, and designating mine spaces for them, it has been perceived that the clashes between the formal and informal mining sectors would be abated.

Improving working conditions

Advocates of formalization argue that it would help miners to receive the necessary support through which their working conditions can be improved (Fold, Jönsson, and Yankson, 2014). It is expected that the support that miners would receive will help improve their health and safety conditions, working environment, and enhance access to better equipment. It would also create an avenue for the state to check issues such as child labour, prostitution, drug abuse, and other social menaces associated with the occupation. Thus, formalization makes it easier to trace those who abuse the vulnerable sections of the population.

Generation of tax

For governments, the issuance of legal documents, in particular licenses to miners, provides the benefit of taxation. As such, the formal system can therefore be described as a win-win for both the state and the miners (Siegel and Veiga, 2009). Several studies have examined the issue of taxation of the informal economy such as the ASM sector. Some suggest that increased taxation, along with burdensome regulation, is counterproductive to the formalization drive (Ihrig and Moe, 2004). Others argue that the relationship between taxation and formalization is not a direct one, claiming that what motivates firms to formalize, register, and/or pay tax is the availability of credit markets and the potential for greater productivity (McKenzie and Sakho, 2010).

Protection of the environment

While the granting of mining rights bestows benefits on artisanal miners, it also imposes duties on them to conform to environmental, human rights, and labour standards. The negative impact of ASM on the environment is well documented in the literature (Clement and Olaniyan, 2016; Owolabi and Opafunso, 2017; Omotehinse and Ako, 2019). Advocates of formalization therefore argue that it makes it easier to identify operations that harm the environment and to monitor compliance to environmental, safety, and health standards. In line with formalization efforts, studies have recommended vocational training courses for miners and capacity-building, provision of mining-related extension services, and adequate institutional support in order to tackle environmental damage traced to the occupation (Hilson, 2002; Hinton, Veiga, and Veiga, 2003; Spiegel and Veiga, 2005).

Access to credit in ASM and implications for formalization

Recent United Nations guidelines on artisanal mining formalization describe access to finance as 'one of the most pressing needs' in ASM (Reichel, 2019). Table III provides illustrations of how poverty and lack of access to credit impede the formalization drive in some sub-Saharan African countries. One essential for access to credit is financial inclusion³. The link between formalization and financial inclusion in ASM is quite complex. Hilson and Ackah-Baidoo (2011) regard formalization as a prerequisite for access to finance for ASM operators. However, Reichel (2019) opined that the absence of formal financial services is a major obstacle to the development and formalization of ASM, especially in areas that are affected by conflict. In places where there are available formal financial institutions, there is often that challenge of ease of access to funds for ASM operators. The reasons for this will be discussed next.

The associated financial risks involved in ASM operations are a primary cause of difficulties in accessing formal finance. Previous studies such as Binks, Ennew, and Reed (1992) reveal that it is harder for small businesses to obtain credit than for larger firms. Binks Ennew, and Reed argue that small businesses have trouble in obtaining loans since they can experience a debt gap caused by insufficient business collateral. Perks (2016) cites local banks' lack of experience in translating geological assets into collateral that is familiar to them as the reason why artisanal miners may not enjoy bank lending. Holistically, for ASM, the reasons for poor financial services can be attributed to a long list of credit risks, some of which are itemized under the next subheading. Reichel (2019) suggested that these factors could contribute to actual or perceived challenges in making loan repayments.

Predicting ASM viability

As highlighted, the inability of formal lenders to predict the viability of ASM operations by quantifying and pricing the credit risks of such investments limits the ability of artisanal miners to access formal bank financing. Hilson and McQuilken (2014) identified the concern of government-sponsored 'mining banks' in supporting ASM operations in developing countries. It is believed that ASM has high technical and financial risks; funding the operations is hence difficult and expensive. It is a fundamental principle that recipients of loans must be creditworthy companies with technically and financially viable operations and projects (Bosson and Varon, 1978). For ASM operations to be technically viable, efficient and safe types of machinery are required. As such, financial viability is a prerequisite for the technical viability of ASM companies.

A nuanced study into the inability of ASM firms to obtain capital for their operations by Seccatore *et al.* (2014) reveals that the high-risk nature of the investment, occasioned by the lack of guarantee of return or fiscal success, is a cause. As a result, there is little attraction for investors in the occupation. This situation is further compounded by the absence of proper geological exploration. As such, artisanal miners restrict their operational planning to instinct and rely on experience based on previous operations (Marin *et al.*, 2016). Any meaningful upgrade

³The World Bank (2018) defined financial inclusion as a term used to describe individuals and businesses' access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit, and insurance – delivered in a responsible and sustainable way

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Table III

Summary of findings on the effect of financial constraint on the attempt to formalize ASM in some case studies

| Publication | Case study | Observation | Recommendations |
|-------------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Spiegel (2012) | Zimbabwe | Government banned ASM activities, then demanded that artisanal miners submit an Environmental Impact Assessments (EIA) before they could resume work. The costs for the EIA were prohibitive (up to US\$4000) and the miners could not afford this. | Decentralized and 'assistance-oriented' ASM sector management policies should guide future political decisions. |
| Van Bockstael (2014) | Liberia | Advanced artisanal miners who wish to improve their production capacity by using earthmoving equipment complained that they are required to apply for a different license, which costs up to US\$10 000, and which is more than they could afford. | Top-down regulatory policies should be avoided. Laws should be made attractive to encourage ASM operators to willingly opt-in. |
| Reichel (2019) | Democratic Republic of Congo (DRC) | Majority of ASM sector is still shut out of financial inclusion programmes, which affects their access to credit. | Miners' village savings groups can contribute to closing the capital gap for ASM operators, especially at the basic personal level. |
| Hilson (2020) | Sierra Leone | Small-scale license costs a whopping US\$1000, requires an annual fee of US\$800 per hectare for plots, and a renewal fee of US\$1000. Fewer than 10 individuals have been able to afford these costs over the 3-year period of the study. | No recommendation. |
| Hilson (2020) | Ghana | Considering the levels of payments that must be made before an application can be reviewed, the costs of obtaining a license to mine on a small scale are so high that only a small group of individuals can consider moving towards legality. | No recommendation. |
| Kinyondo and Huggins (2020) | Tanzania | Training centres set up to enhance capacity-building of ASM workers and other professionals in the mining sector offer courses at a rate too expensive for an average ASM worker. The fees are between US\$260 and US\$434, which is quite a high sum in a nation with a per capita GDP of US\$1050. | Government is advised that affordability of the training courses is essential for formalization. Also, it is argued that if the state uses the training centres primarily to generate profit rather than serve miners' needs, they will become less relevant over time. |
| Hilson <i>et al.</i> , (2021) | Mozambique | Miners have spent huge sums in attempts to get licensed but to no avail. A respondent recounts 'I have spent around 200 000 MZN (US\$3000) to gather all the required documents but still have no license. It's too much money, I don't have a salary'. The poverty situation affects the ability of miners to pay for licenses. | Government should simplify the licensing system for ASM. This, among other steps, would help individuals in ASM to expand their operations. |

of ASM should therefore be accompanied by optimization of the creditworthiness of ASM companies.

To tackle this limitation, some recent studies have proposed methodologies for creating mineral deposit certainty that can help boost the confidence of formal lenders in investing in ASM operations. For example, a recent approach was developed in Marin *et al.* (2016) which simplifies the method for the determination of the feasibility of a new ASM operation. In this approach, there is no need for a large investment to ascertain the feasibility of a small-scale mining operation like that required for large-scale mineral exploration. Instead, only proof of 'minimum reserve and replication' is needed for the project start-up (Seccatore *et al.*, 2014; Marin *et al.*, 2016).

Marin *et al.* (2016) defined 'minimum reserve' as a reserve whose exploitation allows for the payback of the capital expenditure (CAPEX), operational costs of the mining business, provides capital for another round of exploration to extend the proven reserve, and desired profit. 'Replication' is the exploitation in several volumes of minimum reserves (Marin *et al.*, 2016). When applied to a real case, it was shown that the reserve required to prove the feasibility of a responsible small-scale operation is of the order of 1/1000 of that required for large-scale mining. The 'minimum reserve and replication' technique could help boost investors' confidence in ASM operations, specifically

because orebody risk is the single most important characteristic that potential lenders focus on for their due diligence (Benning, 2000).

However, it is also true that proof of economic feasibility through a Proved Mineral Reserve alone is not a guarantee of the sustainability of an ASM operation. It is equally essential that ASM operators can service loans obtained for investment. This re-echoes the need for strengthening of the technical and financial capabilities of artisanal miners, which was identified by Sinding (2005). The study stressed that in some cases artisanal miners may only have enough to cover subsistence and operating costs. Still, a miner is continuously faced with the choice between current consumption (whether for subsistence or operating) and investment. The choice made in this regard may ultimately determine whether the miner will be able to break free from the poverty circle.

Discussion and concluding remarks

Formalization is conceived as an avenue through which government could enhance the economic fortunes of indigenes, protect the environment, and generate tax by regularizing the operations of artisanal miners. ASM, whether formal or informal, cannot simply be wiped out through heavy-handed measures. This could result in a more dangerous social menace being created.

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Rather, the operations must be formalized and their performance upgraded to meet global best mining practices. However, for a sustainable formalization drive, the limited availability of formal lending in the ASM industry is a challenge. It has been shown that the persistence of informality in the ASM sector can be traced to the lack of sustainable finance mechanisms for operators (Fold, Jønsson, and Yankson, 2014; Siwale and Siwale, 2017; Eniowo and Meyer, 2020 *etc.*).

A body of knowledge has attempted to unravel the mystery behind ASM's lack of credit access. Fold, Jønsson, and Yankson (2014) argue that ASM operators face difficulty in accessing formal loans due to a lack of collateral and insecure production outcomes. The question that arises here is, can all ASM operations vaguely be classified as having insecure production outcomes? Perhaps a more robust argument for the justification of formal lenders' apathy in ASM is the point emphasised in Ledwaba (2017), that ASM lacks access to funding due to poor knowledge of the economic potential and lifespan of the mineral resource, economic value of the deposit, market availability, and recording of cash flows .

Other studies such as that of the Environmental Law Institute (2014) question the technological capabilities of miners and cite the unavailability of adequate geological knowledge that can improve lenders' confidence in the deposit. Theoretically, the essence of ore reserve estimation carried out before mining operations commence is to provide proof of the existence of the orebody. Typically, this should be followed up by documented feasibility studies that provide evidence of financial viability of the business – which is what formal lenders want to see, but which ASM operators may not be able to provide. Thus, a reasonable direction for intervention aimed at optimizing the ability of ASM operators to access loans must focus on closing the gap between the requirements of formal lenders and the inadequacies of ASM operators.

In line with this, recent studies on ASM concentrate on how to strengthen and upgrade ASM companies with the goal of tackling the challenge of undercapitalization. Some of the strategies put forward include the creation of ASM designated areas (formalization of ASM spaces) (Corbett, O'Faircheallaigh, and Regan, 2017); provision of revolving loans for ASM companies (Spiegel and Veiga, 2005); establishing village savings and loans associations (VSLAs) (Reichel, 2019); and creation of mineral buying centres (Adesugba, 2018). Likewise, some authors suggest the provision of community-led microfinance schemes, increasing the financial literacy of ASM operators (Reichel, 2019), and training ASM operators on economic sustainability (Stocklin-Weinberg, Veiga, and Marshall, 2019) .

Other studies prescribe emerging alternative forms of project financing such as metal streaming and offtake agreements (Perks, 2016). Specifically, Perks (2016) argues that considering the constraint faced by ASM operators in accessing formal domestic financing sources, which has hindered the capacity of the ASM subsector to move from opportunistic activity to sustainable growth, formal streaming, and offtake agreements could provide a further push for the small-scale mining sector to effectively develop and mature.

However, one key initiative that may play a more sustainable role in enhancing ASM operators' access to credit is the strengthening of associative entrepreneurship movements such as miners' cooperatives. First, this form of association would help miners to accumulate enough capital with which they could engage in more viable and safer operations (Saldarriaga-Isaza,

Villegas-Palacio, and Arango, 2013). Additionally, considering the low tendency of miners to save, which is partly due to the burden of the informal arrangements through which their operation is usually funded, associative entrepreneurship provides an option for artisanal miners to increase their financial capital. Furthermore, due to the perceived itinerant nature of artisanal mining, such associations provide a face for artisanal miners, a governing structure, and an avenue through which miners could be held accountable for excesses in their operations.

As efforts are being made to capture artisanal and small-scale mining operations into the formal economy, as is the case in South Africa and other sub-Saharan Africa nations, attention must now be placed towards upgrading ASM operations economically to sustainable enterprises. In the long run, there is need for ASM companies to be able to operate sustainably without grants from governments and international donors. In this regard, this paper argues that future research and policy frameworks need to focus on optimizing the creditworthiness of ASM firms, with the goal of enhancing their ability to attract formal funding from banks and microfinance institutions. To achieve this, a mechanism must be developed to assist miners in acquiring adequate knowledge of the orebodies as this would improve the confidence of would-be investors and formal lenders.

Again, it has been shown that recipients of loans should be creditworthy companies with financially viable operations. ASM, as is practiced, has been unable to attract formal lending, partly because there is no standard, specific to ASM, for estimation of viability or creditworthiness. It is therefore recommended that future study should also consider creating simplified tools and methods to estimate the viability of ASM operations – such methodology should be void of the encumbrances seen in banks' due diligence for large mining companies. It is equally important that the scope of the current ASM formalization efforts is expanded to familiarize ASM operators with the credit risks inherent in their operations and train operators on mechanisms with which such risks can be reduced.

References

- ADESUGBA, A. 2018. A study of the challenges of gemstones artisanal and small-scale mining in Nigeria. *Journal of Scientific Research and Studies*, vol. 5, no. 4. pp. 97-108.
- ALVES, W., FERREIRA, P., and ARAÚJO, M. 2019. Mining co-operatives: A model to establish a network for sustainability. *Journal of Co-operative Organization and Management*, vol. 7, no. 1. pp. 51-63.
- BARRY, M. (ed.). 1996. Regularizing informal mining: A summary of the proceedings of the International Roundtable on Artisanal Mining. *Industry and Energy Department Occasional Paper* no. 6. Industry and Energy Department. World Bank, Washington.
- BENNING, I. 2000. Bankers' perspective of mining project finance. *Journal of the South African Institute of Mining and Metallurgy*, vol. 100. May/June. pp. 145-152.
- BINKS, M.R., ENNEW, C. T., and REED, G.V. 1992. Information asymmetries and the provision of finance to small firms. *International Small Business Journal*, vol. 11. pp. 35-37.
- Bloomberg. 2019. Death toll at Glencore's mine puts spotlight on illegal mining. *Mining Weekly*, June 2019.
- BLORE, S. 2015. Capacity building for a responsible minerals trade (CBRMT), working with producers to responsibly source artisanal gold from the Democratic Republic of Congo. https://pdf.usaid.gov/pdf_docs/PA00TNFP.pdf
- BOCKSTAEEL, S.V. 2014. The persistence of informality: Perspectives on the future of artisanal mining in Liberia. *Futures*, vol. 62. pp. 10-20.
- BOSSON, R. and VARON, B. 1978. The mining industry and developing countries. World Bank, Washington, DC.
- CHAPARRO AVILA, E. 2003. Small-scale mining: A new entrepreneurial approach. *Recursos Naturales e Infraestructura*. https://repositorio.cepal.org/bitstream/handle/11362/64191/S038506_en.pdf [accessed 6 June 2019].
- CLEMENT, A. and OPAFUNSO, O. 2016. Environmental assessment of lead contaminated site from artisanal gold mining in Bagega community, Nigeria. *Archives of Current Research International*, vol. 5, no. 4. pp. 1-9.

Implications of credit constraint on the formalization of artisanal and small-scale mining

- COLLINS DICTIONARY OF ECONOMICS. 2005. Collateral security. <https://financial-dictionary.thefreedictionary.com/collateral+security> [accessed 29 June 2021].
- CORBETT, T., O'FAIRCHEALLAIGH, C., and REGAN, A. 2017. 'Designated areas' and the regulation of artisanal and small-scale mining. *Land Use Policy*, vol. 68 (August). pp. 393-401.
- CUVELIER, J. 2019. Mining in comparative perspective: Trends, transformations and theories. *The Extractive Industries and Society*, vol. 6, no. 2. pp. 378-381.
- DE SOTO, H. 2000. *The Mystery of Capital: Why Capitalism Triumph in the West and Fail Everywhere Else*. Basic Books, New York.
- ENIOWO, O.D. and MEYER, L.D. 2020. Financing artisanal and small-scale mining for sustainable rural development in sub-Saharan Africa. *Financial System, Entrepreneurship and Institutional Support for Inclusive and Sustainable Growth in Africa*. eJojo, J.A.T., Oladele, P.O., Oloyede, J.A., Olayiwola, S.O., Ajayi, M.O., and Olowokere, E.N. (eds). University of Lagos Press and Bookshop. pp. 45-64
- ENVIRONMENTAL LAW INSTITUTE. 2014. Artisanal and small-scale gold mining in Nigeria: Recommendations to address mercury and lead exposure. Washington, DC.
- FOLD, N., JONSSON, J.B., and YANKSON, P. 2014. Buying into formalization? State institutions and interlocked markets in African small-scale gold mining. *Futures*, vol. 62. pp. 128-139.
- GEENEN, S. and RADLEY, B. 2014. In the face of reform: What future for ASM in the Eastern DRC? *Futures*, vol. 62. pp. 58-66.
- HENTSCHEL, T., HRUSCHKA, F., and PRIESTER, M. 2002. Global report on artisanal and small-scale mining (ASM). *Minerals, Mining and Sustainable Development, MMSD*. no. 70, January 2002.
- HENTSCHEL, T., HRUSCHKA, F., and PRIESTER, M. 2003. Artisanal and small-scale mining - Challenges and opportunities. IIED. <https://pubs.iied.org/sites/default/files/pdfs/migrate/9268IIED.pdf>
- HILSON, G. 2002. Promoting sustainable development in Ghanaian small-scale gold mining operations. *Environmentalist*, vol. 22, no. 1. pp. 51-57.
- HILSON, G. 2020a. The 'Zambia model': A blueprint for formalizing artisanal and small-scale mining in sub-Saharan Africa? *Resources Policy*, vol. 68, April 2018. no.101765.
- HILSON, G. 2020b. Formalization bubbles : A blueprint for sustainable artisanal and small-scale mining (ASM) in sub-Saharan Africa. *The Extractive Industries and Society*, vol. 7, no. 4. pp. 1624-1638.
- HILSON, G. and ACKAH-BAIDOO, A. 2011. Can microcredit services alleviate hardship in African small-scale mining communities? *World Development*, vol. 39, no. 7. pp. 1191-1203.
- HILSON, G., HILSON, A., and MACONACHIE, R. 2018. Opportunity or necessity? Conceptualizing entrepreneurship at African small-scale mines. *Technological Forecasting and Social Change*, vol. 131, October 2017. pp. 286-302.
- HILSON, G. and MCQUILKEN, J. 2014. Four decades of support for artisanal and small-scale mining in sub-Saharan Africa: A critical review. *The Extractive Industries and Society*, vol. 1, no. 1. pp. 104-118.
- HILSON, G., MONDLANE, S., HILSON, A., ARNALL, A., and LAING, T. 2021. Formalizing artisanal and small-scale mining in Mozambique: Concerns, priorities and challenges. *Resources Policy*, vol. 71, January 2020, no.102001.
- HINTON, J.J., VEIGA, M.M., TADEU, A., and VEIGA, C. 2003. Clean artisanal gold mining: A utopian approach? *Journal of Cleaner Production*, vol. 11, no. 2. pp. 99-115.
- IHRIG, J. and MOE, K.S. 2004. Lurking in the shadows. *Journal of Development Economics*, vol. 73. pp. 541-557.
- INTERGOVERNMENTAL FORUM ON MINING, MINERALS, METALS AND SUSTAINABLE DEVELOPMENT (IGF). 2018. Global trends in Artisanal and small-scale mining (ASM): A review of key numbers and issues. A report for the International Institute of Sustainable Development, IISD.
- JAMASMIE, C. 2016. Illegal miners refuse to leave AngloGold's Obuasi operation. <https://www.mining.com/illegal-miners-refuse-to-leave-anglogolds-obuasi-operation/> (accessed 22 March 2020)
- KINYONDO, A. and HUGGINS, C. 2020. Centres of excellence' for artisanal and small-scale gold mining in Tanzania: Assumptions around artisanal entrepreneurship and formalization. *The Extractive Industries and Society*, vol. 7, no. 2. pp. 758-766.
- LEDWABA, P.F. 2017. The status of artisanal and small-scale mining sector in South Africa: Tracking progress. *Journal of the Southern African Institute of Mining and Metallurgy*, vol. 117, no. 1. pp. 33-40
- MALLO, S. 2011. Artisanal mining of cassiterite: The sub-surface (loto) approach. *Continental Journal of Environmental Sciences*, vol. 5, no. 2. pp. 38-50.
- MARIN, T., SECCATORE, J., DE TOMI, J., and VEIGA, M. 2016. Economic feasibility of responsible small-scale gold mining. *Journal of Cleaner Production*, vol. 129. pp. 531-536.
- McKENZIE, D. and SAKHO, Y.S. 2010. Does it pay firms to register for taxes? The impact of formality on firm profitability. *Journal of Development Economics*, vol. 91, no. 1. pp. 15-24.
- MUTEMERI, N., WALKER, J.Z., COULSON, N., and WATSON, I. 2016. Capacity building for self-regulation of the artisanal and small-scale mining (ASM) sector: A policy paradigm shift aligned with development outcomes and a pro-poor approach. *The Extractive Industries and Society*, vol. 3, no. 3. pp. 653-58.
- NOETSTALLER, R. 1995. Historical perspective and key issues of artisanal mining. Keynote address: *International Roundtable on Artisanal Mining*, 17-19 May 1995. World Bank, Washington DC,
- OMOTEHINSE, A.O. and AKO, B.D. 2019. The environmental implications of the exploration and exploitation of solid minerals in Nigeria with a special focus on tin in Jos and coal in Enugu. *Journal of Sustainable Mining*, vol. 18, no. 1. pp. 18-24.
- ORAMAH, I.T. 2013. Artisanal and small scale mining livelihoods in Nigeria: Drivers, impacts and best practices. PhD thesis, University of Alberta, Canada.
- ORAMAH, I.T., RICHARDS, J.P., SUMMERS, R. GARVIN, T., and MCGEE, T. 2015. Artisanal and small-scale mining in Nigeria: Experiences from Niger, Nasarawa and Plateau states. *The Extractive Industries and Society*, vol. 2, no. 4. pp. 694-703.
- OWOLABI, A. and OPAFUNSO, Z. 2017. Quality assessment of water bodies in selected mining communities of Plateau State, Nigeria. *Archives of Current Research International*, vol. 7, no. 1. pp. 1-7.
- PEDERSEN, R.H., MUTAGWABA, W., JONSSON, J.B. SCHONEVELD, G., JACOB, T., CHACHA, M., WENG, X., and NJAU, M.G. 2019. Mining-sector dynamics in an era of resurgent resource nationalism: Changing relations between large-scale mining and artisanal and small-scale mining in Tanzania. *Resources Policy*, vol. 62, December 2018. pp. 339-346.
- PERKS, R. 2016. I loan, you mine: Metal streaming and off-take agreements as solutions to undercapitalisation facing small-scale miners? *The Extractive Industries and Society*, vol. 3, no. 3. pp. 813-822.
- PLANETGOLD. 2020a. Unlocking finance for artisanal and small-scale gold mining. Report for Global Environment Facility (GEF). UN Environmental Programme.
- PLANETGOLD. 2020b. Access to finance: Options for artisanal and small-scale mining. Report for Global Environment Facility (GEF). UN Environmental Programme.
- REICHEL, V. 2019. Financial inclusion for women and men in artisanal gold mining communities: A case study from the Democratic Republic of the Congo. *The Extractive Industries and Society*, October 2018. pp. 1-8.
- SALDARRIAGA-ISAZA, A., ARANGO, S., and VILLEGAS-PALACIO, C. 2015. A behavioral model of collective action in artisanal and small-scale gold mining. *Ecological Economics*, vol. 112. pp. 98-109.
- SALDARRIAGA-ISAZA, A., VILLEGAS-PALACIO, C., and ARANGO, S. 2013. The public good dilemma of a non-renewable common resource: A look at the facts of artisanal gold mining. *Resources Policy*, vol. 38, no. 2. pp. 224-232.
- SECCATORE, J., VEIGA, M., ORIGLIASSO, C., MARIN, T., and DE TOMI, G. 2014. An estimation of the artisanal small-scale production of gold in the world. *Science of the Total Environment*, vol. 496. pp. 662-667.
- SIEGEL, S. and VEIGA, M.M. 2009. Artisanal and small-scale mining as an extralegal economy: De Soto and the redefinition of 'formalization'. *Resources Policy*, vol. 34, no. 1-2. pp. 51-56.
- SINDING, K. 2005. The dynamics of artisanal and small-scale mining reform. *Natural Resources Forum*, vol. 29, no. 3. pp. 243-252.
- SIWALE, A. and SIWALE, T. 2017. Has the promise of formalizing artisanal and small-scale mining (ASM) failed? The case of Zambia. *The Extractive Industries and Society*, vol. 4, no. 1. pp. 191-201.
- SPIEGEL, S.J. 2012. Microfinance services, poverty and artisanal mine workers in Africa: In search of measures for empowering vulnerable groups. *Journal of International Development*, vol. 24. pp. 485-517.
- SPIEGEL, S.J. and VEIGA, M.M. 2005. Building capacity in small-scale mining communities: Health, ecosystem sustainability, and the global mercury project. *EcoHealth*, vol. 2, no. 4. pp. 361-369.
- STOCKLIN-WEINBERG, R., VEIGA, M.M., and MARSHALL, B.G. 2019. Training artisanal miners: A proposed framework with performance evaluation indicators. *Science of the Total Environment*, vol. 660. pp. 1533-1541.
- VERBRUGGE, B. 2014. Capital interests: A historical analysis of the transformation of small-scale gold mining in Compostela Valley Province, Southern Philippines. *The Extractive Industries and Society*, vol. 1, no. 1. pp. 86-95.
- WORLD BANK. 2012. Implementation completion and results report (IDA-401120) on a credit in the amount of SDR 80.1 Million (US\$120 Million equivalent) to the Federal Republic of Nigeria for a Sustainable Management of Mineral Resources Project (SMMRP). World Bank Report No : ICR2258. Washington, DC.
- WORLD BANK. 2018. Financial Inclusion. The World Bank IDRD.IDA. 2018. <https://www.worldbank.org/en/topic/financialinclusion/overview> [accessed 6 June 2021].
- YANKSON, P.W.K. and GOUGH, K.V. 2019. Gold in Ghana: The effects of changes in large-scale mining on artisanal and small-scale mining (ASM). *The Extractive Industries and Society*, vol. 6, no. 1. pp. 120-28. ◆