

Formalisation of Artisanal and Small-Scale Mining in Ghana: A Critical Review of Key Challenges and the Way Forward

Akuba Bezeba Yalley 

Department of Mining Engineering, University of Mines and Technology, Tarkwa, Ghana
Email: abyalley@umat.edu.gh

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Abstract

The aim of donor circles and governments for a couple of decades now has been to formalise the Artisanal and Small Scale Mining (ASM) sector in a bid to optimise the benefits of the sector and to minimise the negative effects. ASM which occurs in many developing countries has been identified to be a significant contributor to economic growth, a huge employment generator and a contributor to rural development. In addition, ASM operations provide an alternative for mining smaller deposits which otherwise would have been uneconomical mining utilising Large Scale Mining (LSM) operations. Even though the sector presents significant economic benefits, the problem of the operations mostly occurring in the informal spaces with the associated consequences of illegalities, low recovery, environmental degradation and safety hazards has bedeviled the sector. In Ghana, illegal mining operations continue to pose serious environmental threats profoundly water pollution and safety threats to inhabitants. The government and various stakeholders have made several attempts to formalise the sector in a bid to control the negative impacts but such attempts have yielded little results. This study evaluates the formalisation challenges regarding ASM in Ghana and outlines the way forward. The study identified inadequate geological information, inappropriate mining methods, bureaucratic licensing and permitting procedure, poor monitoring and technological assistance, conflict of interest on the part of the actors of the implementation process and political interferences as the major challenges regarding formalisation. The study recommends incentivization of the formalisation process, governments investment in geological studies and ASM operations, inclusive policy making and implementation process, collaboration amongst various stakeholders and promotion of research in improved ASM methods and technology as key strategies to address the challenges.

Keywords

Artisanal and Small Scale Mining, Formalisation, Geological Data, Mining Technology, Sustainability

1. Introduction

The diversities and dynamisms in ASM have made it difficult to get a single globally accepted definition for the sector (De Haan et al., 2020). In practice, the sector is seen in different lights in different countries, as it is in different developmental stages in different countries thereby resulting in different concepts of definition and definitions across the globe (Amegbey et al., 1997; Avila, 2003; Hentschel et al., 2003; Salati, 2015; Bansah et al., 2016). International Organisations such as the United Nations (UN), International Labour Organization (ILO), etc., have defined ASM based on the objectives of the organisations. According to Eshun and Mireku-Gyimah (2002) and Hentschel et al. (2003), individuals, countries and organisations have based the concepts of their definitions on the sizes of operations, capital investments, techniques of operations, number of workforce, concession sizes, reliability of operations, operations sustenance, management structure, output of the mine and legislative requirements as shown in Table 1. Dreschler (2001) explained that the historical, economic, developmental, geological and social conditions of the sector in the various countries vary in numerous cases. For instance, in developed countries, the sector has evolved into formal businesses which operate similarly to the Large Scale Mining (LSM) operations except that the ASM operations are smaller in terms of operational sizes (Hilson, 2003). However, ASM in most developing countries is facing challenges with regards to regularization, enforcement of laws, inadequate geological information, techniques of operations, sustainability and the generation of intense negative environmental, safety, security and socio-economic impacts which are similar to that of any informal enterprise (Hilson, 2003). Table 1 summarises the criteria for ASM definitions by various organisations and countries.

Noetstaller (1987) explained that ASM has been in existence since human beings learnt the importance of exploiting natural resources for the manufacture of tools, equipment and infrastructure. In essence, ASM has been an ongoing activity since the dawn of civilization through to date (Noetstaller, 1987). This economic activity occurs in 80 countries across Africa, Asia, Oceania, Central and South America with estimated employments of about 44.5 million globally (Fritz et al., 2018; Schwartz et al., 2021).

ASM obviously is an important economic activity of which if account is taken off presents a host of positive attributes. The miners exploit a wide range of minerals and collectively produce significant quantities of minerals with production in some countries being equal to or more than production from LSM. ASM is noted to produce about 20% of the global gold production, 90% - 100% of the global

gemstones and 80% - 100% of the global diamond production (Fritz et al., 2018). In Ghana, gold production from ASM has seen a tremendous growth between year 2000 to 2019 (see Table 2). This increment accounts for Ghana overtaking South Africa in 2018 to become the leading producer of gold in Africa. ASM produces 75% of the bauxite in China and 100% of diamond in Ghana (Boaduo, 2022; Fritz et al., 2018). In addition, construction materials such as sand and gravels are produced during the processing of gold. Moreover, employment generated from the sector presents the highest numbers in the mining industry. For instance, ASM accounts for about 90% of the total global gold mining employment (Hruschka, 2012; Yalley, 2024; Yalley et al., 2025a, 2025b).

Table 1. Criteria for ASM definitions by selected Organisations and countries.

Organisations/Countries	Criteria for Definitions
United Nations (UN)	Capital investment, annual and daily output, annual sales, total workforce and life of mine
International Labour Organization (ILO)	Concluded that the definition should be bestowed on the relevant controlling agency
Intermediate Technology Development Group (ITDG)	Poverty-driven nature, mining technique and types of tools
World Bank Group	Poverty-driven nature, place of occurrence, levels of literacy and mining expertise
Cote d'Ivoire	Level of mechanisation
Ethiopia	Annual production, level of mechanisation
Ghana	Capital investment, number of participants, size of concession
Guinea	Types of minerals exploited
Senegal	Depth of working, crude production levels
South Africa	Capital investment
Tanzania	Capital investment, labour and technology requirements
Zambia	Size of concession
Zimbabwe	Size of concession, capital investment
Mali	Level of geological exploration, mining techniques, level of mechanisation
Nigeria	Legality, formality, availability of resources for mineral exploration, capital investment and mining technology
Brazil	Annual production
China	Annual production

Sources: Dreschler 2001; Aryee, 2003; Azevedo, 2011; Mallo, 2012; Bansah et al., 2016; Mutagwaba et al., 2018; Abdurashidovich, 2020.

The industry also supports local businesses in the countries in which they occur. These come in the form of supply of goods and services provision. The rural folks who otherwise may not have had any forms of employment, have the sector as a source of income generation or in some cases the only source of income available to them. In addition, the sector serves as a source income generation and foreign exchange earnings for the various governments which have ASM operations in their

countries. Income generation comes in the form of taxes and royalty payments from the licenced operations, various licences and permits fees paid to the governments. In many cases, the development of the rural communities having such operations reduces the rural-urban migration trend which tends to overcrowd the cities and putting much pressure on the facilities within the cities. In addition, the sector provides an alternative for mining relatively smaller deposits which otherwise would not have been economically viable mining using LSM techniques.

Table 2. Comparative gold production in Ghana: LSM versus ASM.

Year	Large Scale Producers, Oz	Small Scale Producers, Oz	Total Ghana Production, Oz	% of Small to Total Ghana
1990	517,818	17,234	535,052	3.2
1991	825,114	15,601	840,715	1.9
1992	976,223	17,297	993,520	1.7
1993	1,222,344	35,145	1,257,489	2.8
1994	1,338,491	89,520	1,428,011	6.3
1995	1,581,506	127,025	1,708,531	7.4
1996	1,474,746	112,349	1,587,095	7.1
1997	1,677,911	107,097	1,785,008	6.0
1998	2,244,819	128,334	2,373,153	5.4
1999	2,358,423	130,833	2,489,256	5.3
2000	2,168,802	145,662	2,314,464	6.3
2001	2,184,313	185,596	2,369,909	7.8
2002	2,075,954	160,879	2,236,833	7.2
2003	2,085,070	221,063	2,306,133	9.6
2004	1,783,400	246,570	2,029,970	12.1
2005	1,913,534	225,411	2,138,945	10.5
2006	2,095,553	247,063	2,342,616	10.5
2007	2,239,678	388,594	2,628,272	14.8
2008	2,378,012	418,943	2,796,955	15
2009	2,564,095	555,737	3,119,832	17.8
2010	2,624,391	767,196	3,391,587	22.6
2011	2,697,612	978,611	3,676,223	26.6
2012	2,842,585	1,481,670	4,324,255	34.3
2013	2,868,763	1,528,224	4,396,987	34.8
2014	2,960,583	1,510,990	4,471,573	33.79
2015	2,592,564	1,031,176	3,623,740	28.45
2016	2,576,489	1,283,791	3,860,280	33.26
2017	2,807,025	1,424,351	4,231,376	33.66
2018	2,813,913	2,130,155	4,944,068	43.1
2019	2,994,771	1,679,203	4,673,974	35.93

Source: Minerals commission annual report 2020.

Despite the positive contributions of the sector towards economic growth, it is a highly informal sector with aggravated negative impacts such as water pollution, land degradation, health and safety problems, air pollution, illegalities and conflicts generation. Governments and donor circles in a bid to solve these problems have resorted to formalisation but this has woefully failed. Although considerable scholarly attention has been devoted to ASM formalisation, existing studies have predominantly examined the subject from legal, regulatory, environmental, or socioeconomic perspectives, with comparatively limited emphasis on the technical and geological prerequisites required for sustainable formalisation. In Ghana, the discourse has largely focused on licensing, regulatory compliance, and the environmental consequences of illegal mining, while insufficient attention has been paid to the interrelationships among geological information, mining technology, institutional capacity, policy implementation, and governance in shaping formalisation outcomes. Consequently, the fundamental technical and institutional barriers that continue to drive informality remain inadequately synthesized within a single analytical framework. This paper addresses this knowledge gap by providing a critical review of the principal challenges hindering the formalisation of the ASM sector in Ghana, integrating legal, institutional, geological, technological, financial, and governance perspectives. Unlike previous studies that examine these issues in isolation, this review demonstrates that successful ASM formalisation requires a holistic and integrated approach that extends beyond legalisation to include reliable geological information, appropriate technologies, effective institutional support, participatory governance, and evidence-based policy implementation. The paper therefore seeks to identify the key constraints undermining the formalisation process and to propose strategic policy interventions that can enhance the sustainability, productivity, and long-term governance of Ghana's ASM sector.

2. Materials and Methods Used

Relevant literature on the formalisation of Artisanal and Small-Scale Mining (ASM) in Sub-Saharan Africa, with particular emphasis on Ghana, as well as the broader concepts of formalisation, was sourced from several scientific databases, including Academia, ResearchGate, Google Scholar, and Google. The literature search covered publications from 1987 to 2025 and was conducted in August 2023. These databases were selected because they provide extensive access to peer-reviewed publications, along with comprehensive citation and indexing services.

The search was conducted using the keyword "Formalisation in Artisanal and Small-Scale Mining". A total of 91 articles were initially retrieved and manually screened across the selected databases. Following the removal of 28 duplicate records, 63 unique articles remained for further assessment. These articles were subsequently screened based on their abstracts, methodologies, and findings to determine their relevance to the study. After applying the inclusion criteria, 31 articles

were identified as directly relevant, focusing specifically on the formalisation of ASM in Sub-Saharan Africa, particularly Ghana, and were therefore included in the final review.

3. What Is Formalisation?

Formalisation is defined as the process of transforming informal activities or enterprises into formal types through public policies and regulatory instruments designed to foster growth (Laing et al., 2022). During the formalisation process, explicit rules, regulations, policies and procedures are enacted to govern the organizational activities (Laing et al., 2022). A formalised industry is an industry that has legal recognition to operate, is duly registered, pays all the necessary taxes and adheres to all regulations outlined for responsible operations.

Governments in several countries work to create the best conditions for private sector growth and sustainability regardless of the operational sizes and outputs (Foster & Rana, 2019). However, many industries continue to operate illegally without registration or taking the necessary steps to guarantee conducive working conditions for the growth of their businesses and the general well-being of their employees and the surrounding communities (Foster & Rana, 2019). The issue of formalising the diverse informal industries was gaining global attention before the International Labour Conference (ILC) adopted a Recommendation Concerning the Transition from the Informal to the Formal Economy (R204) in 2015 (Foster & Rana, 2019). It was estimated in 2015 that about 61% of the global workers were engaged in informal activities. In order to address the complex problems regarding the transition from an informal industry to a formal industry, the Women in Informal Employment: Globalising and Organising (WIEGO) indicated that policy makers should start by listening to the informal workers. For effective formalisation, the WIEGO report outlined 5 basic considerations to be made by policy makers which have been outlined below as (Foster & Rana, 2019):

1) Formalisation should be a two-way exchange between governments and the industries. Attention should therefore shift from just making sure that businesses get registered and taxed. The formalisation policies should be incentivised to attract the mass of informal businesses into the main economic stream;

2) The misconception that the informal sector does not contribute to economic growth should be relegated before realistic and sustainable policies can be developed;

3) Formalisation should not be generalised but policies should be made to address the different needs of the diverse enterprises;

4) The best path to formalising is different for every country and even within different parts of a country. A local, consultative process is needed to get it right; and

5) Policy making and implementation should not be a top-down approach but informal workers should be involved in the policy making and implementation process.

3.1. What Is Formalisation within the ASM Context?

De Haan et al., 2020 defined ASM formalisation as “a process that ensures that ASM actors are licensed and organised in representative entities that represent their needs; policies are implemented, monitored, and enforced; and ASM actors receive technical, administrative, and financial support that empowers them to adhere to requirements prescribed by national regulations”. Legalisation of ASM was defined as “a process that ensures that ASM actors possess the licenses and permits required by national law” (De Haan et al., 2020). It can therefore be deduced from the definition that the formalisation process does not only entail the formulation of policies and regulations, but it also involves empowering the miners to adhere to the policies and implementation of the laws to integrate the ASM industry into the formal economy.

A body of literature on ASM formalisation are of the view that formalisation of the sector is a process rather than a product and as such revolves around a number of dimensions (Davidson, 1993; Spiegel & Veiga, 2010; Hilson et al., 2017; Barreto et al., 2018; De Haan et al., 2020; Fritz et al., 2018). Spiegel & Veiga (2010) emphatically explained that formalisation goes beyond just policies formulation as even the most elaborate policies are likely to fail if there are no systematic governmental implementation plans which the miners will not find to be costly and a threat. Furthermore, Spiegel (2012) concluded that legalisation happens to be just one dimension of the formalisation process, as such formalisation can only be achieved if policies and implementation programs deal with the various dimensions of ASM operations concurrently and in an integrated manner. De Haan et al., 2020 gave the dimensions of ASM formalisation to be legal, institutional, financial, socio-economic and geo-environmental.

3.2. What Is Policy?

Torjman (2009) explained that there is no simple answer to what policy is. The research disputed the claims that some people make that policy does not affect any aspect of their lives (Torjman, 2009). Torjman (2009) in evaluating the concept of policy from a general perspective established that in fact policies affect the quality of air people breath, the quality of water, agriculture, the supply chain, the transportation systems, it controls the tax regimes and all other aspects of human lives. Various researchers have come up with different definitions of policies. Eshun (2020) simply defined policies as “general statements which guide managerial decision making and control the behaviour of employees in an organisation”. Howlett and Cashore (2014) defined policies as “actions which contain goal(s) and the means to achieve them, however well or poorly identified, justified, articulated and formulated”. Wies (1994) showed that there are different definitions of policy based on the complexity of management tasks.

3.3. Policies Governing ASM in Ghana

ASM laws in Ghana were first promulgated in 1989 by the Small Scale Gold Min-

ing Laws (PNDC Law) in attempts to formalise the sector following governments realization of the amount of gold smuggled out of the country by the illegal miners. The laws were annulled in 2006 by the Mining and Minerals Act 2006 (Act 703). Although the Minister of Lands and Natural Resources is in charge of granting an ASM licence, application is to be made through the Minerals Commission. The Minerals Commission, an institution which regulates the mining sector of Ghana, established Small Scale Mining District Offices in designated operational districts with the aim of decentralising the licencing process and promoting strict monitoring. ASM operations in the country are also regulated by the *Minerals and Mining Regulations 2012* (L.I. 2182). ASM policies are documented in Sections 81 to 99 of the Act 2006 whereas Regulations 469 to 492 of the L.I. 2182 make provisions for small scale mining (*Minerals and Mining Act 703, 2006; Minerals and Mining (Health, Safety and Technical Regulations), 2012*).

The Ghanaian ASM laws reserve ASM for only Ghanaians forbidding foreigners from partaking in ASM operations in the country. Application for ASM licence can be made for a maximum period of 5 years subject to renewal for further periods. Also, an ASM licence can only cover a maximum concession size of 25 acres of land. Licence application can only be made once an individual or a corporate has been registered by the District Office closer to the intended operation site. Upon registration, an application will be made to the District Office with the requisite requirements provided which will then be submitted to the Head Office of the Minerals Commission for subsequent reviewing. The Minister of Lands and Natural Resources then grants or disapproves the grant of a licence based on the recommendation of the Commission. The laws permit the use of explosives only under the approval of the Chief Inspector of Mines and also permits the use of mercury in the processing of the ore (*Minerals and Mining Act 703, 2006; Minerals and Mining (Health, Safety and Technical Regulations), 2012*). In order to fastrack the registration and licencing procedure, the Mineral Commission has introduced the Mining Cadastre Administration System (MCAS) software, a digitalized licensing process to fastrack the registration process and reduce the human errors in the process. However, the final process of licencing is manually done by the Minister.

4. ASM Formalisation Challenges in Ghana

Although the concept of ASM formalisation was construed several decades ago, this concept is yet to be really actualised (*Davidson, 1993; Hilson et al., 2017; Barreto et al., 2018; De Haan et al., 2020; Fritz et al., 2018*). The delay in formalising the sector has been attributed to a range of challenges impeding the process. *Salati (2015)* cited poor ASM management as the main reason for the informality within the sector. It was further explained that if the twin problems of illegality and informality associated with the sector are addressed, the sector will be easier to handle (*Salati, 2015*). *Hilson et al. (2017)* observed that the policies and regulations which are formulated to govern the sector are mostly irrelevant and in some cases

actually bedevil the formalisation process. Hilson (2020) reiterated this point by explaining that majority of the ASM workforce are pushed under the informal umbrella by the inflexible regulatory tools and policies. De Haan et al. (2020) alluded that the approach to formalisation process is the main challenge to the process. It was further explained that the top-down approach of policies formulation and the fact that the miners are not involved in the policy formulation and the formalisation process sets the stage for its failure (Kuma & Yendaw, 2010; Dehaan et al., 2018). Others have also expressed their views that the formalisation process has not exploited the technological needs of the miners, thereby setting the stage for an unsustainable sector (Salati, 2015; Bansah et al., 2016; Dumakor-Dupey & Bansah, 2017; De Haan et al., 2020). According to De Haan et al. (2020), the challenges facing the formalisation process have the tendency to create inequalities and cause friction between the government and the citizens if not addressed. The sections below explain the various challenges facing the formalisation of ASM in Ghana with the view of bringing out the areas of concern which need to be addressed.

4.1. Insufficient Geological Information

Geological information happens to be the bedrock information required to establish a mine as it forms the basis upon which the feasibility and the viability of a mining project is established. De Haan et al. (2020) stated explicitly that geological prospecting for viable ore deposits is the vital point to begin the ASM formalisation process. Formalisation is therefore required to incorporate the occurrence, distribution, quantity and availability of the ore deposits (De Haan et al., 2020). Geological information required to establish the viability of a mineral project according to Mireku-Gyimah (2016) include:

- 1) A map and good description of the regional and local geology.
- 2) Thickness of overburden.
- 3) A good description of the country rocks (hanging and footwalls).
- 4) Plans and sections and a good description of the mineable orebodies.
- 5) Size and orientation of orebody including the depth, dip, strike and thickness.
- 6) The continuity or discontinuity within the mineralized zones.
- 7) The distribution of various minerals in the mineable orebodies.
- 8) The sharpness between mineralized zones and waste material.
- 9) Presence of alteration zones in both mineralized and waste zones.

It has been observed that there is a lack of geological information or insufficient geological information to base the viability of the small scale mining projects in the country on (Davidson, 1993; Hilson & Maponga 2004; De Haan et al., 2020). Hilson and Maponga (2004) explained that the unavailability of geological data and land for ASM is a major barrier to the formalisation process. Ideally, it is the responsibility of state institutions to carry out exploration and block out potential mining areas to be handed over to the miners. In Ghana, it is the responsibility of

the Ghana Geological Survey Authority (GGSA) to carry out exploration for ore reserves and delineate the ore blocks to be given to the miners through the Minerals Commission. The Ghana Geological Survey Authority (GGSA) formerly the Geological Survey Department (GSD), was established in 1913 to carry out detailed exploration programme to block out mineable reserves and publicize the geological information. [Boamah \(2017\)](#), quotes the Section 3(b) of the GGSA Act 928 which states that “the GGSA shall conduct geological, geochemical, geophysical, seismological, hydrogeological, geotechnical and geo-environmental surveys, mineral exploration, systematic mapping of rocks and other geological or geoscience materials including soil and clays of the Republic of Ghana, both onshore and offshore”. However, the GGSA lacks funding to carry out detailed exploration work. At best what the institution does is to undertake geological mapping, which only informs the presence of minerals but does not quantify the mineral value. Therefore, those mapped up areas which are awarded to the ASM miners does not give them enough information about the mineral quantity and in essence the establish the economic viability of the mining projects. And it is this practice that is leading to the “trial and error” mining where the miners invest in concessions where they do not know the revenue that will be generated from the concessions. If the miners run at losses, they eventually lose hope in the institutions and eventually prefer to operate anywhere at all since the assigned mining concessions from the state institutions did not yield profits.

In order to solve this problem, some countries hold the miners accountable to carry out their own exploration, in which cases they are required to secure exploration licenses to carry out such exploration works. It is only when the economic viability of the discovered deposits has been established that they are granted mining licenses. For instance in Tanzania, a primary licence is issued for prospecting and mining but mining can only proceed upon the provision of satisfactory evidence of availability of viable ore deposits. However, that is not the case in Ghana, rather the miners are given the licences without proving the mineral value of the concession. The Minerals Commission is of the view that the miners will use the initial years of the 5-year licence period to carry out exploration and use the remaining years for the exploitation. This is definitely impossible as the miners lack the financial and technological resources to carry out exploration. Unable to assess geological information, majority of the miners are forced to mine illegally. This is because the illegality gives them freedom to exploit concessions upon concessions without being restricted to stay on invaluable registered concession.

4.2. Biasness in Awarding Mineral-Rich Concessions

[Dreschler \(2001\)](#) stated that an unformalized mining industry has the potential to result in social conflicts which will consequently result in misuse of land and land degradation. This is unfortunately the clear situation in the ASM sector. Whereas most governments seem to be working at achieving formalisation of the sector, the same governments are actually fueling the informality of the sector with their

biasness in concession awarding. Most of these governments favour the foreign LSM companies over the ASM companies in terms of concession awarding. Even though, it is obvious that ASM licences can only be granted over concessions which may prove to be economically inviable to mine using LSM methods, however, in certain cases concessions which are suitable for ASM operations are still awarded to LSM companies. A clear case is that of the Upper East region of Ghana, where all the ASM concessions have been taken over by a LSM company.

De Haan et al. (2020) observed that the preference for foreign multinational LSM companies over ASM companies is a global issue. This preference according to the study has resulted in demarcation of vast lands which contain deposits suitable for ASM operations to LSM companies. On the other hand, ASM companies are being awarded with concessions whose deposits are not viable economically to mine (De Haan et al., 2020). Siwale and Siwale (2017) give account of the Zambian government awarding concessions with little or no mineral value to the ASM miners. Hilson (2019) explains that governments in Sub-Saharan Africa tend to favour LSM operations over ASM operations in terms of mining policies, concessions awarding and all other terms related to mining operations. According to Hilson (2019) governments are biased because of the huge revenue (which come in the forms of different taxes, royalties, various permitting fees) which are collected with ease from the LSM companies even though the sector had failed to become the “growth-poles” in the subregion as initially predicted by the World Bank. Table 3 below shows the vast land sizes demarcated for LSM operations within the subregion.

Table 3. Land sizes demarcated for LSM operations within Sub-Saharan Africa.

Countries	LSM Landmarks and Operation Sizes
Ghana	25% of the country's land size of 238,533 km ² demarcated for reconnaissance, exploration and mining with 11 operating Large Scale Mines and 230 active prospecting licenses
Tanzania	LSM companies are awarded 150 km ² of land for reconnaissance and prospecting. Mining companies awarded concession sizes ranging from 220 km ² to 7200 km ² for mining over long periods.
Liberia	Large quantities of land areas demarcated for foreign LSM companies during the early days of the mining sector reform. Government approved 54 exploration licences covering a total land area of 12,150,446 acres in 2007 and 9 Mineral Development Agreements (MDA) covering about to 885,000 acres.
Democratic Republic of Congo	Foreign LSM companies allowed to own up to 50 permits, valid for five years with 400 km ² maximum land size each (or a combined land size of 20,000 km ²). There were 4353 exploration permits issued by government in September 2007, out of which 4246 belonged to foreign LSM companies. Large plots of land ranging from 21 000 km ² to 83 000 km ² had been awarded to foreign LSM companies for long periods.

Sources: Wallace and Lepol, 2008; Hilson, 2019.

Furthermore, the land tenure system in some of the countries are quite complex thereby inhibiting potential ASM miners from getting registered and acquiring licensed concessions to operate formerly. Whereas the Ghanaian government

through the Ministry and the Minerals Commission has the mandate to award concessions, ownership over lands mostly belong to the chiefs, clans and families who present the miners with unrealistic land tenure agreements systems. This leaves the miners who would have most likely registered and acquired permits to mine on concessions with no option than to engage in illegal mining. This constraint contributes to illegal mining, environmental degradation and the conflicts that are generated from illegal miner's encroachments on LSM companies' concessions (Hilson & Maponga, 2004; Yalley, 2019).

4.3. Long, Complicated and Expensive Licencing Procedures

Fritz et al. (2018) analysed the licensing procedures for ASM and concluded that the processes in most countries are long, expensive, tedious and burdensome. According to the research, most governments operate a centralised licensing system, which requires applicants to travel long distances to the capital cities before their documents could be submitted and processed. The licensing procedure is associated with so much bureaucracy which sometimes leaves the applicants documents missing at one point in time. Others are faced with the issue of having to wait for several months to years before their applications are approved. According to Fritz et al. (2018), some miners have confirmed having made informal payments to agents and corrupt governments officials before their licenses were processed and issued. This becomes a huge barrier to the formalisation process as most miners get discouraged from obtaining licenses to mine legally (Fritz et al., 2018).

Hilson et al. (2017) observed that governments in sub-Saharan Africa are creating bureaucracies including the licensing processes which are actually impeding the formalisation of the sector. De Haan et al. (2020) indicated that ASM licensing and regulations are the key factors required for the successful implementation of the formalisation process. It was further argued that there should be more than one mining license obtainable under the ASM umbrella for efficient formalisation. For instance, there should be different licences for mechanised and manual operations, underground and surface operations, hard rock, oxide and alluvial mining (De Haan et al., 2020). The ASM miners in Ghana were engaged in a stakeholder meeting to ascertain the challenges they face within the sector and the way forward. The miners were quick to identify that the licensing procedure was clouded with too much bureaucracy and also the centralised system of licensing was not helpful. It was furthermore explained that the roles of the traditional leaders in the licensing process was also not clearly stated. It was suggested that for an efficient formalisation process, the licensing procedure should be decentralised, free from bureaucracy and the Small Scale Mining Associations should support in the licensing process (Kumah, 2022).

4.4. Poor Policy Frameworks

It can be observed that many governments have made attempts to formalise ASM by first of all legalising the operations and formulating policies to regulate the

sector (Salati, 2015). Unfortunately, the policies formulated have actually fostered informality within the sector as the concept behind the policies have mainly been focused on getting the miners registered to pay all the fees and taxes to the governments instead of ascertaining the problems inhibiting the miners from operating within the formal “spaces” and looking for sustainable solutions to them (Spiegel & Veiga, 2010; Hilson, 2020; Hilson & Maconachie, 2017). Moreover, the policies have in many cases not taken into account the concerns of the miners, instead policies formulations have been construed in the top-down approach, that is based on governments visions of how the sector should look like. In evaluating the laws governing ASM in Ghana and the implementation of the process, Kuma and Yendaw (2010) argued that the laws do not consider the set-up and the concerns of the miners. It is seen that majority of the miners about 80% globally according to (Fritz et al., 2018) choose to remain illegal and operate in an informal manner because they see the policies as ways in which governments seek to exploit them, as a result getting one registered and regulated will compel one to fall into that bait of being exploited.

4.5. Lack of Access to Financial Support

Franks (2020) emphasised that the lack of accessible and affordable funding for ASM operations has led to the underdevelopment and informality of the industry. The fact that the sector is mostly viewed as a poverty-driven venture does not make it credit credible in many countries. Besides, the many uncertainties coupled with the high risk, negative environmental impacts, health, safety and security hazards make it even more unattractive for investors who are looking out for promoting green production and the global Sustainable Development Goals (SDGs) to invest in. Moreover, the lack of adequate geological information and the difficulty in accessing mineral-rich concessions make it even harder for the miners to establish the economic viability of their operations to access the needed financial support. It can be seen that the formalisation process itself is quite costly, considering the various fees to be paid for getting registered and licensed, concession acquisition as well as all the other fees and taxes to be paid in the course of operations. Also, efforts to reduce the environmental impacts, health, safety and security hazards as well as a good reclamation programme come at a cost which are usually too much for the miners to finance especially for the poor miners who may be only looking for a means of livelihood.

Occasionally, donor organisations such as the World Bank have provided funds for exploration programmes in some countries in a bid to give the miners the needed information to help secure funds for their operations. They have also provided funds to some government agencies in a bid to properly resource them to carry out proper monitoring and implementation. However, in many cases these programmes have failed to achieve their objectives due to lack of commitment on the part of governments and the lack of coordination between governmental institutions in charge of regularizing their operations (Hilson, 2020).

4.6. Poor Policies Implementation and Inadequate Resourcing of Regulatory Institutions

McQuilken and Hilson (2016) cleared the misconception that ASM formalisation is just about the legal, regulatory and policy frameworks guiding sustainable the operations. But explained that the formalisation process also involves the extent to which those laws and regulations are activated, implemented and enforced by the relevant authorities (McQuilken & Hilson, 2016). Asamoah and Osei-Kojo (2016) emphasised that policy implementation can be a painstaking and frustrating process because the process is often faced with enormous challenges ranging from inadequate resources and logistics to the conflict of interest of the authorities of the implementation process. Therefore, the objective of formalising ASM can only be achieved with robust implementation of laws and regulations by all stakeholders, as without effective implementation policies tend to lose their significance (Asamoah & Osei-Kojo, 2016).

Franks (2020) pointed out the fact that formalisation of the sector has been stifled because the entire process has failed to address the challenges being faced by the miners such as availability of technology, proper land tenure system, financial support, market constraints and participatory economic development. Kuma and Yendaw (2010) also indicated that the ASM laws and the implementation process do not consider the set-up and the concerns of the miners. The top-down approach of policy implementation has failed and will continue to fail because the process is usually coined to favour governments gain income with nothing motivating the miners to be formalised. The situation is worse in Ghana where military force is been used to get them formalised which usually results in abuse of human rights and all sorts of conflicts. It is therefore worth noting that the challenges hindering the formalisation can only be resolved and the sustainable development of the sector can only be achieved if the miners are actively involved in the governance of the sector (Franks, 2020). The process should be such that the miners will see formalisation as an opportunity instead of a burdensome process.

Moreover, the process has failed because governmental agencies especially those within the developing countries responsible for regulating the activities of the miners mostly lack the necessary resources to effectively carry out their operations. They usually lack the needed human resources, financial resources and the technological resources to actively carry out monitoring and provide the needed technical assistance to the miners. In Ghana, the ASM District offices were established to foster adequate monitoring and provide technological assistance for the mining operations (Bansah et al., 2016). However, Bansah et al. (2016) state that the institution has not been able to provide the adequate technical support and monitoring of the miners citing the inadequate human and financial resources as the main challenges hindering the achievement of these mandates.

4.7. Formalisation Has Not Addressed the Technological Needs of the Miners

Mining is a capital intensive business irrespective of the scale of operations. The

venture requires improved technology in order to optimise operations and reduce the associated environmental, health, safety and security. It is therefore paramount that an economically viable and environmentally sustainable operation should start with a detailed exploration programme, accurate ore block modelling, proper feasibility studies, an appropriate selection of mining method, a good mine design and schedule, appropriate equipment and labour selection and selection of the best processing method for optimal ore recovery. All the above listed processes require some form of technology to achieve the best results. In certain cases, more than one technology is applied to select the most cost effective and highly productive technology.

In LSM operations, various technologies have been developed and are being used to achieve the objectives of the operations. Apart from the already developed technologies, researchers, technological experts, engineers, mining workers, manufacturers and service providers continue to work round the clock to come up with technological innovations and solutions to industry's challenges. For instance an exploration work involves the use of modern exploration drilling rigs such as the Diamond Drill rigs which is operated by an experienced operator for detailed exploration drilling. The drill cores and assay samples are then analysed by the exploration geologists and subsequently assayed at the Assay Laboratory to come up with accurate ore grade and tonnage prediction. The results are then used to design the block model which will be used for the feasibility study. The block model is done with the aid of computer-aided software such as Surpac, Hexagon MinePlan, Datamine, etc. The feasibility studies which is highly dependent on the exploration programme and block model is done by experts in mining experts, sometimes by independent consultants to come up with the best decision. This study is again done using modern cost analysis tools. The selection of the mining method is done by experts who use various technology available through to the processing stage.

However, the same cannot be said about the ASM sector which is seriously lacking in expertise and technology. It is observed that the ASM operations are not only neglected by governments, but also by researchers, mining experts and professionals, engineers, manufactures and service providers. There is a global skewed attention given to only LSM operations mainly due to the overall acceptance and the huge income generation capacity. It is very rare to see mining experts who have specialised in ASM, mining professionals mostly do not have any interest in working for ASM companies and there are very few researchers interested in ASM technology research and development of innovative technology. In addition, there is yet to be a mining software developed for ASM operations and majority of the mining service providers are solely for LSM operations. Most manufacturers have concentrated on LSM equipment and consumables manufacturing neglecting the ASM sector.

There is a clear indication that the sector has been neglected in terms of technological development even though majority of researchers and stakeholders have

stated the economic contributions of the sector towards the development of different economies and have called for improved technology as a way of sustainable development (Bansah et al., 2016). Policy makers, governments and implementers have failed to consider the technological needs of the sector in the formalisation process. In Ghana, there have been some conditions given in the mining laws geared towards compelling miners to use improved technology, there is still a gap as to the availability and accessibility of such technology. The issue of mining method selection is a huge problem as there are virtually minimal sustainable mining methods developed for the ASM terrain. Even though the Ghanaian policies require the miners to use the best mining methods, it is not enough considering that the sector lacks the professionals who would be able to ascertain the best mining methods. The mineral processing phase also requires more technological development. It is therefore needful that the formalisation process tackles the gaps in technology of the sector as a way of sustaining the industry.

4.8. Conflict of Interest and Political Interference

The institutional framework of the ASM sector has set the pace for the informality of the industry. For instance, too much power has been given to the Minister of Lands and Natural Resources and the national headquarters of Minerals Commission. The district offices have been marginalized in the control of the industry. The fact that only the Minister can approve a license gives too much room for governmental control which mostly favours political party members and also encourages corruption. Some miners have even expressed that certain individuals within the regulatory institutions have portrayed themselves as consultants who could help award mineral – rich concessions for the miners.

4.9. Synthesis of the Formalisation Challenges

The foregoing discussion demonstrates that the barriers to ASM formalisation in Ghana are highly interconnected and mutually reinforcing rather than occurring in isolation. Inadequate geological information increases uncertainty regarding the economic viability of mineral deposits, making it difficult for miners to secure finance, invest in appropriate technologies, or justify the costs associated with formalisation. At the same time, cumbersome licensing procedures and inequitable access to mineral-rich concessions discourage legal participation, further limiting miners' access to formal financial services and government support. Weak institutional capacity, characterised by inadequate technical expertise, financial resources, and monitoring capability, undermines effective policy implementation and restricts the provision of extension services needed to improve mining practices. These institutional shortcomings, combined with limited access to finance, constrain the adoption of appropriate mining and mineral processing technologies, resulting in low productivity, poor environmental performance, and continued informality. Consequently, formalisation should not be viewed as a legal or administrative exercise alone, but as a systemic governance challenge requiring

coordinated interventions that simultaneously address geological uncertainty, licensing reforms, institutional strengthening, financial inclusion, and technological development.

5. The Way Forward

The formalisation process is not just about the formulation of policies and regulations, but it also entails the successful implementation of those policies and regulations (McQuilken & Hilson, 2016). It can be observed that the formalisation of the Ghanaian SSGM sector has not been entirely successful. The sections below indicate the strategies to used towards achieving sustainable formalisation and reducing the negative environmental, safety, economic and social impacts.

5.1. Inclusive Policy Making and Implementation Process

The active participation of ASM miners in the formulation, implementation, and evaluation of policies is critical to the success of formalisation initiatives. Adopting a participatory and inclusive governance approach ensures that policies are informed by the operational realities, socioeconomic conditions, and constraints experienced by ASM stakeholders. Such stakeholder engagement enhances the legitimacy, transparency, and contextual relevance of regulatory frameworks while fostering a sense of ownership among miners. Consequently, ASM miners are more likely to perceive the formalisation process as equitable and responsive to their needs, thereby increasing their willingness to comply with regulatory requirements and actively support policy implementation. Furthermore, meaningful stakeholder participation promotes trust between government institutions and mining communities, facilitates knowledge exchange, reduces resistance to regulatory interventions and strengthens the long-term effectiveness and sustainability of formalisation strategies.

5.2. Access to Geological Data

Governmental institutions should ensure that non-confidential geological data generated through publicly funded exploration programs are systematically disseminated and made readily accessible to prospective and existing ASM miners. Improved access to geological information can enhance resource efficiency, reduce indiscriminate mining activities, and promote environmentally responsible extraction practices. Furthermore, there is a critical need for government agencies, particularly the national geological survey and related institutions, to undertake systematic exploration programs to delineate economically viable mineral deposits suitable for ASM. Such initiatives would facilitate the identification and demarcation of mineralised zones for legal ASM operations, thereby reducing encroachment into environmentally sensitive areas and minimising conflicts over mineral rights. Publicly funded exploration programs can also lower the financial and technical barriers that often prevent ASM operators from accessing geologically prospective concessions.

To maximize the effectiveness of these initiatives, robust governance, financial accountability, and institutional oversight mechanisms must be established to ensure that funds allocated for geological exploration are utilized exclusively for their intended purposes. Transparent procurement procedures, independent financial audits, periodic project evaluations, and public disclosure of exploration expenditures and outcomes are essential to prevent the misappropriation of resources and improve public confidence in government-led exploration programs. Such measures would help eliminate the recurring pattern of contracting substantial external loans for exploration activities without the successful execution or completion of the proposed projects.

In addition, the long-term financing of national geological exploration programs should prioritize the mobilization of domestic financial resources over excessive reliance on external borrowing. Sustainable financing mechanisms—including dedicated mineral development funds, mineral royalty allocations, public investment, and strategic public-private partnerships—can provide a more resilient and fiscally responsible approach to supporting exploration activities. Reducing dependence on external debt would not only minimise fiscal risks but also enhance the continuity of geological investigations and ensure the sustained availability of high-quality geoscientific information required to support evidence-based policymaking and the formalisation of the ASM sector.

5.3. Incentivization of the Formalisation Process

A comprehensive review of the existing policy, regulatory, and institutional frameworks governing the formalization of the artisanal and small-scale mining ASM sector is essential to ensure that the formalisation process is accessible, efficient, and responsive to the socioeconomic realities of ASM operators. Given that a significant proportion of artisanal miners engage in mining primarily as a livelihood strategy due to limited alternative employment opportunities, formalisation policies should be designed to reduce barriers to legal participation rather than inadvertently excluding economically vulnerable groups. An enabling regulatory environment that balances effective governance with socioeconomic inclusiveness is therefore critical to increasing participation in the formal sector.

Particular attention should be directed toward revising licensing regimes that impose excessive financial and administrative burdens on prospective ASM operators. High licensing fees, complex application requirements, prolonged processing periods, and multiple layers of administrative approval often discourage miners from obtaining legal mining rights, thereby perpetuating informality and non-compliance. Simplifying licensing procedures through streamlined administrative processes, digital service delivery, decentralized application systems, and clearly defined approval timelines would significantly improve accessibility while reducing transaction costs for miners.

Furthermore, efforts should be made to depoliticize the allocation of mineral rights and licensing decisions by strengthening institutional independence, trans-

parency, and accountability within the regulatory system. The influence of political parties, discretionary decision-making, and unequal access to mining concessions undermines confidence in the formalisation process and creates opportunities for corruption and regulatory capture. Establishing transparent, merit-based licensing procedures supported by objective eligibility criteria, public disclosure of licensing decisions, and independent oversight mechanisms would enhance fairness and improve stakeholder trust in regulatory institutions.

In addition, policy reforms should incorporate incentive-based approaches that encourage voluntary formalisation rather than relying predominantly on regulatory enforcement. Such incentives may include affordable and progressive licensing fees, simplified compliance requirements, access to geological information, technical assistance, financial services, equipment financing, and extension support for licensed ASM operations. By reducing the economic and institutional costs associated with formalisation while simultaneously increasing its perceived benefits, governments can create a more attractive and inclusive regulatory environment that encourages legal participation, improves regulatory compliance, and advances the long-term sustainability of the ASM sector.

5.4. Promotion of Research in ASM Systems

Increased investment in research and development on ASM systems should be prioritized by governments, academic institutions, development partners, industry stakeholders, and international organizations to generate the scientific evidence required for effective policymaking and sustainable sector development. Comprehensive interdisciplinary research is essential for improving the understanding of the technical, environmental, socioeconomic, institutional, and governance dimensions of ASM, thereby providing an evidence base for the design of context-specific formalisation strategies and regulatory interventions. Research efforts should focus on critical areas including mineral resource characterization, appropriate mining and mineral processing methods, occupational health and safety, environmental management, mine rehabilitation, mercury-free and low-impact extraction techniques, socioeconomic impacts, value chain development, and institutional governance. In addition, continuous monitoring and evaluation studies are necessary to assess the effectiveness of existing policies and formalisation initiatives, identify implementation gaps, and inform adaptive policy reforms based on empirical evidence.

Adequate and sustained funding mechanisms should therefore be established to support collaborative research involving universities, geological survey organizations, government agencies, mining associations, local communities, and international research institutions. Such partnerships facilitate knowledge exchange, technology transfer, and the development of innovative solutions tailored towards the operational realities of ASM. Furthermore, the findings from publicly funded research should be effectively disseminated to policymakers, regulatory institutions, and ASM operators through extension services, technical training, and

knowledge-sharing platforms to maximise their practical application. Strengthening the research ecosystem surrounding ASM will contribute significantly to improving resource efficiency, enhancing occupational health and safety, minimising environmental degradation, promoting responsible mineral extraction, and supporting evidence-based policymaking. Ultimately, sustained investment in scientific research and innovation will provide the technical foundation necessary for the successful formalisation and long-term sustainability of the artisanal and small-scale mining sector.

6. Conclusions

ASM remains one of the most significant contributors to employment, rural livelihoods, mineral production, and local economic development in Ghana. Despite these socioeconomic contributions, the sector continues to operate largely within the informal economy, resulting in widespread environmental degradation, occupational health and safety risks, low resource recovery, illegal mining activities, and conflicts over mineral resources. Successive governments have introduced legislative and regulatory reforms aimed at formalising the sector; however, the persistence and expansion of informal mining demonstrate that these interventions have achieved only limited success.

This review has shown that the limited effectiveness of ASM formalisation in Ghana is largely attributable to the narrow interpretation of formalisation as a legal and regulatory exercise rather than as an integrated process encompassing technical, institutional, economic, environmental, and governance dimensions. The study identified several interrelated constraints that continue to impede the formalisation process, including inadequate geological information, inequitable access to mineral-rich concessions, cumbersome and costly licensing procedures, weak policy and institutional frameworks, inadequate financial support, ineffective implementation of regulations, insufficient technical and technological assistance, political interference, and conflicts of interest within the governance system. These challenges reinforce one another and collectively discourage miners from participating in the formal sector, thereby perpetuating informality and limiting the effectiveness of existing regulatory interventions.

A major finding of this review is that the technological and geological foundations required for sustainable ASM have received inadequate attention within Ghana's formalisation agenda. Reliable geological information, appropriate mining technologies, technical extension services, and continuous professional support are indispensable prerequisites for economically viable, environmentally responsible, and legally compliant mining operations. Consequently, formalisation efforts that focus predominantly on licensing, taxation, and enforcement, while neglecting these technical requirements, are unlikely to produce the desired long-term outcomes.

The study further demonstrates that sustainable formalisation cannot be achieved through top-down regulatory approaches alone. Rather, it requires participatory

governance that actively incorporates ASM miners into policy formulation, implementation, monitoring, and evaluation. Such an inclusive approach enhances policy legitimacy, improves compliance, strengthens institutional trust, and facilitates the development of regulatory frameworks that reflect the operational realities of the sector. Equally important is the need to strengthen the institutional capacity of regulatory agencies by providing adequate financial, human, and technological resources to enable effective monitoring, technical support, and enforcement.

Ultimately, successful ASM formalization in Ghana will depend on adopting an integrated, evidence-based, and incentive-driven framework that simultaneously addresses geological uncertainty, technological limitations, institutional weaknesses, governance deficiencies, and socioeconomic constraints. Moving beyond a compliance-oriented model toward a development-oriented formalisation strategy has the potential to transform ASM into a more productive, environmentally sustainable, and socially responsible component of Ghana's mining industry. Such a transition would not only improve the livelihoods of ASM operators but also enhance national mineral governance, increase government revenue, reduce environmental degradation, and contribute significantly to the achievement of the Sustainable Development Goals (SDGs).

7. Recommendations

Based on the findings of this review, improving the effectiveness of ASM formalisation in Ghana requires the adoption of a comprehensive and integrated approach. Formalization should extend beyond legalization and licensing to include geological exploration, technological support, environmental management, institutional strengthening, financial inclusion, and continuous stakeholder engagement. Strengthening national geological exploration programmes through the Ghana Geological Survey Authority and ensuring access to reliable geological information would reduce exploration risk, improve investment decisions, and facilitate the allocation of economically viable mining concessions.

Reforming the licensing and concession allocation system is equally critical. Licensing procedures should be decentralized, transparent, time-bound, and cost-effective, while bureaucratic inefficiencies, political interference, and administrative bottlenecks should be eliminated. In addition, participatory governance should be institutionalized by actively involving ASM operators, traditional authorities, local communities, mining associations, civil society organizations, and other stakeholders in policy formulation, implementation, monitoring, and evaluation to enhance policy legitimacy, compliance, and long-term sustainability.

The effectiveness of formalization also depends on strengthening institutional capacity and promoting technological advancement. Regulatory agencies should be adequately resourced with qualified personnel, financial support, digital infrastructure, logistics, and modern monitoring technologies to improve oversight and enforcement. At the same time, governments, research institutions, and the

private sector should collaborate to develop affordable, context-specific mining technologies, supported by technology transfer, extension services, and continuous technical training. Expanding access to finance through concessional credit, equipment financing, mineral development funds, and public-private partnerships would further enable ASM operators to adopt improved technologies and implement sound environmental management practices.

Finally, enhancing transparency, accountability, and research is essential for achieving sustainable ASM formalization. Strong governance mechanisms, including independent oversight, periodic audits, transparent licensing processes, and accountable management of exploration funds, should be institutionalized to reduce corruption and build public confidence. Sustained investment in interdisciplinary research and innovation should also be prioritized to generate evidence that informs policy and practice. Collectively, these interventions provide a pathway toward a more inclusive, technologically advanced, and institutionally robust ASM sector capable of supporting sustainable mineral development, environmental stewardship, poverty reduction, and national economic growth in Ghana.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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