



AfricaMaVal

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Guideline on business models meeting ESG objectives

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Summary

This task includes the assessment and benchmarking of new business and operational models leading to fewer impacts and long-term legacies, responding to the ESG challenges posed by a mining sector that significantly relies on smallscale and artisanal mining. The final output will be a guideline on how to integrate ESG goals into business models in various African countries, which will also be part of the recommendations in WP5 and WP7.

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Executive Summary

This report explores business models for artisanal and small-scale mining (ASM) in Africa that aim to meet environmental, social and governance (ESG) challenges while supporting sustainable development of mineral supply chains connecting Africa and Europe.

The ASM sector plays a significant economic role in many African countries but faces challenges related to informality, poor working conditions, environmental impacts, and governance issues. At the same time, there is growing pressure from downstream buyers and consumers for responsibly sourced raw materials.

Key findings and recommendations include:

1. Formalisation of ASM should be seen as an end goal rather than a starting point. Many artisanal miners prefer to remain informal due to socio-economic factors and weak governance environments.
2. Sustainable business models require economic incentives aligned with ESG improvements. Examples include:
 - Delineation of official ASM zones by governments,
 - Symbiotic relationships between large-scale mining companies and ASM,
 - Formation of ASM associations or cooperatives to increase bargaining power,
 - Diversification along mineral value chains,
 - Development of mining clusters to concentrate activities and infrastructure.
3. Access to financing remains a major challenge for ASM. Potential solutions include:
 - Training for financial institutions on ASM-specific risks,
 - Mobile banking services to reach remote areas,
 - Equipment leasing and financing rather than cash loans,
 - Cooperatives to provide collective collateral.
4. Integration of ESG goals requires acknowledging that ASM often externalises environmental and social costs. Gradual improvements can be incentivised through:
 - Market access and price premiums for responsible ASM products,
 - Due diligence and traceability schemes,
 - Capacity building on ESG practices.
5. Tools such as the Triple Layer Business Model Canvas can help ASM operators and stakeholders visualise sustainability challenges and opportunities holistically.
6. Government policies should focus on creating enabling environments for responsible ASM through appropriate regulatory frameworks, infrastructure development, and formalisation support.

7. Downstream actors in the EU may need to pay premiums to see ESG ambitions fulfilled, while recognising that transforming the sector is a long-term process requiring sustained engagement and also improvements on governance at national and lower administrative levels.

By combining economic incentives, capacity building, appropriate policies, and market-driven approaches, ASM in Africa can evolve to better meet ESG expectations while supporting local development. EU policy-makers should contribute by leveraging trade and international cooperation policies to improve ASM conditions. Key actions include:

- Supporting capacity-building initiatives in countries where ASM significantly contribute to CRM production with a view to meet EU sustainability standards,
- Supporting the development of infrastructure in areas where it is possible to foster mining clusters,
- Encouraging EU companies to engage in long-term partnerships with responsible ASM operations,
- Developing preferential trade agreements that incentivise responsible ASM practices.

These recommendations require collaborative efforts between miners, governments, large-scale mining companies, buyers, and development partners.

Keywords

Mining, Artisanal and Small-scale Mining (ASM), Environmental, Social, and Governance (ESG), Business Models, Sustainable Development, Mineral Supply Chains, Trade Policies, Capacity Building, Mining Clusters, Responsible Sourcing.

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Abbreviations and Acronyms

Acronym	Description
ASM	Artisanal and Small-Scale Mining
CAPEX	Capital expenditures
CASM	Communities and Small-Scale Mining Initiative (World Bank)
CRM	Critical Raw Materials
ESG	Environment, Societal, Governance
ICMM	International Council of Mining and Metals
LSM	Large-Scale Mining
MFI	Microfinance institution
OHS	Operational Health and Safety
OPEX	Operational expenditures
VSLA	Village Savings and Loans Association
WP	Work Package

1. Introduction

1.1. Objectives

One of the overarching policy-goals of the EU is to ensure a fair, responsible, sustainable and sustained supply of (critical) raw materials (CRMA, 2023). It is acknowledged, that this goal still is far from being achieved for a wide variety of reason.

Much of the mineral endowment of Europe that is within comparative ease to reach has been extracted over the course of several thousands of years of mining. There are also a variety of minerals that have attained economic importance only in recent years and that are not found in economic quantities in Europe. For this reason, Europe has developed and continues to develop trade relationships with mineral resource-rich countries around the world. The Horizon Europe project AfricaMaVal (www.africamaval.eu) aims to develop and strengthen such relationships with African countries on an equitable footing with a view to create win-win situations for all parties (Elkington, 1994). It is considered of particular importance, that such business relationships are based on good environmental, societal and governance (ESG) standards.

While there is no universal agreement of what good ESG standards could or should be, there is a certain broad tacit understanding that environmental and societal impacts need to be reduced and that mining should not lead to undermining of certain minimum governance standards as expressed by indices such as the World Bank Global Governance Indicators (Kaufmann & Kraay, 2023), or the Global Corruption Barometer (GCB) – Africa (Transparency International, 2019).

Thus, the present report aims to explore business models applicable in the African context that would be conducive to achieving the EU policy-goals, creating at the same time a win-win situation for the African countries. It should be stressed that this work only concerns mineral supply-webs and not general development goals.

New business and operational models leading to less impacts and long-term legacies were to be explored, responding to the ESG challenges posed by a mining sector that, in many African countries, significantly relies on artisanal and small-scale mining (ASM) (cf. Awases et al., 2023).

Based on an assessment of various business models, including those applicable in an ASM context, guidance on how the ESG challenges can be met is provided. This aims to offer EU policy-makers and -implementers an overview of potential options and to help capital allocators to better understand potential solutions to the challenges posed by the informality of the ASM sector. In this sense, the current report complements recommendations coming out of other parts of the AfricaMaVal project (namely WP3, WP5, WP6, and WP7). It has to be understood, however, that the actual situation in individual African countries is quite different and may change quickly, so attempts to provide country-by-country guidance would be futile.

The set-up and character of extractive operations can vary considerably, from large multi-national companies to small single-person operations. In consequence, their capabilities to embrace good

governance aspirations, their societal impact, and their capabilities to minimise environmental impact varies also greatly.

It should be noted that most current business and economic models currently comprise only the very first stages of most mineral value webs, i.e. the extraction per se and often processes to obtain marketable concentrates. There is legitimate desire of the African countries to bring more of these value-webs to their own territories with a view to strengthen their industrial base. This requires, however, substantial amounts of investments into both, the respective industry as such as well as the supporting infrastructure (mainly transport and energy networks), technology transfer, and the development of the necessary skills bases. As can be seen from Awases et al. (2023), certain countries have already formulated policies into that direction, but it also requires for them to provide the right governance framework to attract these investments. As will be discussed in this report, another first step into this direction will be different modes of formalisation of ASM and buffering the socio-economic changes that this entails.

This report will focus on ASM operations, assuming that large, multinational operations will subscribe to international voluntary standards, such as those of the International Councils of Mining and Metals (ICMM, cf. <https://www.icmm.com/en-gb/resources>) or the Initiative for Responsible Mining Assurance (IRMA, cf. <https://responsiblemining.net/resources/#resources-standard>), and have the capability to improve their performance through their own means.

1.2. Why ESG goals?

We have to recognise above all that the drive to integrate ESG goals into business models are mainly borne out of the ethical framework of the Western world. Other cultures may have different ethical standards and normative systems, hence different attitudes towards topics, such as environmental protection, child labour, democracy, etc. It would be rather condescending to assume that other people of the world only have been waiting to adopt our Western world norms and values, even though their respective national governments may have signed up to UN conventions and such. The UN norms and values largely reflect the Western world traditions stemming from ideas developed from the Age of Enlightenment on. Reflecting on this may help to understand, why we perceive in the Western world challenges and obstacles to the adoption of our ESG goals in other parts of the world.

The business models under which miners operate reflect the prevailing economic, socio-political, environmental, socio-cultural and above all normative situation in the respective countries. The European desire for their supply-web actors to follow their ESG aspirations naturally come at a price for these actors and requires therefore additional efforts and costs on their side. This in turn means that sufficient incentives need to be provided to those upstream actors.

It is, however, not only an economic question, but often also a question of awareness and of training and education. Up-stream actors may be willing to adopt ESG goals, but may not have the necessary knowledge to overcome the technological, socio-cultural, or normative barriers (Buxton,

2013). Often it is not actually a barrier, but rather a threshold, a threshold that can be both, material and immaterial. Overcoming such economic or socio-cultural thresholds can result in objective benefits to the individual, such as, for instance, improved occupational safety and health (OSH) or improved market access. But it requires upfront investment of money and/or time. Education and training can help to understand that overcoming the threshold can or will lead to a win-win situation for both, miners and value-web members downstream.

Based on these broad observations a number of strategies for integrating the ESG goals into business models can be envisaged.

1.3. ESG Reference Frameworks

Any mining company will have to operate within the regulatory and policy framework of their respective country. However, certain frameworks are more conducive to improving ESG conditions than others. The regulatory framework may also implicitly prohibit certain types of business models or they may not be compatible with the socio-cultural context.

ESG requirements and their specific conditions in the various African countries have been investigated for AfricaMaVal (Awases et al., 2023). To guide these country assessments, which essentially covered the whole continent, an (unpublished) guidance document was developed. For this guidance document a range of ESG challenges had been identified (cf. Appendix 1). These will provide the reference framework for assessing the various types of business, operational, and financing models.

The categories of challenges outlined in Appendix 1 are indicative, as the structure of the country-specific rules and regulations may vary and may be covered by different sets of laws in each country. There may be also not so clear delimitation between different laws and policy documents.

When the AfricaMaVal country assessments were developed (cf. Awases et al., 2023), a catalogue of issues was compiled that guided these assessments. The tables in Appendix 1 listing the ESG-related aspects are based on this catalogue. They may shape the business models in general and may also determine the kind of business that can be implemented in any one country. The business and operational models investigated, as well as the related financial aspects have been reviewed with respect to their capabilities to address the issues below in a satisfactory manner. Just as one example, many business models under which ASM operate do not allow for managing potential mining legacies adequately, either for lack of financial resources or for lack of adequate technological knowledge. Such elements would need to be made an integral part of the business models to arrive at responsible mining operations.

ESG challenges in the African mining sector were investigated further in AfricaMaVal Task 4.2 through specific desk research and interviews with mining experts. In this case, for each E, S and G pillar, dimensions and sub-dimensions of interest were identified, leading to the collection of insights into specific impacts of mining operations on the various dimensions of interest. Results were organised in a hierarchical framework comprising four layers denominated *pillars*,

categories, aspects, and impacts. The first three layers of the framework are represented in Figure 1; further details are provided in the AfricaMaVal deliverable D4.2 (Ghezzi et al., 2024). This hierarchical categorisation can also inform the assessment of business models with respect to their potential to address sustainability challenges in the African mining industry. As the challenges identified in the framework were directly validated by field experts, the coverage of the business models spectrum can be considered as an indicator of correspondence to ESG challenges in the African mining sector.

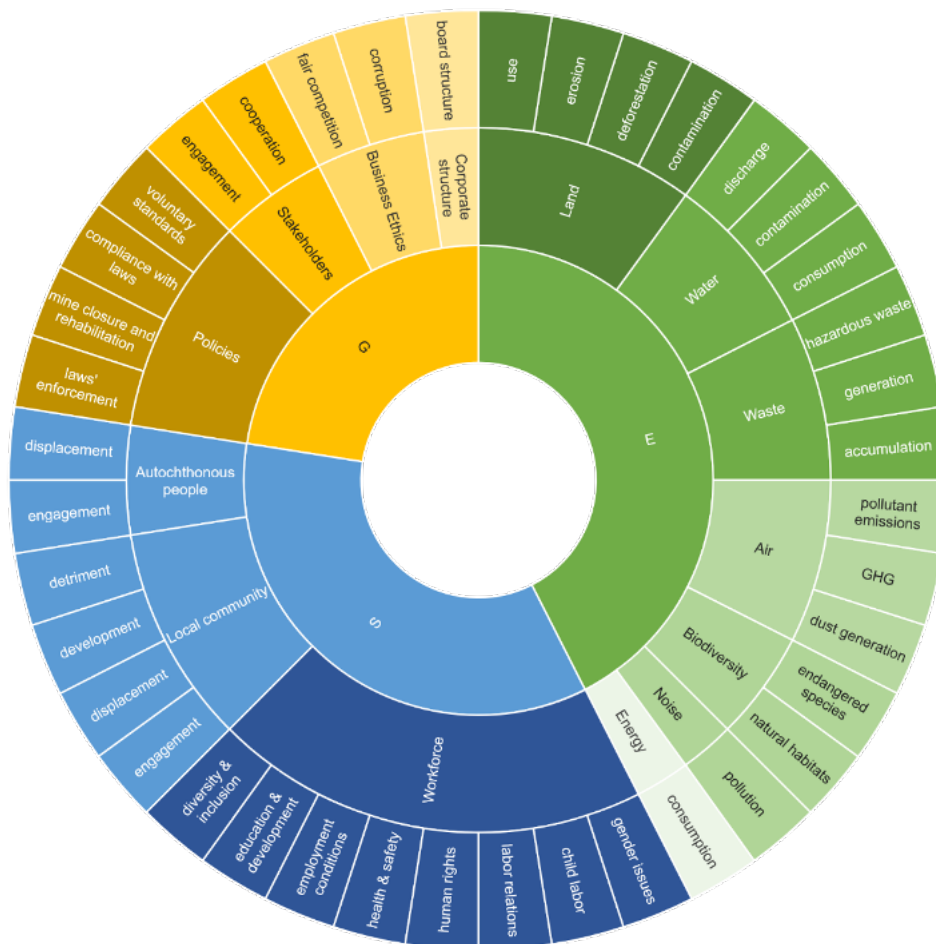


Figure 1. ESG framework developed in AfricaMaVal Task 4.2
(Ghezzi et al., 2024)

2. Approaches to Value Creation in Mining

2.1. Key value drivers and risk factors

At its core, mining is a capital-intensive industry that requires substantial upfront investments in exploration, development, and infrastructure. The primary value driver is the ability to discover and extract valuable mineral resources efficiently and profitably. However, business and operational models can be combined or adapted based on the specific needs, resources, and risk profiles of the mining companies involved. Additionally, regulatory frameworks, environmental considerations, and community engagement play a crucial role in shaping the appropriate models for each phase of the mine life-cycle.

To provide a more comprehensive perspective on the industry's value creation mechanisms, it is essential to examine the key value drivers and risk factors that underpin successful mining operations. These drivers and factors not only shape strategic decision-making but also significantly impact the overall performance and sustainability of mining companies.

Key value drivers in the mining sector include:

- **Resource quality and quantity:** the grade, tonnage, and overall quality of the mineral deposit significantly impact the economic viability of a mining operation.
- **Access to reserves:** securing mineral rights and obtaining necessary permits and licenses are crucial for accessing and developing reserves.
- **Operational efficiency:** Maximising productivity through advanced technologies, optimised processes, and effective workforce management is essential for cost control and profitability.
- **Commodity prices:** as mining companies typically have limited control over commodity prices, their profitability is heavily influenced by global market dynamics and demand.

Key risk factors in the mining sector include:

- **Geological and technical risks:** uncertainties related to the quality and quantity of mineral resources, as well as technical challenges in extraction and processing, can impact project viability.
- **Commodity price volatility:** fluctuations in global commodity prices can significantly affect profitability and the economic viability of mining operations.
- **Environmental and social risks:** mining activities can have significant environmental impacts, and projects must address concerns related to water management, land rehabilitation, and community relations.
- **Regulatory and political risks:** changes in regulatory frameworks, taxes, and political instability in host countries can pose significant challenges for mining companies.
- **Operational risks:** safety incidents, equipment failures, labour disputes, and supply chain disruptions can lead to operational disruptions and additional costs.

The interplay between these value drivers and risk factors influences the roll-out of mining operations and explains the mining industry dynamics and trajectories.

2.2. Cost structures

Cost structures in the mining industry are characterised by high capital expenditures (CAPEX) and ongoing operational expenditures (OPEX). CAPEX includes costs associated with exploration, mine development, equipment acquisition, and infrastructure construction. OPEX encompasses costs related to labour, energy, consumables, maintenance, and environmental compliance.

It is worth noting that the CAPEX requirements are typically front-loaded, with significant investments required during the exploration, planning, and construction phases. OPEX, on the other hand, is an ongoing cost throughout the operational life of the mine, with costs varying depending on factors such as the mining method, scale of operations, and commodity prices.

Effective management of CAPEX and OPEX is crucial for mining companies to ensure project viability, profitability, and long-term sustainability. This is especially true because, when considering the different stages of a mine's life-cycle, CAPEX and OPEX needs vary significantly. The examples below elucidate these variations and their implications for each stage of a mine's life cycle.

Exploration

Junior exploration companies often take the lead in early-stage exploration activities, with a business model focused on identifying and acquiring prospective mineral properties. These companies may operate independently or form joint ventures with larger mining companies to share risks and costs. Specialised exploration service providers can be contracted for specific activities such as geophysical surveys, drilling, and sample analysis. CAPEX includes costs related to acquiring mineral rights, conducting geological surveys, drilling, sampling, and developing a geological model. OPEX includes salaries for exploration teams, field expenses, assaying costs, and administrative overheads.

Planning and Feasibility Studies

Larger mining companies often take the lead in conducting detailed feasibility studies and mine planning activities. They may employ in-house teams of geologists, engineers, and environmental specialists or outsource specific tasks to consulting firms and experts. Partnerships or joint ventures with engineering and construction firms can be formed to leverage specific expertise. Similar to exploration, CAPEX typically includes costs associated with detailed geological and engineering studies, environmental impact assessments, and permitting processes, and OPEX includes salaries for technical teams, consulting fees, and administrative expenses.

Construction

Mining companies typically engage Engineering, Procurement, and Construction (EPC) contractors to manage and execute the mine construction process. EPC contractors may further

subcontract specific tasks to specialised firms for activities such as earthworks, concreting works, and equipment installation. CAPEX includes major capital investments for site preparation, mine development, processing facilities, infrastructure (roads, power, water), and equipment procurement. OPEX is limited during this stage, and it includes expenses related to site supervision and support services. Project financing models, such as project finance or joint venture arrangements are usually employed to fund this capital-intensive phase.

Mine Operation

Mining companies can choose to operate the mine directly with their own workforce and equipment. Alternatively, they may engage mining contractors or enter into operating service agreements with specialised mining service providers for specific operations (e.g. for specific tunnelling/raise boring, blasting or transportation). At this stage, business models such as owner-operated or contract mining can be employed, depending on the company's strategy and risk appetite. CAPEX includes ongoing capital expenditures for mine development, equipment replacements, and sustaining capital for infrastructure maintenance, and OPEX covers operating costs (normally significant), including labour, energy, consumables (explosives, reagents), maintenance, and transportation.

Closure and Remediation

In most jurisdictions mining companies are responsible for the closure and environmental remediation of their mine sites ('polluter pays'-principle). They may employ in-house teams or engage specialised environmental consultants and contractors for tasks such as demolition, site rehabilitation, and ongoing monitoring. CAPEX includes costs for demolition, site remediation, waste disposal, and environmental monitoring systems, and OPEX includes ongoing monitoring and maintenance costs, potentially extending for many years after closure ('long-term stewardship'). At this stage, regulatory frameworks, environmental considerations, and community engagement play a crucial role in shaping closure, remediation and after-use plans (and corresponding costs). Collaborative models with local communities and stakeholders that are designed and adopted early-on (ideally at the planning stage) are key to limit negative impacts and maximise potential opportunities.

2.3. Conventional business models in the mining sector

The mining sector uses a variety of business models to navigate the complex and often volatile landscape of mineral extraction and processing. This variety stems from four main models: the prospect generator, the production miner, the streaming/royalty sharing model, and the integrated miner. Each of these models represents a unique approach to the challenges and opportunities presented to the mining industry, reflecting different risk appetites, capital requirements, and strategic objectives.

It is important to note that these models primarily apply to what are normally considered large-scale miners (LSM). These are typically well-established companies with significant operations,

substantial financial resources, and the capacity to undertake large-scale mining projects. LSM often have access to advanced technologies, employ a large workforce, and can significantly impact local economies and environments. Their scale allows them to pursue diverse strategies across different stages of the mining lifecycle, from exploration to production and beyond, aligning with one or more of the business models described below.

2.3.1. Prospect Generator

The prospect generator model is primarily employed by junior mining companies and focuses on the early, high-risk phases of identifying and proving mineral resources. This model is characterised by its emphasis on exploration and the acquisition of mining rights, with the ultimate goal of 'farming out' promising projects to larger miners for further development.

Companies operating under this model typically maintain a wide portfolio of potential mining sites, conducting initial geological surveys and assessments to identify the most promising prospects. Once a site shows potential, these companies will often seek to partner with larger, more established mining firms. In exchange for transferring the rights to develop the site, prospect generators may receive cash payments, equity stakes in the project, or royalty interests on future production.

The key advantage of this model is that it allows smaller companies with limited capital to explore a wide range of potential mining sites without assuming the enormous costs and risks associated with full-scale mine-development. By focusing on the early stages of the mining process, these companies can leverage their geological expertise and local knowledge to identify valuable deposits, then monetise these discoveries by partnering with firms that have the resources to bring them into production.

Examples of companies active in Africa employing this model include Orion Minerals (South Africa and Malawi), Madison Minerals (Namibia), Mkango Resources (Malawi) and Kodal Minerals (Mali). These firms typically operate with smaller teams of geologists and mining experts, using advanced exploration techniques to identify promising mineral deposits across multiple sites simultaneously.

However, the prospect generator model is not without its challenges. The early stages of mineral exploration are inherently high-risk, with many projects failing to yield economically viable deposits. Furthermore, the success of this model relies heavily on the company's ability to negotiate favourable terms when farming out projects to larger partners.

2.3.2. Production Miner

The production miner model represents the traditional approach to mining, focusing on the operation of mines to extract and process ore into mineral concentrates or refined metals. Companies employing this model aim to achieve low production costs and economies of scale to maximise profits over long mine life-spans.

Production miners typically take on projects that have already been proven to contain economically viable mineral deposits. They invest heavily in infrastructure, equipment, and personnel to establish and operate mines efficiently. The goal is to extract and process minerals at a cost that allows for profitable operation even during periods of lower commodity prices.

Growth for production miners often comes through the acquisition of additional mining assets and reserves. This can involve purchasing existing mines, developing new sites, or acquiring junior mining companies with promising deposits. By expanding their portfolio of producing assets, these companies aim to increase their overall production capacity and diversify their risk across multiple sites and commodities.

Examples of companies operating under this model in Africa include Anglo American, Zijin and Kumba Iron Ore. These firms often have significant market capitalisation and employ large workforces across their various mining operations.

The production miner model offers the advantage of direct control over mining operations and the potential for substantial profits during periods of high commodity prices. However, it also exposes companies to significant operational risks, including geological challenges, environmental concerns, and fluctuations in commodity prices. Moreover, the capital-intensive nature of this model means that companies must carefully manage their finances to ensure they can weather periods of lower prices or unexpected operational challenges.

2.3.3. Streaming/Royalty Sharing

The streaming/royalty sharing model represents a more financially focused approach to the mining sector. Rather than directly operating mines, companies employing this model focus on providing financing to miners in exchange for the right to purchase future metal output at set prices or for a royalty share of mine revenues.

This model has gained popularity in recent years as it offers a way for investors to gain exposure to the mining sector without taking on the operational risks associated with mine development and operation. For mining companies, streaming and royalty agreements provide an alternative source of capital that can be particularly attractive during periods when traditional equity or debt financing may be challenging to secure.

Under a streaming agreement, the financing company provides upfront capital to a miner in exchange for the right to purchase a portion of the mine's future production at a predetermined price. This price is typically set well below market rates, allowing the streaming company to profit from the difference between the purchase price and the market price of the commodity.

Royalty agreements, on the other hand, give the financing company the right to a percentage of the mine's revenue or profit. This can be particularly attractive for investors as it provides exposure to potential upside if commodity prices rise, without the downside risk of cost overruns or operational challenges.

It is worth noting that some downstream companies in the mining value chain have expressed interest in this model. For example, electric vehicle manufacturer Tesla has explored streaming agreements as a way to secure long-term supply of critical minerals for battery production.

Examples of companies operating under this model in Africa include African Thunder Platinum and Desert Royalty. These firms typically maintain a portfolio of streaming and royalty agreements across multiple mines and commodities, allowing them to diversify their risk and potentially benefit from price increases across a range of minerals.

The streaming/royalty shares model offers several advantages, including reduced operational risk, exposure to commodity price upside, and the potential for steady, long-term cash flows. However, it also comes with its own set of challenges. These include the need for careful due diligence when selecting mining partners and projects, as well as the potential for reduced returns if commodity prices fall significantly below expectations.

2.3.4. Integrated Miner

The integrated miner model represents the most comprehensive approach to the mining sector. Large diversified miners employing this model vertically integrate both upstream and downstream activities across the mining value chain. This includes exploration, development, extraction, processing, smelting, refining, and marketing of commodities.

Companies operating under this model typically have a global presence and engage in the production of multiple commodities. By integrating across the value chain, these firms aim to capture value at every stage of the mining process, from initial exploration through to the sale of refined metals or mineral products.

The integrated miner model offers several potential advantages. By controlling the entire value chain, these companies can optimise operations across different stages of production, potentially reducing costs and improving efficiency. They also have the flexibility to adjust their focus between different commodities and stages of production in response to market conditions.

Moreover, the diversified nature of their operations provides a natural hedge against volatility in individual commodity markets. If prices for one mineral are low, stronger performance in other areas of the business can help to offset the impact.

Examples of companies employing the integrated miner model include Glencore, Vale, and Palabora Mining. These firms typically have substantial market capitalisation and employ large workforces across a range of global operations.

However, the integrated miner model also comes with significant challenges. The scale and complexity of these operations require sophisticated management and substantial capital investment. There is also the risk that poor performance in one area of the business could drag down overall results. Additionally, the global nature of these operations exposes companies to a wide range of political, regulatory, and currency risks.

2.4. Value drivers and cost structures in an ASM context

The considerations above apply to regular, licensed and, therefore controllable (see the following chapter) mining companies, where costs are internalised within the stipulations of national regulatory frameworks.

However, ASM operations are particularly characterised by the fact that many of the environmental cost and also some of the societal costs are socialised to the whole of the society or most frequently left unmet in form of serious environmental damage or not remediated mining legacies. Particularly, ASM is characterised by an externalisation of virtually all costs that are not immediately OPEX. ASM is also characterised by minimal CAPEX due to the limited availability of investment capital and the general strive to minimise OPEX, often at the expense of safety and efficiency.

ASM often operate in an environment of poor governance and are exposed the risk of extortion from the side of equipment suppliers, money lenders, and product buyers. Buyers in such a context strive to minimise their market risks by paying low prices.

3. Business and operational models in the ASM sector

3.1. What is Artisanal and Small-Scale Mining?

ASM is not easy to capture as a phenomenon due to the wide variety of its occurrence across the world in various geographical, geological and in particular societal and governance settings. The OECD in its guidance document (OECD, 2016) has attempted to provide a phenomenological description: “ASM – formal or informal mining operations with predominantly simplified forms of exploration, extraction, processing, and transportation. ASM is normally low capital intensive and uses high labour-intensive technology. ‘ASM’ can include men and women working on an individual basis as well as those working in family groups, in partnership, or as members of cooperatives or other types of legal associations and enterprises involving hundreds or even thousands of miners. For example, it is common for work groups of 4-10 individuals, sometimes in family units, to share tasks at one single point of mineral extraction (e.g. excavating one tunnel). At the organisational level, groups of 30-300 miners are common, extracting jointly one mineral deposit (e.g. working in different tunnels), and sometimes sharing processing facilities.”

In terms of governance in the sector and, hence capability to meet ESG challenges, the distinction of three different groups of producers: *controlled*, *uncontrolled* and *uncontrollable*, by Chaparro Álvares (2003) appears to be particularly useful. The three groups differ with respect to their involvement in the implementation of the mine life-cycle (see below) and hence with respect to their cost and investment profiles:

- *Controlled miners* implement the whole life-cycle (sometimes without remediation) and comply with regulations (equivalent to the typical miners described in section 2.3).
- *Uncontrolled miners* try to avoid costs associated with certain life-cycle elements; they do not spend money on proper engineering; they buy cheap, poorly maintained second-hand equipment that results in poor OHS conditions; they act opportunistically, rather than invest in exploration; they avoid proper invoicing and tax declarations; they abandon a mine site, when profits fall below expectations and leave behind mining legacies.
- *Uncontrollable miners* are artisanal subsistence miners that try to find an income or are driven by the desire for fast gains ('gold rush'); they typically do not have training or experience in mining; whole families, including children, may be involved; they follow rumours and others, rather than undertaking exploration; they typically only implement the 'exploitation' phase of the mine life-cycle; their processing capabilities are limited with related inefficiencies and high losses of mineral resources.

Controlled miners are typically well-established national or international mining companies or their subsidiaries, i.e. LSM. They submit annual shareholder reports, fulfil their tax obligations, and often subscribe to transparency regimes (such as the EITI Extractive Industries Transparency Initiative, <https://eiti.org>) or are members of organisations such as International Council on Mining and Metals (ICMM, <https://www.icmm.com>) that promote good practices and conduct. These kinds of corporations and their financial and funding models are discussed in deeper detail in AfricaMaVal's WP7.

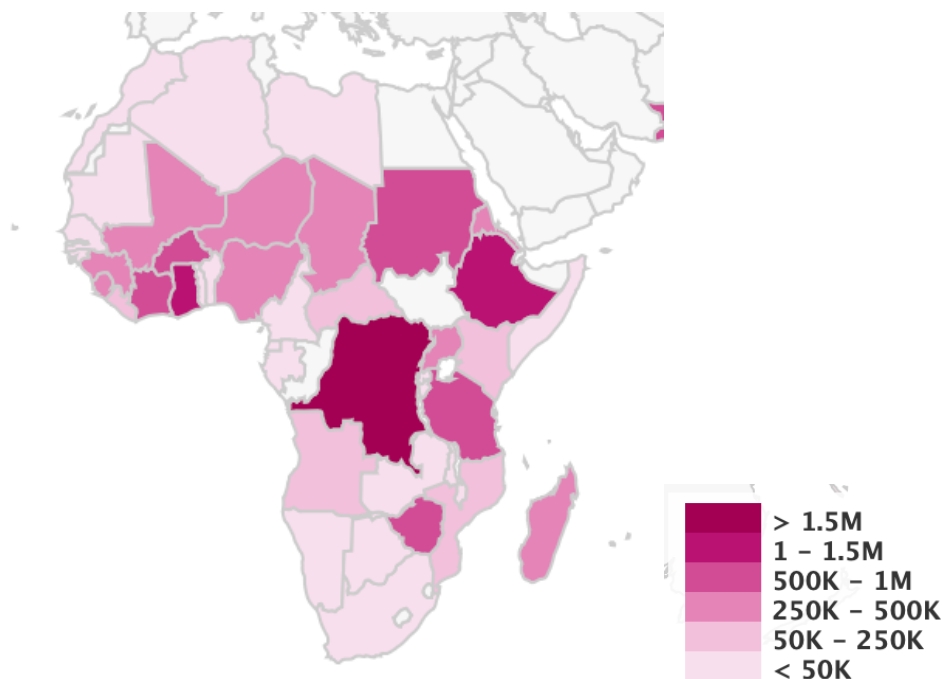


Figure 2. Number of people employed in the ASM sector in Africa.

(Source: <https://www.delvedatabase.org/data>)

While *controlled miners* with a few exceptions contribute the lion-share in mineral production, in terms of economic and socio-economic importance *uncontrolled* and *uncontrollable miners* play an important role in certain regions of Africa. Figure 2 provides an overview of the prevalence of ASM operators in various African countries. The data however only cover gold, diamonds, tin and tantalum, but not any of the other minerals critical for the EU.

From a governance perspective, different countries have different approaches to identify and classify ASM activities, e.g. on the basis of the volume of production (Colombia), the amount of capital invested (Argentina and Thailand), the number of workers involved (Chile, Pakistan and the United States), or the granting of mining title or ownership (Ghana, Zambia and Zimbabwe). Some countries reach the sophisticated level of classifying small-scale mining by the volume of the production according to the tonnage produced underground or at the surface (Colombia) or according to the degree of mechanisation (e.g. Chaparro Álvarez, 2003; Table 1).

Table 1. Characteristics of small-scale mining (after Chaparro Álvarez, 2003).

<ul style="list-style-type: none"> • Intense use of manpower • Low level of technological development • Supplying local markets • Wide range of products • Employment option in poor areas • Low production costs 	<ul style="list-style-type: none"> • Precarious health and safety conditions • Social and legal conflicts • Many stakeholders involved • Variable volume and size according to the mineral and the region • Stimulates local economies 	<ul style="list-style-type: none"> • Takes place worldwide • Generates local value chains • Encourages geopolitical development • Encourages larger projects • Explores new deposits • Widespread geographical distribution
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ILO (1999) mentions some of the obvious features of ASM, namely intensive use of labour, which implies a modest level of mechanisation as well as low production. Other aspects include a level of environmental impact or degradation that is often high, a high degree of legal informality and a lack of business organisation, the generation of low-quality employment, and a low level of tax revenue from this activity for the State. Taxation and effective tax collection is also quite variable from country to country and in various African countries ASM activities are reserved to nationals only (cf. Awases et al., 2023).

The definition of ASM normally does not include small open-cast extraction of aggregate and building materials that is often only operated when the need arises locally. Such extraction occurs also in Europe and then is regulated appropriately. Conversely, ASM typically targets high(er) value resources destined for export, at least beyond the immediate region or State.

ASM operations can also be characterised according to their development over time or as a response to certain socio-economic conditions (Table 2Table 1). Thus, CASM et al. (2010) distinguish ‘traditional’ ASM operations, where particular mineral occurrences have been exploited for sometimes generations, ‘seasonal’ ASM to complement e.g. agriculture during low activity periods, ‘permanent cohabitation’, where ASM works e.g. at the fringes of LSM, ‘shock driven’ ASM in response to economic or environmental crises, and ‘influx’ situations in sense of

the historical gold rushes in California or Alaska. Mutemeri & Ponnann (2024) introduced also the notion that ‘traditional’ artisanal mining can be a form of cultural heritage, ancestral practice and traditional way of living requiring protection, but whether this applies to the African context would need to be investigated.

Table 2. Characteristics of ASM as a response to socio-economic conditions
(after Weber-Fahr et al., 2002, Hruschka & Echavarría, 2011, and CSAM et al., 2010)

Type of ASM	Description	Income Factor*
Permanent artisanal mining	Full time, all-year round activity. Mining is frequently the only economic activity and is sometimes accompanied by other activities such as farming, herding or other extractive tasks.	1.5 – 5
Seasonal artisanal mining	Seasonal alternating of activities or seasonal migration of people into artisanal mining areas during idle agricultural periods to supplement their annual incomes.	0.8 – 1.5
Rush-type artisanal mining	Massive migration based on the perception that the expected income opportunity from recently discovered deposit far exceeds the current actual income of the people who are lured into it. It is not uncommon to observe former rush areas converting into new communities and rush miners converting into settlers. The rising price of e.g. gold plays a key role in the exacerbation of rush mining.	0.5 – 20
Shock-push artisanal mining	A poverty driven activity emerging after recent loss of employment in other sectors, conflicts or natural disasters. Many of the individuals, mostly itinerant and poorly educated, have no other options and remain trapped in the poverty cycle.	0.5 – 0.9
* Compared to alternative or previous occupations or economic activities.		

Some authors observe that artisanal mining focuses on making a living from mineral extraction, while small-scale mining focuses more on investment and profits. If such entrepreneurs do not belong (or have no close links) to the community, then it is not considered ASM, but a small conventional mine (e.g. Hruschka & Echavarría 2011). The criteria to distinguish such enterprises from legitimate small-scale mining operations can appear somewhat blurred from the outside, but to community members it is very clear. However, the authors do not define what they mean by ‘community’ and this definition may not apply to ‘rush-type’ artisanal mining situations, where ‘communities’ develop on the spot (cf.

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Table 2).

It is also interesting and useful to identify the various stakeholder groups that are engaged in or related to ASM operations. CASM et al. (2010) provide such overview as part of their practical guidance for engagement between LSM and ASM. It should be noted that individual can be members of more than one stakeholder group (Table 3 below).

In summary, the distinction between *controlled*, *uncontrolled* and *uncontrollable* miners is the most useful, as it describes in broad terms the ESG challenges, irrespective of the specific socio-economic or technical circumstances in anyone country.

Table 3. Potential stakeholder groups in ASM operations
(after CSAM et al., 2010)

Stakeholders	Stakeholder activity
ASM Operators	ASM Miners
	ASM processors, including people involved in crushing, grinding, sieving, panning, etc.
Buyers	Buyers of mineral products, potentially represented by local agents
Financiers	Individuals or organisations who supply equipment or financial support to ASM operators to carry out their activities
Co-operative or association leaders	Representatives of ASM miners that are operating through a co-operative or association structure
Government regulators	Local, regional, or national agencies, incl. mining and environmental inspectors
Government official	Local, regional, or national officials from non-mining related agencies
Other industry actors	Other companies (incl. LSM) operating within the same region with potentially overlapping interests
	Industry associations that may have a viewpoint or endorsed an approach to work with ASM operators

International organisations or initiatives	Focus on improving the situation of ASM operators through aid, education, or financing programmes
Communities and their individual members	Local community, pre-existing or newly formed by ASM activities
	Local communities near LSM operations, if different from above
	Communities in the region
Specially affected groups	Indigenous communities
	Children or forced or bonded labour working in ASM operations
Advocacy groups	Human rights, social justice, environmental and community-based groups working locally, regionally, nationally or internationally
Civic organisations	Churches, trade and labour organisations, charitable organisations, and other NGOs working in community development, capacity building and other overlapping programmes in the ASM region
Internal	Employees, cooperative members, contractors, shareholders, management and directors (of small- and large-scale mining companies).

3.2. Challenges to ASM business models

Some economists or business managers may question the notion that there is such thing as a ‘business model’ in artisanal mining. It depends, however, on the definition of ‘business model’ used. Economists may assume by default that any ‘business’, if it is to be called like that, has the ambition to maximise profit and expand. This may not necessarily be the case for artisanal mining, where often subsistence mining prevails, which poses conceptual challenges to business and financial analysts (see on this section 2.10 in Alberly et al., 2024 and for more details Section 3.4.1 of this report). In order to better understand ASM, here a very generic description is used in the sense that a ‘business model’ describes the mode by which value for the ‘entrepreneur’ is generated and which are the conditions in which the ‘business’ operates. In the simplest case, the artisanal miner extracts a ‘common good’, i.e. the mineral that may actually belong to the state and sells it, typically through intermediaries, to a market. Part of the ‘business model’ is that environmental and societal impacts are not internalised as costs and passed on to customers, but remain with society at large.

From a life-cycle perspective, *uncontrolled* and *uncontrollable* (cf. Ch. 3) mining activities obtain profit from the mineral raw materials endowment, but leave environmental, economic and social burdens and legacies to society at large, sometimes with impacts beyond the local or regional scale. Therefore, “... since the end of the first half of the twentieth century, small-scale mining has come to be seen as an undesirable and damaging part of extraction activity, causing great social, technical, economic, and environmental problems.” (Chaparro Álvarez, 2003). For the past couple of decades such environmental and governance issues gave rise to concern among national, European and international policy-makers. One response has been to set up ‘responsible sourcing’ initiatives and schemes with a view to formalise this economic activity and, hence, to improve the level of governance. The underlying strategy is to deprive upstream value-web actors of their markets, if they do not comply with certain environmental or ethical standards, such as no child-

or forced labour and adequate OHS. While fulfilling the ethical expectations of the developed countries, it may deprive many families of their subsistence means and drive them from being *uncontrolled* to become *uncontrollable* miners. The latter may be promoted by economic actors in the market that have significant raw materials needs, but little ethical constraints and scruples.

The main challenge for business models therefore would be a) how to bring *uncontrolled miners* into a (more) controlled, formalised regimes and b) how to prevent *uncontrolled miners* from slipping away into an *uncontrollable* situation.

The scientific literature and the outputs from international (aid) organisations abound with analyses of the phenomena of *uncontrolled* and *uncontrollable* miners and the underlying reasons for their choice of activities. Not all of these analyses are helpful, as they are sometimes guided by certain socio-political expectations and value-systems.

From a governance perspective the challenge is turn uncontrolled miners into controlled ones by a process of formalisation in which existing customary practices, that were developed informally by the miners into the mainstream of a country's legal and economic system (Siegel & Veiga, 2009). These authors cite, on the other hand the example of Uganda, where, despite official formalisation policies on the books, ASM continues to operate outside the formal economy. As will be discussed further down, it appears in order to make formalisation work, miners must also be given access to capital, which permits them to move from transient artisanal mining, to more sustainable small- and medium-scale mining.

However, it is natural for any 'entrepreneur' to try to escape as much as possible regulatory constraint and oversight, and to reduce the tax and regulatory burden (including the associated costs). This must be seen in the wider context of societal attitudes to governments and their representatives, which in turn depends on the quality of governance. Poor governance in licensing and taxation of mining activities naturally promotes evasion. Another factor is the presence of a fair and transparent market. A market characterised by extortion and price-rigging naturally promotes, marginal cost cutting practices with little room for investment into equipment and good OHS practices. In *uncontrolled mining* there are obviously also no incentives to internalise environmental and societal costs. Even mining under regulatory control has to be constantly reminded of these societal expectations. Thus, ASM has to been in the wider socio-economic context, irrespective of the ethical expectations in certain end-user countries of the mineral resources.

Most artisanal miners probably would be more than happy to pay the relatively low governmental royalties (usually 3-5%) in comparison to informal royalties to landlords or concession holders (usually 10-20%), or to pay clearly defined taxes on profits, instead of being permanently subject to extortion and paying bribes (Hruschka & Echavarría 2011).

Any attempt to formalise ASM in a particular region has to understand the vested interests of the miners and design any intervention in response to these (Levin-Nally & Tufo, 2024). It is certainly not a cliché that in many ASM sectors, powerful individuals (or families) benefit tremendously from the status quo and are likely to be resistant to formalisation. Thus, any ASM intervention –

whether led by government, international donors, downstream actors, large-scale miners, or NGOs – must understand and consider the existing societal fabrics, the political economy and the distribution of benefits and burdens across the community or region.

Levin-Nally & Tufo (2024) suggest that mapping financial flows through a minerals value chain and economy is one method for uncovering who holds economic and political power, and how they use the local mining, trading, processing sector to grow this. However, given the often Mafia-like structures, this is likely to meet with practical difficulties and even aggression. Interventions that do not understand where power is located, and how they are likely to redistribute or destabilise existing power structures could find themselves with serious barriers to success, and personal safety issues for the promoters. Given such covert power structures it will not be easy to avoid that attempts at formalisation will not benefit the informal power-structures and cement them in place, while *de facto* the informal activities continue.

These observations may help to more realistically frame business models that aim to improve the efficiency of previously uncontrolled mining and to remove certain hurdles and (psychological, economic) thresholds that prevented them from subjecting themselves to an adequate regulatory regime.

As noted earlier, many governments and donor agencies use volume of production as a major criterion for aid and objective of development. Instead, a clear policy of entrepreneurial promotion, offering growth options to those small business units that have the legal, geological, mining, and economic potential for competitive mining, irrespective of their size might have a more sustained impact (Chaparro Álvares, 2003). On the other hand, his view that “..., those who do not have this combination of elements should have the opportunity of appropriate, healthy and productive jobs in areas associated with mining, without a requirement that their assets include mining property, a deed or ownership.” May need to be seen with some reservation, as putting mining into a sustainable context would require also addressing the underlying governance issues, rather than ignoring them. Providing technical assistance to ASM operators without addressing underlying socio-economic and socio-political issues may not lead to a long-term stable development, at least as long as there is no sustained access to financing beyond that of donor agencies.

In order to be sustainable, business models must have the capacity to become self-sustained and address those aspects that may hinder them from becoming so. Such hindrances can be very country-specific and be related *inter alia* to governance issues, the administrative or regulatory system, but also geographical, logistic and general market conditions, including the availability of finance.

For obvious reasons, it is outside the scope of AfricaMaVal to address the mentioned governance issues as such, the business models to be proposed will have to be adapted to such external circumstances. Adaptation to external circumstances in order to increase their resilience and to make them workable is indeed key to all business models.

A careful analysis of all external factors is the basis for any type of business model. This typically includes the following aspects:

1. **Regulatory system** – this concerns all regulations potentially pertinent to business development, such as incorporation, financing and taxation, permitting, environmental legislation, labour and OHS regulations, etc.
2. **Geographical and geological situation** – location with respect to logistics infrastructure, distance to markets, knowledge of mineral occurrence, etc.
3. **Market conditions** – is there a functioning market, access conditions to the market, market needs vs. mine output options (can the business produce the minerals in the form that is needed by the market), etc.?
4. **Access to technology** – are equipment and technology providers accessible and affordable? Can the technology be deployed and used (training needs) by the ASMs?

In addition to these external factors, internal factors can be very important:

1. **Geological and engineering knowledge**
2. **Business administration knowledge**
3. **Financial management knowledge**
4. **Technical processing knowledge**
5. **Environmental and societal awareness** – As noted by Chaparro Álvares (2003) and many others, in general those who finance, manage or carry out informal artisanal mining work, whether controlled or controllable, do not show any concern for possible damage to the environment. Many of these miners operate in areas where they do not own the land, and are thus not interested in conserving and protecting it.

The challenges associated to these external and internal factors, that need to be considered when developing business models for ASM, have been summarised in Table 4 below.

Table 4: Typical problems of artisanal small-scale mining
(after Hentschel et al., 2003).

Geology	Technology
<ul style="list-style-type: none"> • lack of viable ore bodies • lack of information about these ore bodies 	<ul style="list-style-type: none"> • use of labour-intensive technology • high losses of values and time • lacking transparency of the hardware market
Regulations	Human resources
<ul style="list-style-type: none"> • discouraging investment climate • illegality of ASM • lack of social security • lack of political and legal stability • difficulties of legalising mines • contradictions between different/official acts • Most working without legal mining titles 	<ul style="list-style-type: none"> • unskilled labour force • lack of written contracts • social dependencies • lack of cultural understanding • bad social image of mining • subsistence economy • lack of knowledge about <ul style="list-style-type: none"> ○ economic principles
Marketing	

<ul style="list-style-type: none"> • access to the market only via intermediaries • market barriers • market regulations 	<ul style="list-style-type: none"> ○ credit and finance aspects • gambler mentality • access to foreign experts limited
Finance	Organisation
<ul style="list-style-type: none"> • difficulties in low-cost preparation of feasibility studies • uneconomical investment decisions • lack of bookkeeping and cost-calculation • lack of capital • high tax and royalty burden • limited access to foreign currency • limited access to investors and equity capital 	<ul style="list-style-type: none"> • lack of umbrella organisations • lack of service offers by Governments • seasonal activity of ASM • coordination or cooperation difficult because of widely spread-out mine locations

Viable business models need to take into consideration and/or provide solutions for amelioration through training small-scale entrepreneurs so that they can make their operations feasible in technical, economic, social, and environmental terms and to encourage entrepreneurial change in the administrative and technological aspects (e.g. Chaparro Álvares, 2003).

Sustainable business models also need to take into consideration possible market dynamics to which ASMs are subject, on which they may have little insight and over which they have no control. Particularly artisanal miners typically only have indirect access to markets through middle-men. Their output is bought by such intermediaries with greater economic capacity, who may have the capital to expand the initial facilities, and then displace the original miner. In fact, this can be one way by which artisanal and informal mines expand and can become legitimate (Chaparro Álvares, 2003). While the operation as such then may become legitimate, this process may result in the initial artisanal miners moving to other locations and/or moving from being *uncontrolled* to become *uncontrollable* miners.

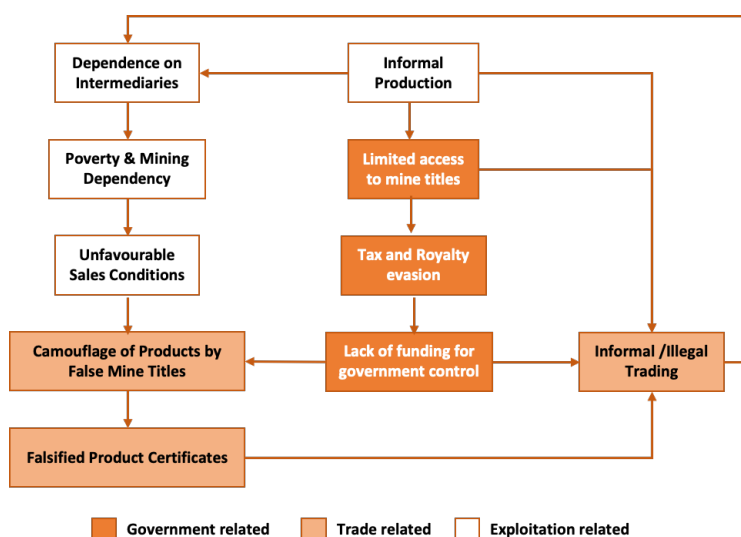


Figure 3. The vicious cycle of informality in the ASM sector
(modified after Hentschel et al., 2003).



Figure 4. Factors influencing the willingness of ASM to operate lawfully
(Hentschel et al., 2003).

This lack of formality may also become exploited by intermediaries, such as traders or predatory lenders, triggering a vicious cycle for the primary actors in the value-chain (Figure 3, Hentschel et al., 2003; Hilson, 2012). These intermediaries, who can be community members or outsiders, will have little interest in breaking the vicious cycle and may even violently trying to prevent it, as it undermines their own ‘business model’ or at least may reduce their margins. Violent opposition against improvements in artisanal mining communities that would redistribute economic benefits can be one reason, among others, that leads to a lack of willingness of ASMs to move from being *uncontrolled* to become *controlled* (see Figure 4).

Figure 3 can give ideas, where appropriate business models or government action could break these vicious cycles. A point in case is Burkina Faso, where until recently ASM were required to sell the gold they extracted to government agents, who paid a premium over the (smuggling) market price (<https://knowledge.uneca.org/ASM/burkinafaso>). This practice was effective in curbing illegal exports of gold from the country.

National and international development agencies and charities often try to support formalisation as the road to improved conditions for ASM operators. The assistance given to ASMs is often only stand-alone and disconnected from integral development programmes. In rural areas, where ASM is taking place, it is often seen that the support for ASM is mainly donor and NGO driven. As long as the donor and/or NGO worked together with the government, the ASM sector receives attention. However, as soon as the donor/NGO support ceases, the necessary governmental attention is waning (Steinmüller, 2017). One reason for this is that governments tend to be more interested in large scale mining, because they are inherently easier to regulate and manage and in addition, bring more royalty income and taxes to the national economy. The important relationships between local communities and ASM with a view to make formalisation and business models more sustainable are discussed in more detail in Chapter 3.5).

Levin-Nally & Tufo (2024) also note that approaches to ensure legal frameworks are realistic and that they do not promote seemingly attractive ideas that work well in theory but are not locally feasible. Existing commercial realities and political economies should be legalised as far as possible, whilst nudging them towards more rational systems of production to achieve higher formalisation rates. This requires the national/regional laws to envisage formalisation as a process that is:

1. achievable because it is accessible and both commercially feasible and attractive, and
2. gradual because the miners take steps to professionalise and legitimise their activities.

Given the complexity of factors that influence individual decisions as well as determine the specific local situations, there are no simple solutions to overcome the precarious situation of artisanal miners. The more so, as the *uncontrolled* situation often is the preferred choice given the actual and perceived economic and social risks associated with moving into a *controllable* situation. It thus may be erroneous to assume, as is the basis of many development programmes, that artisanal miners would wish to become formal, which is why many such initiatives fail once the economic incentive of the programme ends.

3.3. Strategies for ASM business models

3.3.1. General considerations

In the following a number of more traditional and more innovative strategies to overcome the issues and hindrances outlined above are discussed from a top-down, analytical perspective. Section **Error! Reference source not found.** discusses options and strategies more from the individual and societal perspective.

These strategies are built on basic concepts, such as to increase the economic (bargaining) power (e.g. versus traders, lenders/suppliers of equipment, or money lenders) of actors by aggregation

into larger entities, and increase of efficiency by division of labour or sharing of (technological, geological, processing, ...) knowledge.

Innovative elements can be introduced by moving away from traditional approaches to added value generation from the exploitation of primary raw materials. In the traditional ASM model the resource is extracted from the ground and then sold for good (often only with minimal processing) into the corresponding value-webs. This means that the actors in the primary step of added value generation will not participate anymore in further steps of adding value.

It should be noted here that the term ‘value-web’ is used here instead of the more common ‘value-chain’ to indicate that for many of the so-called EU Critical Raw Materials (CRMA, 2023) there is often not a linear chain from the mineral occurrence to the end-user (as e.g. in the case of diamonds or gem-stones), but an array of material streams with crossing nodes. The reason is that certain metals are accessories to major metals and smelters may sell on residues from their main products for further processing and extraction of accessories. The situation may become even more complex, when a mixing between primary and recycling materials streams occurs.

The complexity of supply-chains or value-webs that have ASM as their key upstream element has made many buyers to avoid them, as due-diligence on them, as required e.g. by the EU Conflict Minerals Regulation (EU 2017) or encouraged by the OECD Due Diligence Guidance (OECD, 2016) is an onerous burden. This in turn may further marginalise the ASM sector and makes it easy prey for informal or criminal supply-chain actors from buyers to armed groups. In response to this critical challenge, the Alliance for Responsible Mining (ARM, <https://www.responsiblemines.org>) and RE-SOLVE (<https://www.resolve.ngo>), with initial funding support from the European Partnership for Responsible Minerals (EPRM, <https://europeanpartnership-responsibleminerals.eu>), decided in 2016 to develop a market entry standard under open-source terms, enabling OECD-conformant ASM producers to deliver into legal supply chains. The resulting Code of Risk-mitigation for ASM engaging in Formal Trade (CRAFT) is intended to serve as an instrument for ASM and the downstream industry to validate its eligibility to sell and source minerals and metals originating from ASM in conformance with OECD (2016) and EU (2017).

The CRAFT guidelines (<https://www.craftmines.org/>) for ESG assessment conceptualise the ASM ecosystems by various functional criteria. Thus, three organisational types can be distinguished:

- Individuals
- Groups (family groups, partnerships, associations, cooperatives, companies, etc.)
- Clusters (any combination of individuals and/or groups).

This can be further refined by distinguishing between

- organisational structures of miners without processors and/or aggregators (i.e. a production-based group or cluster),

- organisational structures comprised of miners and processors and/or aggregators, with stable internal commercial relations (i.e. a supply-chain based group), and
- organisational structures comprised of processors and/or aggregators without stable commercial relations with miners (e.g. buying from random miners), which do not qualify as artisanal or small-scale producers.

3.3.2. Strength in numbers – associations, cooperatives and syndicates

A traditional way to overcome the weakness of small players in the field is to team up with others. This increases their combined economic weight.

The difficult conditions under which ASM takes places, as in agriculture, naturally leads to the formation of different types of associations (Chaparro Álvarez, 2003). Such associations can take the form of (trade) syndicates or cooperatives, though the distinction between these forms often is not clear. Trade syndicates are associations of individual ASM operators that are formed with a view to increase bargaining power and to provide a more organised and structured access to the market. Such syndicates may also have been set up to collectively own and operate equipment, which would be otherwise out of reach for individual operators. Cooperatives on the other hand, may have a similar purpose, but in addition are intended to provide services to individual members or the communities, such as saving or credit facilities, social services, such as health or child-care facilities, etc. While such associations may have been set up upon the initiatives of one or more individual, they are organised bottom-up and usually each member has one vote.

Syndicates and cooperatives are sometimes also founded to provide an economic or political counterweight against large-scale businesses or corporations. Government bodies at various levels often have an ambivalent stance towards them and are reluctant to support and developing them (Chaparro Álvarez, 2003). Depending on national and local governance circumstances this reluctance may result from a fear that they could become too powerful also in the political arena, or that the government has an economic (or taxation) interest in certain large businesses. Given that cooperatives, by definition, are more community welfare-oriented, governments may be more prepared to support these, ranging from legal protection to financial support.

The effectiveness and efficiency of the form of association depends not the least on the purpose. A particular challenge is the balancing between individual and common interests of a cooperative or syndicate. If, for instance, the purpose of a cooperative is to work as group a particular deposit, then it is essential that the workers involved forget the idea of continuing individual operation of their own mine. In addition to sharing resources, such as tools and equipment, the aim should be to make their work legal, market jointly their output, reduce costs by collectively purchase inputs and, ultimately, improve their quality of life. It may be a fundamental trait of individuals engaged in artisanal mining that they are not able to recognise the benefits of collective action and refuse to stop working as individual producers and do not want to produce in association with others. A cooperative or syndicate in which each member has different objectives, interests and views in relation to managing the business is likely to fail sooner or later. Chaparro Álvarez (2003) thus

points to a fundamental problem of a bottom-up organisation without clear leadership and intrinsic lack of means of sanctioning divergent interests.

Hence a challenge for AfricaMaVal would be to propose solutions that can overcome these issues and to remedy the fact that “... current cooperative models suggest they have proved unable to meet the challenge of ... strengthening new production links. These cooperative models have not been able to get off to a good start in the area of mining, because the very essence of the activity, and the difficulties in marketing the minerals produced by the mining members have impeded the development of this initiative. In the case of mining, variations on mining-cooperative options could and should be encouraged, such as, for example, the possibility of taking account in this model of local needs such as repair and maintenance services for machines, equipment and tools, cleaning and maintenance of roads and aqueduct systems and garbage collection and recycling. One should not disregard the possibility of developing cooperative works which generate employment in work of a social nature, particularly for the spouses of the unemployed, such as child care, care of the elderly and services in general.” (Münkner, 1998).

The limited resources for CAPEX of individual miners can also be overcome by forming co-operatives that jointly own tools and machinery. The individual miner can rent out tools and machinery against a (modest) fee and with the aid of this fee the equipment is maintained. Seed funding can come through aid programmes or by miners and other community members buying shares in the co-operative. A cooperative as a whole can also provide the collateral typically required by banks and other formal money lenders, which would not be available for individual ASM actors (see Albery et al., 2024 and Seguin et al., 2023, for a more detailed treatment of the subject).

It should be noted that cooperatives are also at risk of abuse by politician, traditional societal leaders, or other individuals for their personal gain (e.g. Bashwira & Cuvelier, 2019).

3.3.3. Coexistence between LSM and ASM

In various regions of Africa and for certain commodities coexistence between LSM and artisanal miners have been observed. The coexistence between ASM and LSM can range from symbiosis to conflict, depending on the socio-economic and resource-geological circumstances (CASM et al., 2010). The challenge is that LSM and ASM operators have quite different perceptions and expectations concerning their respective rights (Table 5 below).

Table 5: Differing perceptions and expectations of LSM and ASM
(after Priester, 2007, cited in CASM, 2009).

LSM Operators perceive that they have	ASM Operators perceive that they have
<ul style="list-style-type: none"> • a legal mining title and thereby rights over the area titled • followed national legislation to obtain the license by paying fees and levies • economic importance for the country, contributing to national production, paying royalties, etc. • planned their business development and expect not to be harassed by illegal diggers (artisanal miners) • access to national and international media • the right to engage security forces police to remove artisanal miners from their property • lobbying forces in politics and economics 	<ul style="list-style-type: none"> • traditional rights to access minerals on their 'homelands', with or without title • a right to mine the deposits they have encountered • the right to mine as a means to generate income and to sustain their families • no obligation to apply for central government licenses, as other local resources are traditionally managed locally • support from local administration or traditional authorities that support the generation of self-sustained income through ASM • support from local communities living on the direct income from ASM and economic spin-off effects • little recognition by the government, society, or economic key players • limited legal access to full mining titles • difficulties in achieving fair market prices • scant access to capital and funding

There are numerous scenarios under which ASM and LSM may operate in the same areas (Huggins, 2023). For example, in some countries, state-owned mining companies gradually lost capacity to exploit industrial concessions, and ASM simply exploited the vacuum, either with or without formal permission from the state. This is often the case across the Democratic Republic of the Congo (DRC), for instance in the Mutoshi Pilot Project (<https://chemaf.com/artisanal-amp-small-scale-mining-asm/>). In other cases, ASM work tailings or other by-products from LSM activities (Debert, 2022; Sovacool, 2019). In Section 5.1 below another example of collaboration between LSM and ASM in Congo Brazzaville for tantalum mining is discussed.

While the circumstances at each mine site will be different, there are a number of reasons that motivate LSMs to work together with ASM. CASM et al. (2010) list a) risk minimisation and security enhancement (ASM often comes together with criminal activities and trespassing on LSM sites), b) managing reputational risks (human rights, environmental impact and other issues associated with ASM at the fringes of LSM can have repercussion on these), c) maximising community development opportunities (apart from philanthropic motives, this can also contribute to a more peaceful cohabitation), and d) pressure for voluntary corporate commitments (in response to growing corporate social responsibility campaigns world-wide). The report cited provides also a step-by-step guidance for implementing the respective measures.

As noted, LSM corporations are increasingly realising that disputes represent a significant reputational risk, and sometimes prefer negotiated agreements. Such agreements may include (temporary) permission for ASM to take place on industrial mining concessions; purchase agreements where LSM actors buy ASM minerals; or undertakings for ASM actors to cease operating on industrial concessions in return for capacity-building to allow them to operate elsewhere. Kemp and Owen (2019) developed a “base typology of LSM-ASM interfaces” with four types, depending on whether the same minerals or metals are being exploited by the LSM and ASM actors, and whether ASM and LSM are operating in the same physical space inside a mine site (pg. 1097). They note that a “non-competitive cohabitation arrangement” may prevail, for example, when ASM and LSM actors do not attempt to access the same area simultaneously.

The presence of artisanal miners at the fringes of industrial operations is not always welcomed by the mining companies, but can have also certain advantages. Chaparro Álvarez (2003) discussed the opportunities and risks associated with this kind of business model: “Formal companies that have mining rights and are interested in optimising their cost structure, sometimes sublease areas of land and buy directly from their sub-lessees. This practice and its many variations lead to a number of problems. The selling by sub-lessees of their own output leads to a deterioration in the quality of the mines, as the sublessees reduce their costs by working in poor conditions, while the companies make higher profits at their expense. ... Once this process has been established, the companies do not always manage to maintain control of the area and soon the sub-lessees may begin to sell their output to third parties; when this happens a process of invasion may begin which is extremely difficult to manage, or else a process of smuggling, ... Special national studies to determine the extent of this phenomenon would be very useful, as they would help to improve understanding of the pattern of production, the general associated cost, and the effectiveness and validity of mining rights.”

The margins of certain near-surface mineral occurrences may not sufficiently rich in order to be economically exploited using industrial mining technology. Here, artisanal mining can lead to a more comprehensive utilisation of the occurrence. On the other hand, the opportunistic character of the artisanal exploitation generates externalities (mining residues, environmental impacts, etc.) that typically later fall back onto the main mining company. The presence of (large) unregulated groups of people, typically mainly male, leads to a variety of governance and security issues, often associated with this kind of mining communities. There are also cases, where this symbiosis develops into a competition, when the artisanal miners begin to encroach onto the margins of richer occurrences or vice versa that the mining company attempts to widen its claim or to reclaim subleased areas, when the margins turn out to be richer than expected. Such a situation can lead to violent disputes as the artisanal miners see their livelihood put at stake.

In practical terms such cohabitations or symbioses can take different forms. As there is a large mining company present, in principle also a route to the market is there. In this sense, the large mining company can act as an ‘off-taker’ for the artisanal production, sometimes through intermediaries that collect the production from individuals. In such cases, often the production is accounted for in the large company’s accounts and will not appear in any statistics as ‘artisanal’.

Conversely, in cases, where the mine is sufficiently close to a market, the artisanal miners may choose to sell to independent traders rather than the mining company on which fringes they operate, either because these offer better prices or to retain a certain independence. This may cause resentment on the side of the large mining company, as such production comes essentially from their occurrence or in case of sublease, their lease, and they may have tolerated the activity, but then such production does not enter their books and statistics. An added issue would be, that such production may not generate the due royalties for the state, as these would be tied to the lease, rather than on what actually arrives on the market. Under such circumstances it may be in the interest of the state to prohibit the activity of traders that buy of artisanal miners. As such royalties in part should also be used to deal with possible externalities from mining operations, such as not remediated mining legacies, the state effectively loses the means for dealing with such externalities created by artisanal mining.

The hosting mining company may wish to establish more formal relationships with such artisanal miners, but these may have certain reservations against such attempts for reasons discussed earlier in this report. Such attempts may also fail due to a lack of transparency on the side of the mining company and their potential inclination to exploit the artisanal miners. A formalisation of the artisanal mining inevitably increases their cost (e.g. better OHS and internalisation of environmental management costs) and therefore reduces their profit. Logically, this may be a disincentive for both, the artisanal miners and the hosting mining company. Notwithstanding, the campaigns of NGOs etc. who claim to represent the interests of artisanal miners, the latter may actually prefer profits over safety and over the environment in any case.

A business model building on a more formalised relationship between artisanal miners and a hosting mining company first of all needs to build trust between all parties. It needs to aim to remove the disincentives against formalisation. Such a business model needs to create visibly a win-win situation for all partners. The win for the hosting mining company would be an improved overall ESG track record, creating shareholder- and investor-confidence. The win for the artisanal miners would be a more secure tenure, assured market access and safer working conditions. Building such formalised relationship may need to be supported by financing of education and training programmes that raise the awareness that such win-win situations exist and how they can be achieved.

However, such programmes probably should not be organised top-down, when they could be perceived as brain-washing or buying off concerns, but from within the community with the financial aid of the hosting mining company. The success of such business models depends, however, on the overall governance situation in the country and the region. It does require a reasonably stable governance situation and trustworthy regulators and public administration.

3.3.4. Diversification in the upstream value-chain

Such a symbiosis can also take the form, that the mining *per se* is carried by ASM, while the processing is undertaken by a professional company, that acts as the off-taker and is appropriately licensed and supervised (e.g. Veiga et al. 2022). The advantage of such a situation is that

processing and associated waste management is carried out professionally, both being major environmental and OHS risk factors. It should be noted that such an arrangement would only be feasible for near-surface mineral occurrences that are accessible within the technology limits of ASM-style mining. A variant of this model, where processing is done by a specialised company, is that the company is set-up as a co-operative that hires professional staff and buys appropriate equipment and processes.

As noted in the introductory section, there is also the perspective to bring more of the down-stream value-webs closer to the extraction sites, i.e. to the countries where the mines are established. Depending on the commodity, this will require substantial investments into the operation, the supporting infrastructure (transport and energy among others), and the skills base needed to build and operate the facilities. Such diversification of the upstream-value chain actors into down-stream areas, requires a certain economic and governance stability to make the required investments interesting to potential investors.

3.3.5. Specialisation within the mining eco-system

Individuals with sufficient financial means could become micro-entrepreneurs in a mining eco-system by buying equipment and renting it out to others, thus increase the productivity of those that do not have the means to meet higher needs for CAPEX. Such system is not without pitfalls though, as it can lead to situations of dependence, extortion and abuse, particularly when those, who are lending the equipment do so against credit, rather than cash and when there is no competition. There are numerous examples in history, particularly also from the USA in the 19th and earlier 20th, when mining companies created effectively situation of bondage through debt. Notwithstanding these risks, such model would create opportunities for improved efficiency and effectiveness of extraction and could also be operated as a co-operative model.

3.3.6. Profit-sharing arrangements

One particular type of business model is a profit-sharing agreement between investors and contracted workers (Hruschka & Echavarría 2011). From the investor's point of view, it is conventional (investment based) small-scale mining, even if they are applying artisanal techniques. From the miners' point of view and considering the acceptance of payment in form of profit sharing, it can be considered ASM. Sometimes this is a preferred organisational set-up in ASM, whenever investment is required to start-up a mine (e.g. to open shafts, buy processing equipment, winches, etc.). It can even be considered community based ASM if (i) the investor has strong linkages to or even represents the community (frequently in Africa: the Chief), or if (ii) the workers originate from local communities. These set-ups can range from fair to very exploitative depending on the kind of arrangement agreed upon between the investor and the contracted workers.

3.4. Providing finance to ASM operations

3.4.1. Financing challenges

Recently Paschal et al. (2024) undertook a review of the scientific literature on financing in the ASM sector. As only published and peer-reviewed papers were considered, it may present a somewhat narrow view-point (and most papers concern gold mining), but their observations seem corroborate those of Chaparro Álvares (2003) and those of Hilson and Hilson (2023), who notes that banks are apprehensive to lend money to ASMs or their cooperatives because they do not understand the risks associated with mining. Conversely ASMs and cooperatives often do not understand the requirements and procedures for obtaining loans and thus fail to do so (Atkinson and Messy, 2012). Again, these findings are also corroborated by the recent detailed review undertaken for AfricaMaVal (Deliverable D3.2, Albery et al., 2024), which illuminates the challenges from a money-lender's and rational market economy perspective.

Throughout the analyses and guidance produced by development agencies, funding providers, and other reviews one notes the tacit assumption that artisanal miners would want to and should develop and grow their business. This seems to overlook the fact that in many, if not most cases this is a subsistence activity. Moving beyond a subsistence activity poses significant socio-economic and personal skills challenges. Artisanal subsistence mining does not necessarily mean that a person works in isolation, but it may involve several family members. However, growing the business, as would funding providers expect in order to obtain the return on investment they expect and to reduce their economic risk means, that a given site one miner must necessarily grow at the expense of another, which in turn can mean a transition from artisanal to small scale mining. Such a step can bring about social tension, as it displaces other miners or makes them dependent as employees. Funding agencies and donors should recognise that artisanal subsistence miners may not have any interest to develop a 'business' in the common sense, but would require financial resources to e.g. improve their own health and safety situation, switch to less environmental detrimental work practices, reduce the burden of physical labour, or increase the efficiency of their work to free family members, particularly children, from the work while maintaining the family income. Such objectives would not generate the extra profits that would be required to pay the interest expected by money lenders.

The informality of the ASM sector makes it difficult for them to comply with requirements of formal money lenders, be it commercial banks, development banks, or other development agencies. These institutions need to justify and quantify to their shareholders or stakeholders the financial risks they are taking and to secure the loans through collaterals and/or well-founded business-plan. Both of which the ASM actors normally cannot provide (e.g. Eniowo et al., 2022). ASM actors normally do not have any knowledge of the ore reserves, so there is no way to relate the possible size of the business to the size of the loan. It has also been noted in the literature reviewed by Paschal et al. (2024) that the bureaucratic procedures of taking out formal loans act as a deterrent for most ASM actors, who often do not have a sufficient level of education (Last et al., 2022). As Eniowo et al. (2022) noted, that ASM operators are typically not able to prove

feasibility of their operations, lack of knowledge on efficient ore reserves estimation methods, and lack of physical collateral, which inhibit their credit access.

Given that ASM often operates in remote areas, there may be a lack of physical contact between lending institutions and ASM operators. Banks and other institutions may not be present with branch offices in the areas of ASM, although ZELA (2021) observed that a good number of the ASM operations in Zimbabwe interviewed actually held bank accounts. How representative this is for other countries is not known. One may need to think about mobile branches, as once existed also in Europe before the age of Internet-banking. These should be staffed by people with appropriate local knowledge and integration into the community. A general mistrust in the banking system and in particular in loans, probably fuelled by past bad examples and a lack of financial education, can often be observed in ASM communities (Koomson et al., 2023; Simatele and Maciko, 2022).

Also, safe ways of disbursing funds need to be devised, which will depend on the local governance and security situation, as it is likely that grants will have to be provided in cash. A safer model could be that the money lender provides the equipment to be bought through the loan, rather than the loan itself (IMPACT, n.d.). Related experience has been reported e.g. by Finlay (2013), who emphasises that initially it is better to provide equipment, rather than cash and gradually increase the engagement as trust is built and risks become more calculable.

Mutemeri & Ponnann (2024) seem to reduce the financing challenges to these access issues and propose to overcome them using digital technologies, such as ‘mobile money’ and the use of cryptocurrencies. However, this does not resolve the problem money lenders have with assessing the credit risks posed by ASM. Given the typically not very high (digital) literacy in ASM communities, they may be hesitant to adopt such ‘intangible’ solutions.

The lack of formal financing exposes the ASM sector to the risks of informal, sometimes extortionate lending. Loans within a family are perhaps the least risky, but there is always the risk that the lender has to or wants to have the money returned prematurely. Mineral brokers or dealers may offer ASM informal loans in exchange for the right to the excavated material. Such relationships often can be exploitative owing to the high ‘interest’ in terms of percentage taken by the middle men and because such loans can trap the ASM actors in a vicious circle from which they cannot break out easily (cf. Figure 3). While such entrepreneurial individuals often belong to the same social and ethnic group, increasingly illegal foreign money lenders are found on the markets. While the informality of the sector already means that little of the economic activity can be taxed, tax evasion is part of the ‘business-plan’ of these foreign ‘entrepreneurs’.

In summary, as ZELA (2021) observes, for financial inclusion to happen, there is a need to address both, the demand-side (ASM operators) and the supply-side (financial institutions) challenges.

3.4.2. Facilitating financing solutions for ASM

The paper of Paschal et al. (2024) has the merit of bringing together numerous scientific field investigations on the subject, but the phenomena as such were already well understood before. In

the following, a number of possible solutions at both, an operational level and at policy-making level are discussed.

- Formal banking institutions (commercial and development banks) need guidelines on risk-management strategies in order to better understand the risks associated with ASM mining and what the limitations of informal ASM are. The banks not only need to understand better what credit risks the ASM actors poses to them, but also what risks the ASM actors are facing. This may be facilitated by a more bottom-up approach involving the ASM operators themselves (Eniowo, 2024). As European countries are interested in the mineral raw materials, they may want to consider ways to reinsure these banks in order to reduce their commercial risks and thus reduce the need for collateral, which is difficult to provide for the ASM actors.
- Likewise training for ASM to understand the banking system and its concerns and requirements is needed. Such training could perhaps be undertaken as a practical follow up on the AfricaMaVal project.
- One of the key issues for formal money lenders is the lack of information on the viability of the ‘claim’ of the ASM actors, or in other words what the reserves are that can be mined with ASM means. This information would be needed to assess the amount of the loan needed and its time-frame. ASM-zone delineation may provide a generic basis for formal resource assessments, as the necessary exploration would have been undertaken by professional geologist and paid for by the government (see Section 3.5.2).
- In situations, where synergies between large-scale mining and ASM are created (see Section 3.3.3), the large mining company would have undertaken the necessary exploration work that then can be used in the credit assessment for the ASM operations.
- Putting ASM on more solid financial footing will allow them also to obtain better and more environmentally benign technologies and processes. The main challenge will be to break a possible detrimental dependency on intermediaries, such as extortionary mineral dealers (cf. Figure 3), who siphon off profits that could otherwise be used for investment.
- Cooperative models could be used to shift the bargaining power towards the first-line ASM actors.

As noted by ZELA (2021) at least for Zimbabwe, the use of venture capital and revolving funds is largely unexplored in the ASM sector. Seguin et al. (2023) explore various micro-financing models (MFI), including village saving and loan associations (VSLA). Rather than relying on outside capital, these association accumulate capital from within the communities, which is then given as loans to individual members, relying on trust, rather than collateral. This trust eventually can translate into a credit-rating and thus help to attain formalisation, as is illustrated in Figure 5 below.

How Access to Finance Correlates to Formalization



Figure 5. Correlation of financing options with improvement in formalisation
(from Seguin et al., 2023)

Hilson and Hilson (2020) list many examples of ASM financing from various countries. Even though these are mainly for gold, their models can be used for CRMs. Some examples include: Blended finance, Impact funds, group funding models, Direct financing of equipment, Export Credit Agencies.

3.5. Governance challenges in ASM operations

3.5.1. Recognised challenges

The practical implementability of (innovative) business models strongly depend on the overall governance situation in any country (cf. Kaufmann & Kraay, 2023; Transparency International, 2019, Levin-Nally & Tufo, 2024) and at the local level. Usually, the business models found on the ground reflect the governance situation, as in particular artisanal miners react to this. The poorer the governance, the more likely it is that ASM opt to become uncontrolled or uncontrollable miners. Due to the mistrust in any administration, there will be resistance to become more formal. Formality means more opportunities for those who abuse their powers to interfere with the respective ASM operation. Formalisation and transparency can be double-edged sword (e.g. Frohn Pedersen et al., 2021).

Poor governance situations pose challenges for both, the ASM operators and for EU buyers of the raw materials. The challenges for ASM operators and their possible responses have already been discussed above. This section discusses possible responses further down the value-webs.

It is important for down-stream actors to recognise these governance challenges and to react accordingly. It is beyond the remit of AfricaMaVal to fully unravel the complex challenges of responsible sourcing, which are embedded into the overall governance situation of the source countries. However, downstream actors can follow the recommendations of organisations specialising in this subject. For instance, the OECD Due Diligence Guidelines (<https://www.oecd.org/corporate/mne/GuidanceEdition2.pdf>) identify in Annex II a range of governance-related risks:

- Serious human rights abuses associated with the extraction, transport or trade of minerals
- Direct or indirect support to non-state armed groups
- Public or private security forces
- Bribery and fraudulent misrepresentation of the origin of minerals
- Money laundering
- (Non)payment of taxes, fees and royalties due to governments

While downstream actors in most cases will have little direct impact on the governance situation in a source country or region, selective buying behaviour can create market pressure to induce slow changes. However, such ethical behaviour might be exploited by other, less ethical actors to their commercial advantage, resulting in less market pressure than hoped for.

In any case, responsible sourcing needs to be based on awareness and thus reliable information. Chaparro Àlvares (2003) notes that “...two issues of great interest: (a) enhancing information management in order to promote mining investment, through the creation and updating of databases, and of networks for exchanging and sharing information to promote mining activity; and (b) creating regional mining observatories.”

Attempts for responsible sourcing are frequently confounded by the fact that “[s]upply chains sourcing from ASM are often quite complex, particularly if they lack clear “choke points” determined by technology, as in the case of gold. Complex supply chains require complex due diligence processes that are costly. The situation is exacerbated by legal and reputational risks of sourcing from legitimate but still predominantly informal ASM mines. Consequently, many downstream supply-chain actors have become reluctant to source minerals or metals from ASM or otherwise accept them in their supply chain. However, the rational response of many companies to avoid sourcing from ASM altogether further marginalises the ASM sector and makes it easy prey for informal or criminal supply chain actors from buyers to armed groups.” (ARM, 2021).

Such governance issue will continue to persist, as long as they serve certain economic and political interests and as long as there will be down-stream market actors who have no interest in these issues. In fact, certain buyers may have an interest in a continued poor governance in the producer

countries at it strengthens their own position in both respects, with respect to the producers and with respect to competitors, who are constrained by their ethical scruples. Building up sufficient market pressure from more ethically driven down-stream actors is a slow process, but has entailed effects in other areas of primary production, such as certain food-stuffs.

Poor governance in the extractive sector can be symptomatic to this specific sector, but likely also reflects the overall governance situation in a whole country. Therefore, these issues cannot be addressed by the mineral raw materials sector alone. Attempts to strengthen the governance in the raw materials sector will need to be embedded into wider support for strengthening the governance in a country through e.g., development programmes. It is, however, beyond AfricaMaVal to discuss the pros and cons of development programmes and their efficacy or otherwise.

Formalisation is a long-term process, beyond programmatic quick wins and is deeply rooted in economic, social and political factors, in other words the governance situation, which can hinder or enhance its success. Thus, support to formalise ASM should equally focus on supporting mining organisations and addressing the systemic challenges that are obstacles to the formalisation process (Levin-Nally & Tufo, 2024).

There have been in the past programmes to strengthen the resilience of ASM actors against certain effects of poor governance. For instance, an initiative by the World Bank under the acronym CASM (Communities and Small-Scale Mining), but it is not clear, whether this is still active. A UNESCO-sponsored programme to aid ASM actors has been terminated some years ago.

3.5.2. A potential solution: delineating ASM Zones

Recognising the loss of revenue for society at large and the resulting externalisation of mining legacies (environmental impacts, orphan mine sites) various governments have attempted to make ASM more formal. Recognising also the inherent reluctance of particularly artisanal miners to become more formal, governments tried to contain such mining activities geographically by declaring ASM ‘zones’ (e.g. Steinmüller, 2017). The AfricaMaVal deliverable D4.1 and the ‘country reports’ (D9.1) list such instances including the underlying legislation, but without going into any detail.

In order to make sense, such zones need to be delineated on the basis of geological knowledge, some exploration or at prospection and supported by adequate land-use planning. At the same time, it makes economic sense from the country’s perspective to not ‘sterilise’ high-quality resources for large-scale exploitation. In certain instances, such zones could be established at the fringes of large-scale operations. While this would clarify the land-use rights, such an arrangement is still prone to infringement, when it turns out that the resources in the ASM zone are richer than anticipated (tempting the large company to encroach on the ASM zone) or when they become depleted (tempting the ASM operators to squat the large mining concession) as already discussed in Section 3.3. Steinmüller (2017) points to this issue of inadequately defined ASM zones. Delineating a ‘zone’ does not eliminate the problem of assurance of the right to a particular ‘claim’ or the potentially violent competition between different ASM operators.

An area being declared an ASM zone can and probably will have a profound effect its natural environment and the socio-economic fabric. As part of the supporting land-use planning a wide variety of stakeholders would need to be consulted, such as those representing agricultural, forestry and fishery, nature conservation, and tourism interests, as well as the current land-owners, of course. Ideally, each potential ASM operator should be given a certain ‘claim’, but it may be in practice questionable, whether such level of formalisation can be attained. At least such ASM zones, if established after thorough investigation and stakeholder consultation, have the potential to avoid conflict between the current land-owners and their economic activities and the artisanal miners, who may simply squat the land and utilise its natural resources (incl. water and forests). Governments need to be aware, that within the ASM zone there may be a certain lack of governance. There is, however, always the risk that uncontrollable artisanal mining begins to spread into the areas outside the ASM zone.

The delineation of ASM zones, if accepted by actual and potential ASM operators, would help to contain the externalities of ASM within certain boundaries. It would in particular facilitate the government to undertake overall environmental impact assessments and planning for proper closure and remediation of such sites.

It is evident from above that making such ASM zones meaningful a considerable investment in terms of financial and human resources is required. The geological mapping and the exploration have to be financed, if such information does not already exist. EIA and closure/remediation planning require specific knowledge and the right human resources. The eventual implementation of closure and remediation could be paid for from contributions levied on the ASM operations – which actually may turn them away from such zones. It may be at the bottom line an optimisation calculation, whether it is better to socialise such costs across the whole country, in which way the ASM operators externalise these costs to the rest of the country’s society, or to assume the responsibility for the legacies of ‘uncontrolled’ ASM operations. A balance has to be struck between the respective socio-economic costs and benefits. In addition, an economic assessment of the resource has to be undertaken in order to ensure that the ASM operators have a profit commensurate with the investment by the government and/or donors.

It is, on the other hand, conceivable that foreign donor and development organisations are prepared to foot some of the bills. Such assumptions are made implicitly in many ASM-related reports produced by NGOs concerned with ASM (e.g. Mutemeri & Ponnann, 2024), but rarely viable sources of financing are identified. European governments may sponsor the geological reconnaissance through their geological surveys or other instruments, which may have the added benefit that local experts can be trained through programmes, such as PanAfGeo (<https://panafgeo.eurogeosurveys.org>).

Notwithstanding the risk, issues and challenges potentially associated with delineating ASM zones, it may offer a practical way forward to geographically constrain the externalities arising from such difficult to control practices. Whether the zones are accepted by potential ASM operators may be a question of how they are advertised, whether as a constraint or better as an

‘opportunity’. Steinmüller (2017) provides a comprehensive practical guidance on how to establish and manage such zones, although he implicitly assumes that controlled ASM takes place, while in many cases the governance challenge is to contain uncontrolled and uncontrollable artisanal mining. ASM zones can also provide a basis for assessing or classifying resources and reserves (cf. Section 8.2). Particularly for individual artisanal operations it is very difficult to assess their reserves due to the multitude of small workings. In addition, artisanal miner may guard information on how ‘rich’ their claim is jealously for fear of losing it, which is a considerable risk in a poor governance environment. If the assessments are updated periodically as new information on both, the geology as well as the overall conditions in the area becomes available, a summary resource assessment using CRIRSCO-aligned codes or UNFC (see Section 8.2) should be possible, even though these schemes were designed for individual mines. Such formalised resource assessments will provide some assurance to money-lenders and therefore improve the financing of ASM operations (see also Section 3.4.2).

3.5.3. Responsible upstream-downstream supply-chains

For certain minerals/metals certified responsible supply-chains could be established to ensure full transparency from upstream miners to downstream (end-)users through certification e.g. according to CRAFT (ARM, 2021)), of the mining operation (cf. Figure 6 next page).

CRAFT was specifically designed for the ASM sector, but has only been validated so far for gold, 3T, cobalt, and gemstones. The UNFC (United Nations Framework for Classification, cf. Section 8.2), PARC (Pan-African Resource Classification, cf. Appendix 1) and/or SAMREC (South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves, <https://www.samcode.co.za/samcode-ssc/samrec>) compliant classification also includes ESG aspects and thus improves market entry of the producer. Due to reputation-driven customer demand, such products could command higher prices, for which a fair share can and should arrive at the beginning of the value-chain. This in turn enables further improvement of the value chain.

CRAFT is an open-source standard, which implies that the prescription of an exclusive certification scheme is impossible. On its own it is not a certification scheme. Many non-exclusive ways to determine conformance with the CRAFT, such as already existing assurance schemes of supply chain initiatives or due diligence procedures of supply chain operators, can co-exist. Notwithstanding, CRAFT may be incorporated into existing certification schemes and/or certification schemes may be built on top of CRAFT. This flexibility provided by the Open Source license eliminates from the outset the risk that the CRAFT creates additional ‘audit burden’. The CRAFT is not prescriptive with regards to demanding any specific formally established organisational structure, it is focusing on function and not administrative set-up.

The Cobalt for Development (C4D) discussed in Section 5.1 is an example, among others concerning mainly gold, for undertaking to establish responsible and traceable supply-chains for specific minerals. While there may be a general mistrust in government in the ASM communities,

governments acting as buyers and paying above market price, increases trust and discourages illicit trading and tax evasion, because in this way artisanal miners can achieve a fair price.

However, such schemes require comprehension and buy-in from the miners in the first instance. It would also require compliance and buy-in from processors and traders to be viable. Such buy-ins can only be brought about through extensive educational and awareness campaigns as essential elements of the business plan.

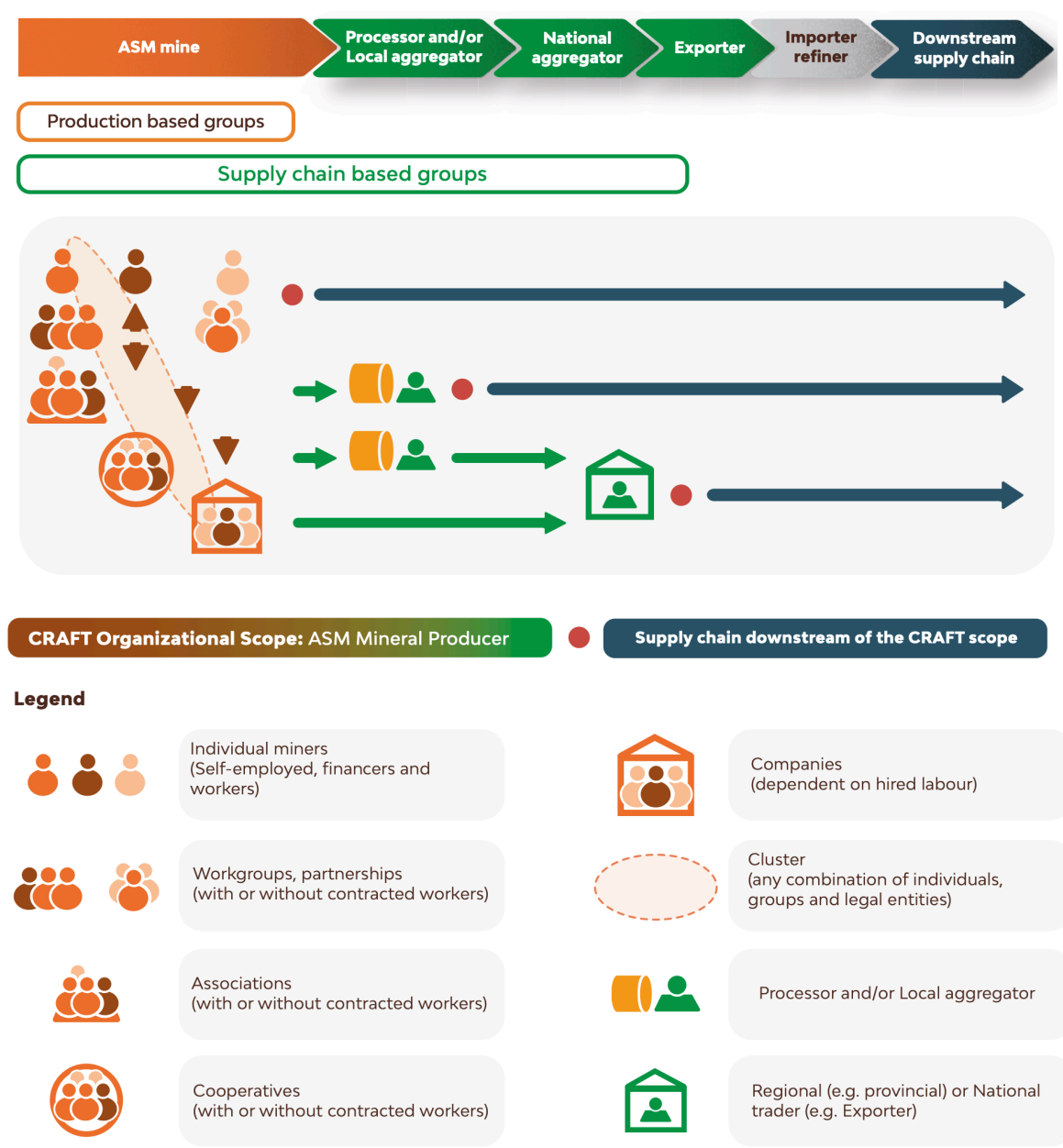


Figure 6. Organisation flexibility of CRAFT certified supply chains (<https://www.craftmines.org/>).

4. Innovative value-webs

4.1. Overcoming technology limitations in ASM

As noted above, ASM operations are characterised by a generally low level of the technologies and techniques employed. This may range from simple hand-tools used by individual artisanal miners to standard earth-moving or ore processing machinery used by co-operations or small-scale mining concerns. The underlying reasons are a lack of finance and a lack of training or knowledge. In fact, there is a complex socio-economic relationship between people pursuing artisanal mining and the technologies used.

NGOs typically call for improved technology adoption in order to overcome OHS issues and improve efficiency, and aid on the way to formalisation (e.g. Mutemeri & Ponnann, 2024), supposing implicitly that this is what ASM operators desire. This approach, however, seems to ignore the reasons, why people pursue artisanal mining. As noted earlier, a technology-driven move to increased formalisation may actually push out those miners that resent formalisation for a number of reasons. It also tacitly assumes that artisanal miners are keen to adopt better technologies, but are hampered by circumstances, which is not necessarily case as this may pose mental and socio-cultural challenges.

It is important to introduce technology that is easy to understand and operated, and most importantly that can be maintained with the local skills and infrastructure and locally available materials. Many development programmes have failed for that reason. An example from the African fisheries are the boats made from glass-fibre reinforced plastics (GRP) that could not be repaired with local materials, so that that the fishermen reverted to their traditional wooden boats. One could think of ‘old-fashioned’ hammer-crushers driven by water-mills or animal power (as opposed to more efficient jaw-crushers),.

Simple and ‘crude’ technology will help to keep both, CAPEX and OPEX down, because the machinery could be produced locally (or at least nationally) and maintained locally. One has to acknowledge that almost every improvement in the technology used entails a shift away from individual miners (or family groups) working for themselves to more organised business models, where CAPEX (and OPEX) can be shared by groups. Training and education in the construction and maintenance of locally sourced or repurposed machinery could be an important aspect of increasing the efficiency of operations. It has been shown that youth mobile between education and being engaged in ASM activities can become an important vector for knowledge and innovation transfer (Arthur-Holmes et al., 2023).

Most of the literature concerned with the introduction of more environmentally benign ASM is about replacing mercury and cyanide in gold mining, or better work practices using these reagents. There are, however, many other environmentally detrimental practices associated with the extraction of those mineral raw material that are considered critical (CRMs) by the EU (EU, 2024). For instance, small-scale mining of placer deposits involves high-pressure water-jets (hydraulic mining) loosening of river bank deposits or dredging in the rivers themselves. Such techniques

result in large amounts of suspended solids being released into the water courses. The same applies to washing and gravity-sorting of sediments. The resulting turbidity impacts aquatic fauna and flora and may also release toxic constituents. Of course, any measure to contain such slurries e.g. in settling ponds, will increase the OPEX and possibly also the CAPEX of the operation and thus may be unattractive to operators. Here, work practice changes will have to be supported by educational programmes that probably have to be funded by donors. Nevertheless, many donor programmes focus on improving extractive efficiency to improve profits (e.g. IMPACT, n.d.).

It should also be noted that improvements in technology used in both, ASM and LSM, can have the effect of replacing less-skilled work with machinery. This in turn may push LSM workers into ASM or workers from now more formalised ASM operations into more marginal areas of ASM. This in turn may result in an unintended further spread of ASM.

4.2. Circular economy and added-value

Under ‘materials as a service’ business models, suppliers no longer sell raw materials or semi-finished parts outright to manufacturers. Instead, they offer manufacturers temporary access to these materials, and once the products made from these materials reach the end of their useful life, the suppliers recover them. In an ideal world, this approach, which is fully aligned with circular economy principles, would create shorter resource loops, while maximising resource efficiency and minimising waste generation.

In sophisticated value chains, such as aeronautics, companies such as Rolls-Royce have taken steps to advance the ‘materials as a service’ model. Instead of outright selling aero-engine, Rolls-Royce lease them now to customers (Cimprich et al., 2023). This approach allows the company to retain ownership and facilitates the recovery of valuable raw materials (including rhenium) used in special alloys, from these engines.

Some authors who have attempted to adapt ‘materials as a service’ business models to mining advocate for the collection of royalties in two directions: to governments (as is conventionally done) and to a trust fund (managed by a third party). This fund would repay the money received to the country of origin and to the recycling operator once the metal or mineral is submitted for recycling. (Xerri, 2023). The adaptation of such a model to ASM contexts could provide funds for environmental remediation and for enhanced OHS conditions.

4.3. Development of mining clusters

Industrial clusters have emerged as a powerful strategy for reinforcing industrial ecosystems and contributing to regional development. These geographical concentrations of interconnected businesses, suppliers, and associated institutions in a particular field offer numerous advantages that drive economic growth, innovation, and competitiveness.

Africa boasts several successful industrial clusters across various sectors, from traditional industries, such as textiles in Mauritius (Gibbon, 2000) and automotive in South Africa (Barnes & Kaplinsky, 2000) to emerging sectors such as ICT in Kenya (Drouillard et al., 2014). In the

extractive sector, notable examples include cement industry clusters in the in Angola (Correia, 2019) and Nigeria (Correia, 2018). Nigeria also hosts a sophisticated oil and gas industry cluster, encompassing extraction, refining, and related services in the Niger Delta region (Ovadia, 2013).

One of the primary benefits of mining clusters is the creation of a skilled labour pool. As related businesses congregate in a specific area, they attract and develop a workforce with specialised skills relevant to the industry. This concentration of talent not only benefits existing companies but also attracts new businesses to the region, creating a virtuous cycle of growth and development.

Clusters also foster innovation through knowledge spill-overs and collaboration. When companies in related industries are in close proximity, opportunities for formal and informal exchanges of ideas, best practices, and technologies increase. This environment of shared knowledge can lead to faster problem-solving, increased productivity, and development of new products and services.

Furthermore, mining clusters can lead to improved supply chain efficiency. With suppliers and related businesses nearby, companies can reduce transportation costs and lead times, leading to more efficient production processes. This proximity also allows for better communication and coordination between different parts of the supply chain, potentially resulting in higher quality products and services.

The presence of a strong mining cluster can also attract significant investment to a region. Investors are often drawn to areas with established industry ecosystems, as these locations typically offer lower risks and higher potential returns. This influx of capital can fuel further growth and development in the region.

Mining clusters can also contribute to the development of specialised infrastructure and services. As the cluster grows, it may lead to investments in tailored transportation networks, research facilities, or educational institutions that further support the industry's needs. These improvements not only benefit the cluster but can also enhance the overall quality of life in the region.

However, it must be highlighted that, in the extractive sector, mines are necessarily located where mineral deposits exist, a condition that policy-makers interested in fostering industrial clusters must take into consideration. In the specific case of ASM, it is paramount to cross-check the location of ASM operations with the vicinity of existing transportation facilities, energy production and energy supply infrastructure (Figure 7, below), as these are key aspects for the development of a successful mining cluster.

Existing cases of successful industrial clusters show that clusters thrive in labour markets with large pools of specialised resources within core activities. Hence, the occurrence of mineral deposits in peripheral areas, away from existing infrastructure, provide fewer opportunities for a cluster to evolve. This could be the case in some peripheral areas where ASM operators are active, displaying a high dependency on policy interventions for developing economically viable mining clusters (Hentschel et al., 2003).



Figure 7. Distribution of natural resources and existing infrastructure across Africa
(Source: Rekacewicz, 2011).

Government-led initiatives to foster mining clusters that include ASM, should begin with the formalisation of existing ASM activities, followed by promoting collaboration, innovation, and resource mobilisation among stakeholders. To adapt the cluster concept to ASM, policy-makers should consider:

- Mapping existing ASM operations and their proximity to infrastructure,
- Identifying potential cluster areas based on mineral deposits locations and existing infrastructure,
- Developing policies to encourage formalisation and cooperation among ASM operators and between ASM and LSM,
- Investing in targeted infrastructure improvements that bring benefits to both ASM and LSM,
- Promoting skills development and knowledge sharing (c.f. Buxton, 2013),
- Facilitating partnerships between ASM operators, larger mining companies, and downstream industries.

However, most African mining clusters are still developing and face significant challenges. These include infrastructure limitations, skills gaps, and policy inconsistencies. To tackle these issues and increase regional value retention, government policies should focus on:

1. Promoting complementary activities within the cluster,
2. Attracting investment in both ASM and conventional mining operations and supporting industries,
3. Providing targeted training programs to address skills gaps,
4. Offering fiscal incentives for new enterprises, particularly those that add value to clusters.

In conclusion, mining clusters can play a crucial role in ASM's sustainable development by concentrating mining activities in one site, facilitating various improvements. Firstly, they enable infrastructure development, such as roads and energy networks. Secondly, they enhance service provision, including transport, logistics, equipment suppliers, and financing. Thirdly, they promote knowledge sharing in areas like health and safety, training, and geological information. This concentration simplifies environmental protection measures, governance, mining inspections, rights management, and tax collection. Additionally, business proximity promotes circular economy practices, where waste from one process becomes input for another.

4.4. Information and service exchange platforms

While the level of digitalisation in the ASM is likely to be very low, mobile phones and supporting networks can be found even in remote areas of Africa. Mobile phone applications ('apps') can be used to connect those in need of services (e.g. transport of materials, mechanised digging) with those, who have the necessary vehicles or machinery due to higher capitalisation ('Uber Mining'). Mutemeru & Ponnann (2024) cite examples from African rural areas for tractor-sharing and similar arrangements could also be envisaged for ASM needs. While such arrangements are not fundamentally different from those discussed in Section 3.3, the mobile phone-based platform helps to increase efficiency by real-time delivery of service and more efficient scheduling, which can also reduce the cost for the service provider due to fewer empty trips etc.

Such platforms could also be used to share ASM-relevant information, such as weather-forecasts, buying prices, location of itinerant buyers, etc.

As noted by Mutemeri & Ponnann (2024) and others networking and building B2B relationships can help information to permeate the ASM community at local and wider levels. This has been indeed the purpose of the Platform that was to be developed under AfricaMaVal WP5. A key contents element was to be information about training resources, both in form of courses and downloadable. More informal approaches could include WhatsAppTM-groups and similar.

5. Business and Operational Models in African ASM

5.1. NGO- and Industry-Developed Business Models for ASM

NGOs seem to play a major role in addressing the issues around ASM and are also trying to introduce business models that lead to formalisation and thus better financing. Thus, various international NGOs have developed business models to address the challenges of market access and financing for ASM. The examples below not concern the commodities listed as EU CRMs (EU, 2024), but can serve to some degree as role models. However, the value-webs for gemstones and gold tend to be simpler and in the case of former involves limited processing. One has to keep in mind that in the value-webs of most metals the smelters constitute an obstacle in blockchain-tracing as materials from many sources may become mixed.

- **Moyo Gems Project:** This project by PACT (<https://www.pactworld.org>) facilitates access to international markets for gemstone miners in Tanzania and Kenya. Miners are organised into groups and sell directly to international buyers at fair prices (<https://moyogems.com>).
- **Virtu Gem:** This project enables the virtual buying of gemstones from Malawi, Zambia, and Kenya. It focuses on local value addition and uses blockchain technology to ensure the provenance of traded gemstones (<https://virtugem.com>).
- **The Impact Facility - A Nuanced Approach to Financing:** The Impact Facility, a UK-based NGO, provides mining equipment to ASM gold operators in Kenya and Uganda on a lease-to-own model. The organisation trains miners on occupational health and safety, conducts ESG assessments, and offers loans to eligible miners (<https://www.theimpactfacility.com>).
- **Fair Cobalt Alliance - Cobalt credit:** Recognising this need for investment, The Impact Facility (TIF), together with Fairphone (<https://www.fairphone.com/>) and the support of various other member organisations of the Fair Cobalt Alliance (<https://www.faircobaltalliance.org>), formed a Taskforce for Supply Chain Integration that has developed and launched Cobalt Credits – a ‘book and claim’ based credit system that allows downstream companies to financially contribute to improvements at artisanal mine

sites committed to professionalising their operations – enabling and incentivising the responsible production of artisanal cobalt, through joint work. Cobalt Credits represent an innovative new approach to addressing the complex issues associated with artisanal and small-scale cobalt mining, particularly in the Democratic Republic of Congo (DRC). This credit system connects downstream actors eager to ensure the supply of responsibly produced artisanal minerals, with upstream artisanal producers committed to adopting better practices, allowing downstream actors to buy credits per tonne of mined cobalt equivalent to their cobalt consumption.

- **Better Mining** - RCS's Better Mining programme (<https://www.rcsglobal.com/bettermining/>) is an RMI-recognised upstream assurance and digital traceability mechanism for smelters to validate 3TG exports as conformant to international responsible sourcing requirements. There are various positive examples of addressing the traceability issue. In the DRC for instance, Tantalex Resources has acquired an interest in an area which was mined by ASM for coltan ore (<https://tantalexlithium.com/lubule-tin-tantalum/>). Tantalex then signed an agreement with a tantalum refiner, and has collaborated with the then Better Sourcing Program (now called 'Better Mining') in order to ensure supply-chain due diligence from the mine to the refiner (AfricaMaVal Report 1.3). This is an innovative approach combining several instruments to improve supply-chain due diligence, i.e. the provision of a direct marketing link to ASM (Tantalex acting as buyer), keeping supply chains short (direct collaboration with a foundry), and ensuring third party monitoring of the supply chain (through the Better Mining Programme). Even though mineral supply chains that are subject to these instruments do operate in a kind of 'closed-pipe' system, they nevertheless provide a potential monitoring solution.
- **Cobalt for Development** – The C4D initiative (<https://cobalt4development.com>) in the DRC by the German organisation for international collaboration (GIZ). It is exclusively funded by a cross-industry partnership including BASF, BMW, Samsung Electronics, Samsung SDI and Volkswagen Group. Its goal is to improve the living and working standards for artisanal cobalt miners and their communities. This is done by working with the miners directly through local cooperatives, official authorities and civil society. Ultimately, the aims of the project will be achieved by strengthening legal compliance, improving health and working conditions, managing environmental resources and a focus on economic and social wellbeing.

In the following section also certain types of ASM financing are discussed, such as 'micro-finance', Village Savings and Loans Associations (VSLA), and others as country-based examples.

5.2. Progress in ASM Formalisation

Some African countries have made significant progress in ASM formalisation. Below, some examples are discussed.

5.2.1. Burkina Faso

In Burkina Faso, microfinance Institutions (MFIs) provide financial services to lower-income, unemployed, and financially excluded individuals (Seguin et al., 2023). They are mainly centred in rural areas while banks remain concentrated in urban areas. The growth of MFIs in the country since the mid-2000s is driven by the integration of micro-lending strategies by new actors and has become a major competitor to traditional banks. Thus, in Burkina Faso's gold ASM are often reliant on informal lending sources and networks. Informal financing, such as Village Savings and Loans Associations (VSLA) are located in rural areas. These informal savings groups allow thousands of people to access financing in remote areas (Hendricks & Chidiac, 2022). The core idea of VSLAs is that they change the approach of financial inclusion from debt to savings and rely on existing trust relationships amongst peers in communities. It is based on building financial assets and skills through communal savings to address the needs of the poorest members of these groups. Although widely implemented by large international organisations which have made savings groups a central pillar of their financial inclusion work in rural, informal sectors, VSLAs have not yet been widely implemented across artisanal mining communities. IMPACT was one of the first organisations to adapt the VSLA model to the artisanal mining sector through its Artisanal Mining Women's Empowerment Credit & Savings (AFECCOR) project (<https://impacttransform.org/en/work/project/artisanal-mining-womens-empowerment-credit-and-savings/>).

5.2.2. Ethiopia

Ethiopia has implemented a unique approach to overseeing and encouraging ASM, through formalisation, centralised market, and attractive prices.

Formalisation (Cooperatives)

Since the enactment of Proclamation No. 147/1998 (President of the Federal Democratic Republic of Ethiopia, 1998) more than 25 years ago, Cooperatives have been a fundamental part of Ethiopia's economic landscape, particularly for artisanal miners. While miners have the option to operate independently, they can only access certain benefits by joining a Cooperative or forming one with at least nine other members. As outlined in Section 31 of the proclamation, Cooperatives enjoy several advantages, including income tax exemptions, the ability to acquire land, and eligibility for government support, along with assistance from an institute dedicated to promoting cooperatives and enhancing their members' capacities.

Additionally, the Ministry of Mines has established a system to help cooperatives access loan and savings services in each region. This system also provides capacity-building programmes and

support in the form of technical equipment and infrastructure, promoting greater autonomy and sustainable growth for well-structured cooperatives.

Centralised Market

A distinctive aspect of Ethiopia is the high percentage of artisanal gold that is officially declared. The central government, through its Central Bank and a regional buyers' licensing system, directly centralises all artisanal gold production in the country. This system allows the State to more effectively monitor the sector and take an active role in its oversight. While this policy may be somewhat restrictive for miners, limiting their freedom to sell to whomever they choose, it has become a significant opportunity for miners' cooperatives. These cooperatives not only benefit from the material and training advantages previously mentioned but also gain from the government's proactive pricing policy.

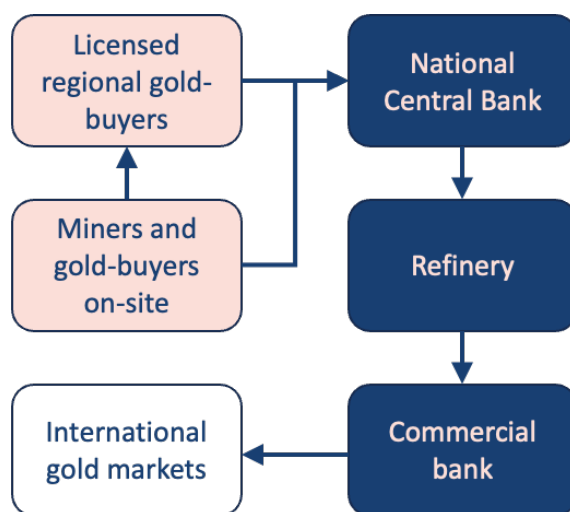


Figure 8. Organisation of the buying chain for artisanal gold in Ethiopia.

(after Betran et al., 2016)

Attractive Price

Ethiopia faces fewer challenges in channelling its gold and controlling its territories compared to some Central African nations. To encourage artisanal miners to operate legally, the Ethiopian authorities have implemented an attractive purchasing system. The Central Bank buys artisanal gold at the current world market price, with an additional 5% premium. This system effectively deters the use of gold for laundering money from illegal trade or financing terrorist activities. Although still expanding and working to win over more artisanal miners, this approach is one of the most successful in terms of proactive government involvement in the artisanal mining sector. By purchasing gold at a higher price, the Central Bank not only accumulates significant gold reserves but also gains better control over the sector.

Key lessons from Ethiopia's approach to ASM practices include:

- The country has established a long-term policy aimed at facilitating and encouraging the formalisation of miners.
- This policy is reinforced by strong incentives, particularly a purchasing price that serves as both an effective channel and a motivation for miners to formalise their activities. Co-operatives generally support the state's purchasing mechanism, as it offers favourable terms.
- The pricing policy has also been used to encourage miners to participate in training programmes on best mining practices.
- The policy of buying gold above the world price has spurred significant development in rural areas and enabled the country to build substantial foreign currency reserves.

5.2.3. Ghana

ASM in Ghana is a significant part of the mining sector, contributing about 30% of the country's gold production. However, ASM is often associated with poor mining practices, leading to environmental and safety concerns. Despite these challenges, ASM remains a critical income source, with various financing models, including equipment rentals, sponsorships, and community mining schemes.

To support ASM, various initiatives have been introduced, such as the Planet Gold project (<https://www.planetgold.org>), which focuses on formalisation, environmental management, and capacity building, particularly for women miners. Educational institutions such as the University of Mines & Technology (UmaT, <https://umat.edu.gh>) and the University of Energy and Natural Resources (UENR, <https://uenr.edu.gh>) offer training programmes to improve the technical and management skills of ASM operators.

Large-scale mining in Ghana is typically managed by multi-national companies, characterised by structured operations that span the entire mining value chain, from exploration to rehabilitation. Key departments, such as sustainability, focus on environmental stewardship, social responsibility, compliance, and other critical areas. For example, Goldfields Ghana (<https://www.goldfields-ghana.com>) has a dedicated ESG department, and their ESG profile is publicly available.

Ownership of large-scale mines often involves a mix of public and private investors, with the Ghanaian government holding at least a 10% stake. Examples include the Ghana Manganese Company (<https://ghamang.com.gh>), which is 90% owned by Consolidated Minerals Africa Limited (<https://www.consmin.com>) and 10% by the government, and the Ghana Bauxite Company (<https://www.ghanabauxite.com>), jointly owned by a Ghanaian consortium and the government.

Overall, while large-scale mining in Ghana is well-financed and structured, ASM faces challenges due to financial constraints and informal operations. However, efforts are being made to improve sustainability and governance in the ASM sector through training, formalisation, and international support.

5.2.4. Madagascar

Although mica is not a critical mineral, the Responsible Mica Initiative (RMI, <https://responsible-mica-initiative.com>) is a good example for an NGO that works on formalisation of ASM and establishing responsible and sustainable supply chains in Madagascar and downstream customers. Mica is mined in Madagascar under conditions of isolation, insecurity, illiteracy and extreme poverty. Moreover, the lack of clarity of the legal framework creates an unstable environment for the sector, which leads to child labour, poor working conditions, poor education and healthcare, but at the same time dependence on the artisanal extraction of mica as the only source of income. In this context, RMI launched in 2022 its initiative in Madagascar with a stakeholder-involvement approach, in order to contribute and actively participate in the better coordination of all actors involved in the mica supply chain (local and global businesses, ...) and with mica artisanal and small-scale mining communities (NGOs, local representatives, ...).

The RMI operates through a collective approach covering the whole value-web. This involves all stakeholders in the development of voluntary standards for the mica sector. RMI facilitates this process through a traceability platform that is blockchain-based and is helping downstream members in understanding and monitoring the progresses that are made upstream. Key elements are the involvement and cooperation of the extreme ends of the value chain, the downstream buyers and the upstream miners as well as leverage of international agreements and national regulations. There are some factors that facilitate the process: on one hand, mica is a relatively low-value material, which reduces the incentive for downstream speculation; on the other hand, international agreements help RMI in obtaining downstream members' support in changing what happens upstream, while the Malagasy mining code explicitly recognises ASSM, facilitating the opportunities to formalise and obtain governmental support for miners. However, the key factor in successfully engaging the miners is to work at a very local level with simple, but focused interventions, that target the real needs of the local miners.

The RMI could serve as a role model for CRM cases. A more detailed description of this example can be found in the AfricaMaVal deliverable D4.2 (Ghezzi et al., 2024).

5.2.5. Morocco

Artisanal mining in Morocco is governed by Law No. 74-15 (Government of Morocco, 2016), which replaced the Dahir of December 1, 1960, that established the Tafilalet and Figuig mining region and created the Purchasing and Development Centre for the Tafilalet and Figuig mining region (Centrale d'Achat et de Développement de la région minière de Tafilalet et de Figuig, CADETAF, <https://cadetaf.com/>). CADETAF is a public entity with legal personality and financial autonomy, subject to state financial oversight.

The Tafilalet and Figuig regions are renowned for their rich mineral deposits, including zinc, barite, manganese, iron, copper, and fluorite. Although mining activity and production in these regions are relatively sparse, the barite deposits are particularly valuable, with ore grades reaching up to 85%, making artisanal and small-scale mining a viable livelihood.

The mining region is divided into zones allocated to investors through a competitive bidding process based on the investment programme, access fee, and royalty rate. Artisanal miners are given priority in obtaining a prospecting permit within the zone where they operate, provided they meet the necessary criteria.

CADETAF is governed by a Board of Directors chaired by the Head of Government or a delegated government authority and managed by a director appointed according to current legislation. The Board includes representatives of the State and the following members:

- Presidents of the concerned regions or their representatives,
- Six members representing artisanal miners from the following provinces: Errachidia, Figuig, Tinghir, Midelt, Zagora, Boulmane.

CADETAF provides critical support to artisanal miners in the Tafilalet and Figuig regions through various initiatives:

- **Technical Assistance:** Offering technical guidance to improve mining practices, safety, and efficiency, including workshops, training, and access to modern tools and equipment.
- **Financial Support:** Providing financial assistance for exploration, mining operations, and infrastructure development, with grants and loans to help miners invest in their activities.
- **Market Access:** Facilitating market connections to help miners sell their products both locally and internationally, boosting income and sustaining livelihoods.
- **Legal Compliance:** Assisting miners in complying with legal requirements, licenses, and environmental regulations.
- **Community Development:** Promoting community projects such as schools, health centres, and water supply systems that benefit both miners and local residents.

Additionally, CADETAF maintains a monopoly on the collection, purchase, storage, warehousing, transport, sale, and general marketing of all lead, zinc, and barite ores extracted from artisanal mining operations.

5.2.6. South Africa

The National Association of Artisanal Miners (NAAM, <https://www.facebook.com/groups/773326350152467/>) is a South African association, where artisanal miners are coming together under one banner to be formalised, as provided for by the ASM policy of 2022 (RSA Department of Mineral Resources and Energy, 2022). This organised national body provides various benefits for artisanal miners, such as guidance on cleaner production and workplace health & safety, access to funding, legal recognition, and protection against illegal miners. The association notes that artisanal miners are often being exploited because of a lack of recognition, while instead the ASM sector could grow formally and becomes a key source of employment and value creation in a country that is facing an unemployment crisis. NAAM is a national body that provides a voice to ASM actors. it builds on (RSA Department of Mineral Resources and Energy, 2022) to provide a framework for artisanal miners' formalisation through the formation of cooperatives. The

cooperatives train and educate miners who then lead other cooperatives of less well-educated individuals who would develop business plans (NAAM statement 04.09.19; <https://macua.org.za/2019/10/27/national-association-of-artisanal-miners-media-statement-04-september-2019/>).

NAAM appears to be the only ASM association at national level and provides advice on technical, legal, financial, and ESG aspects. It attempts to be a regulatory reference in a sector where lack of transparency and exploitation are the normal. However, it appears that ASM governance related issues in the RSA are overlain by socio-political and socio-ethnic issues and criticism of the current government. However, neither the government policy nor NAAM have been able to stop the activities of criminal and armed ‘zama-zama’ gangs and syndicates, who extort the proceeds of ASM operators and force them to work in illegal ASM operations (e.g. Dlakavu, 2021).

A more detailed description of the situation in RZA can be found in the AfricaMaVal deliverable D4.2 (Ghezzi et al., 2024).

5.2.7. Zimbabwe

An example of direct market access are the Fidelity Printers and Refiners in Zimbabwe (<https://fgr.co.zw>), which is owned entirely by the Reserve Bank of Zimbabwe and is the sole authorised buyer and exporter of gold in Zimbabwe, launched the Gold Development Initiative Fund (GDIF, <https://pmcz.co.zw/gold-development-initiative-fund-gdif/>), established in response to small-scale miners’ grievances over a lack of support and capital. It was launched specifically to provide lending in support of the acquisition of gold mining plants and equipment by miners and is accessible to any Zimbabwean-owned business. The application process is fairly stringent, with Fidelity Printers and Refiners demanding prospective applicants to provide significant information (Hilson and Hilson, 2020). The GDIF also provides associated miners with loans (ZELA, 2021).

6. ASM and communities – value beyond economic value

Unlike in agriculture, many trades and services, mining *a priori* aims to generate revenue streams with income coming from outside the communities. Mining has to take place, where the minerals of interest are found. Sometimes this is in or near existing local communities, but frequently a mine (both LSM and ASM) gives rise to the development of new communities. While LSM in remote areas often operate fly-in/fly-out schemes with camps for the workforce, in an ASM context miners settle (at least temporarily) near the operation, usually together with their families. This will give rise to new socio-economic ecosystems, as the miners and their families will need supplies and services. When minerals are found at existing communities, this often leads to an influx of outside people with a resulting change in the societal make-up, often leading to resentment and aggression. If exploitation is sudden and short-lived, particular effort may need to be made to stabilise the local community (Hentschel et al., 2003).

Mining and its supporting activities thus are deeply embedded into the social fabric of the local communities. The main issue is how to better integrate the ASM sector into the local community and to encourage the investment of profits in other forms of economic activity and services with a view to make these communities more resilient in the view of fluctuating commodity prices and dwindling resources. In consequence, the prevalent business models according to which ASM operates has significant repercussions on this social fabric.

Measures aimed at the improvement of productivity, enhanced safety at work, and more transparent supply-chains, as inherent in the requirements for ‘responsible sourcing’ by European buyers will also affect in various ways these social fabrics and the underlying socio-economic ecosystem. Measures associated with the demand for ‘responsible sourcing’, such as improved OHS, elimination of child labour, increased mechanisation, and others need to be contextualised with the socio-economic fabric, as they may result in job losses and reduced family income. This in turn will lead to resentment of the mining communities against such changes and unwillingness to become ‘formal’ miners.

The primary purpose of AfricaMaVal is not development aid, but the strengthening of the raw materials value-chains that connect Africa with Europe with a view to create win-win situations. Hentschel et al. (2003) noted that the extent to which ASM can contribute to the goals of sustainable development, depends on the nature of the mining. Thus, initiatives aimed at supporting the ASM sector must indeed be seen in the context of the whole community. Projects should be based on an integrated approach that considers organisational, social, economic, legal, technical, and environmental issues together.

On the socio-cultural side, Mutemeri & Ponnann (2024) introduced the interesting notion that artisanal mining can be a form of cultural heritage and traditional way of living, but whether this applies to the African context would need to be investigated on a case-by-case basis. It certainly would only apply to ASM communities that have persisted for at least two or three generations, based on sufficient resources and/or low exploitation rate.

The business and operational models discussed in Section 3.3, therefore, need to be assessed with respect to their capability to shore up communities’ support, enhance local governance and drive social improvements. Aspects to be reviewed include:

- Community integration of the ASM sector;
- Community financing and profit sharing;
- Effect of policies and legislation in other domains that affect employment situations and opportunities;
- A wider assessment of the socio-cultural and socio-economic context, looking also at the wider educational and training aspects.
- How to overcome psychological and socio-cultural resistance to become ‘formalised’ ?
- Removing economic, societal, and governance disincentives to create win-win opportunities;
- Economic and personal OHS risk management approaches.

Table 6. Evolution of community approaches to ASM
(after Hentschel et al., 2003).

Period	Approaches for dealing with ASM
1970s	Definitional issues
1980s	Technical issues
Early 1990s	Towards integration of technical, environmental, legal, social and economic issues
1990s	Special attention on legalisation of ASM sectors
Later 1990s	Relation between large mining companies and ASM Gender and child labour issues
2000s	Community-related issues and sustainable livelihoods

Table 6 indicates a gradual move towards this contextualisation, but integration of ESG still remains an issue in the 2020s. It is likely to be a two-way or win-win situation: when ESG issues are resolved, community and sustainability issues will become resolved and vice versa (cf. Elkington, 1994).

Recognising artisanal mining as a livelihood and economic development pathway as well as an opportunity for social advancement and growing political capital, Levin-Nally and Tufo (2024) suggest some of the things actual or potential artisanal miners may be thinking about:

- Why am I mining rather than doing something else? What does it bring for me and my family?
- What is my community like? Is it thriving or struggling?
- How much do I need this livelihood?
- What is my operating environment like? Is it predatory or enabling? Stable or dynamic? Predictable or uncertain?
- Could my operating environment present a problem for me, my family, my co-workers and my community as we seek to make a living from our mining activities?
- How possible is it for me to operate legally (in every aspect)? Why would I or should I? How can I obtain mining rights? Who can support me in the process and to ensure I retain access to production sites?
- What security do I need for myself, my team, my product, my tools, my operation?
- How will the weather affect the viability of my operation?
- How can I get the upfront capital I need to start mining, and the working capital to run my mine? How can I be sure I will be able to repay this? What happens if I can't?
- How do I compete or cooperate with other miners to increase my chances of success?
- Who should I work with? Who shouldn't I work with and why?
- Who will I sell to? How will I know if I'm getting a fair price? Can I make the sale happen regularly enough to meet my needs?
- Can I make enough money to support myself and my family?
- Does the money I can make outweigh the risks I will have to take?

In order to assess the societal relevance that ASM business models could have, it is appropriate to start from the main ESG issues that are usually associated with artisanal mining. Deliverable D4.2 of the AfricaMaVal project (Ghezzi et al., 2024) highlighted the following challenges as the most pressing ones:

- Environment: soil erosion through dredging, pollution of local water sources, artisanal mining taking place after official closure, absence of control over land use when mining activities are informal;
- Social: violence and crime in the community, drugs abuse, poverty of local community, displacement of artisanal miners by LSMs, absence of legal recognition, child labour, forced labour, huge influx of migrant workers, poor education levels and lack of ability to use proper equipment;
- Governance: absence of law application and enforcement among artisanal miners.

Taking into consideration the possible business models discussed in Section 3.3, viz.

- Associations/cooperatives
- Symbiosis between LSM and ASM
- Diversification in the upstream value-chain
- Specialisation in the mining eco-system
- Profit-sharing arrangements

one can aim to analyse their possible contribution to resolving the above-stated issues thus clarifying the societal relevance of these ASM business models.

6.1. Societal impact of associations/cooperatives

According to Banda and Chanda (2021), a socio-economic transmission mechanism can be developed to explain how an ASM plan promotes poverty alleviation and macroeconomic stability through a cooperative approach. From the social transmission mechanism route, the cooperatives have the potential to alleviate poverty in communities hosting mineral resources by providing income to community members through mining. Additionally, the cooperatives can potentially reduce poverty through linkages to other businesses, inducing an economic multiplier effect in communities hosting mineral resources (e.g. agriculture). This, in turn, leads to the alleviation of other social issues generated by poverty and the absence of alternative ways of earning an income, such as violence and crime in the community, drug abuse, prostitution, and child and forced labour. The economic transmission mechanism route demonstrates how minerals can be used to promote macroeconomic stability (Figure 9).

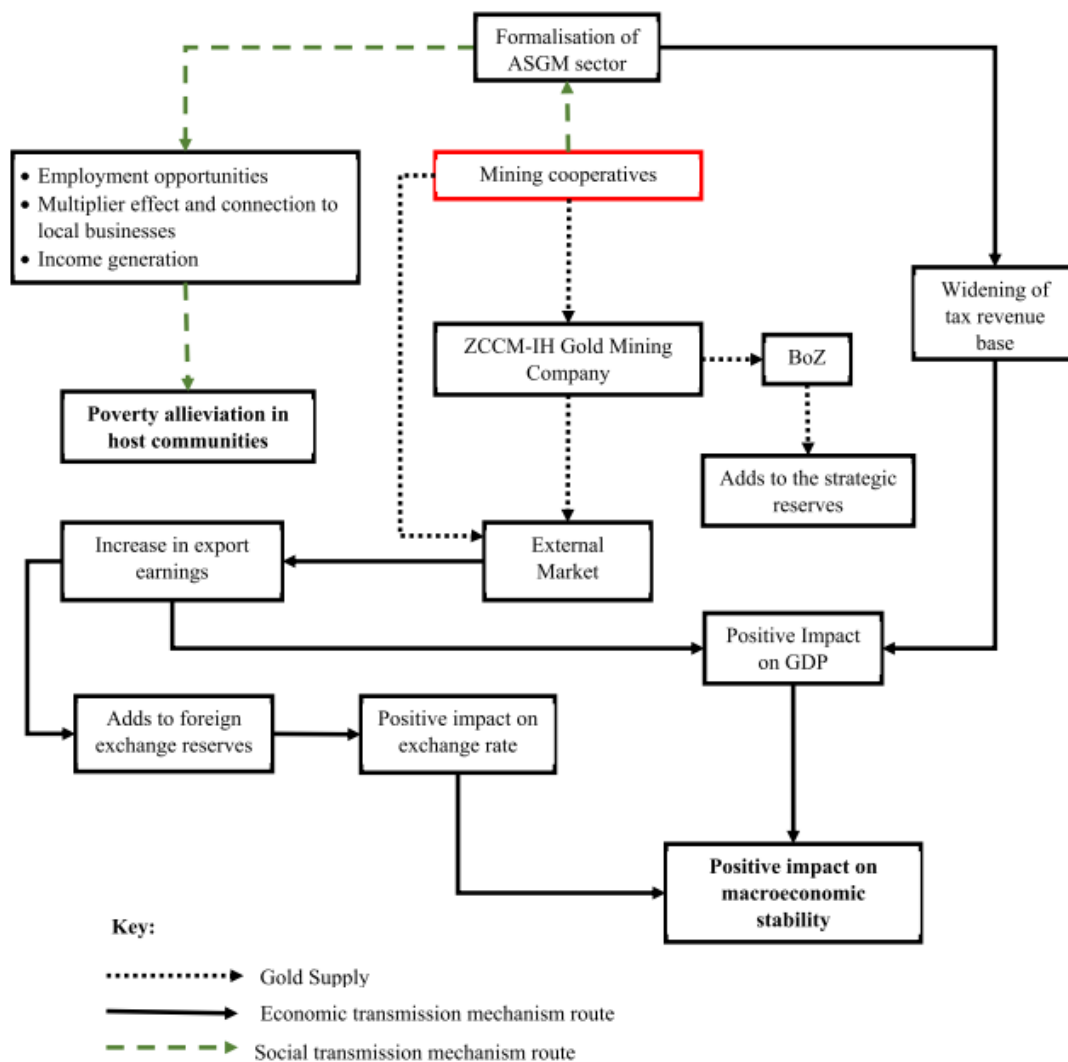


Figure 9. Socio-economic transmission mechanism of ASM cooperatives in Zambia
(Banda and Chanda, 2021).

Firstly, the route elucidates that cooperatives can help in formalizing the ASSM sector, thus widening the tax base and subsequently having a positive impact on the Gross Domestic Product (GDP), which translates into a positive impact on macroeconomic stability. The alternative economic transmission mechanism route explains how mineral supply through cooperatives can increase the strategic reserves of the central bank and promote macroeconomic stability. The supply of minerals to the external market increases export earnings and positively impacts foreign exchange reserves. This subsequently leads to a positive impact on the exchange rate, GDP, and macroeconomic stability.

6.2. Societal impact of symbioses between LSM and ASM

This approach envisions the presence of an intermediary organisation to raise awareness of the issues associated with and achieve sustainable mining practices among ASM miners and their community, and other stakeholders (LSM, states, donors, etc.). With reference to Section 3.3.3, it can be regarded as part of the ASM-LSM symbiosis business models. Fritz and Lara-Rodríguez (2022) report on the case of Barksanem Sarl (<https://www.barksanem.com>), an artisanal and semi-industrial gold mining company that has developed a block-chain solution to trace gold produced from ASM in Burkina Faso. The company aims to establish a replicable model of economic transformation through sustainable practices in the mining sector, encompassing water access, agricultural development, reforestation, and soil remediation. Their digital solution aids in identifying miners, facilitating their formalisation, and enhancing their access to banking, healthcare services, and the international gold market. With this digital solution, all miners can participate in ASM, even if they are not formalised, thereby supporting poverty reduction and equal opportunities. However, they must be organised as a cooperative and adhere to specific production standards set by Barksanem (based on ISO standards and Fair Mined certification – cf. Section 3.5.3). These standards include mercury-free mining, safe digging techniques, and the use of safety equipment. In this sense, the two business models of cooperative and symbiosis are non-excludable, rather complementary, and synergistic in achieving a positive legacy from an economic-societal point of view. This case shows the contributions that the ASM sector can make to sustainable development with the help of an intermediary like Barksanem Sarl. However, as of November 2024 it is not clear, whether this company is still in operation.

6.3. Societal impact of diversified upstream value-chains

At African ASM sites, when assessing the societal relevance of such activities one should take into consideration not only the livelihoods of the individuals engaged in mineral extraction and processing activities directly, but also the people engaged in a multitude of additional income-earning activities found in the wider socio-economic ecosystem. Activities range from selling foodstuff, to tools and electronics, spare parts for generators or motorcycles, medication, and various services, such as renting out accommodation (Zhang et al., 2020). However, the most popular pursuits involve the leasing of “excavators and lighting systems to facilitate mining and evade the security forces that typically swamp the informal ASM sites during the day” (Bansah et al., 2018). Research by Traorè et al. (2024) carried out in the Kéniéba District in Mali provides some insight into the possible societal contributions that the ASM ecosystem can have. For example, ownership of crushing machines by male and female entrepreneurs, who once were miners themselves, generates jobs in the community by local entrepreneurs who know the context first hand. However, this situation is commonly illegal, as the ownership of crushing equipment is not allowed for artisanal miners in Mali. The conditions are different for local equipment suppliers, who perform this service in competition with Chinese suppliers of cheap and low-quality equipment. This form of entrepreneurship can bring value to the society as a whole and at local level if carried legally and with the appropriate tax declarations.

The service providers at ASM sites in Mali are predominantly private individuals rather than associations. These include equipment suppliers, small-scale retailers, and entrepreneurs offering various services. From those who run their equipment supply business independently to those who operate as a private retailer and have built a substantial business around supplying tools and machinery, the majority of entrepreneurs appear to work independently, relying on family networks or small teams rather than being part of formal cooperatives or associations (Traorè et al., 2024). Financing for these activities of diversification within the ASM sector in Mali often comes from personal savings or reinvestment of earnings generated by ASM activities. Many entrepreneurs start by saving money earned from their mining efforts or other small businesses related to ASM, such as food stalls, equipment supply, or retail stores. For instance, an equipment supplier in Sangare Dioura, initially accumulated money from working with his brother before co-managing a small business selling spare parts and equipment (Traorè et al., 2024). Similarly, women entrepreneurs use their mining earnings to open small grocery stalls and food businesses. However, as noted above, access to external financing, such as bank loans, is typically limited due to the informal nature of most ASM businesses, which lack the legal structure needed to qualify for traditional credit lines (Traorè et al., 2024). Equipment requiring a certain amount of investment, such as crushers, is instead generally operated by service providers rather than the miners themselves. Bigger entrepreneurs, who manage and own multiple pits, have invested in crushing machines to process the ore extracted by their employees (Traorè et al., 2024). These machines are operated either by hired employees or family members, depending on the size of the business and the financial capacity of the owner and the skills available. For example, a local entrepreneur in Kénieba District employs around 30 to 60 people depending on the season, including those operating the crushers (Traorè et al., 2024).

It can be concluded that service providers at ASM sites operate with both hired employees and family members, depending on the scale of their business. As businesses grow, they tend to hire additional workers from the local community, especially during busy mining seasons.

7. Integration of ESG goals into ASM business models

7.1. Basic considerations

Framing ESG integration as an opportunity rather than a burden is crucial for ASM. Improved ESG performance can provide a market edge, enhance reputation, and facilitate due diligence for clients down the value chain.

Adapting ASM business models to meet ESG challenges is complex but necessary, as global focus on responsible sourcing intensifies. This requires a combination of policy support, training, technological innovation, and sector-wide collaboration.

Policy support examples include promoting cooperatives or associations. These structures facilitate better organisation, resource sharing, and collective bargaining. In Tanzania, the Mwanza

Women Miners Association has helped members access training, equipment, and markets, improving working conditions and incomes (Buss et al., 2019). Such associations can also implement ESG practices across multiple small operations.

Another approach involves enabling partnerships between ASM operators and LSM. These partnerships provide ASM access to technology, expertise, and markets while helping larger companies fulfil social responsibility commitments. The Ghana Responsible Mining Alliance, a collaboration between large-scale gold miners and ASM operators, has improved safety standards and reduced environmental impacts (McQuilken & Hilson, 2018).

Governments could offer tax incentives or preferential mineral rights access for ASM operations meeting specific ESG criteria. Colombia's formalisation programme for ASM gold miners offers technical assistance and easier mining title access for operators committing to environmental and labour standards (Echavarria, 2014).

Training is key to improving ASM business models. Programmes focusing on business management, accounting, labour management, and technological skills can enhance operational efficiency and ESG performance. The Gemstone and Jewellery Institute of Tanzania provides training in gem cutting and business skills, helping ASM operators move up the value chain and increase income (Kyngdon-McKay et al., 2018).

Technologically, simple innovations like efficient machinery or improved processing methods can reduce fuel costs and environmental impacts. In Mongolia, gravity concentration methods for gold extraction have reduced mercury use and improved recovery rates, demonstrating environmental and economic benefits (Stapper et al., 2021). Combined with basic safety measures, such as personal protective equipment, these practices minimise downtime and reduce accident rates in various countries' ASM operations (Smith et al., 2016).

Better operations planning and geological knowledge integration can improve productivity and reduce risks. Basic geological mapping and prospecting techniques help ASM operators target efforts effectively, reducing unnecessary excavation and environmental impacts. In Rwanda, a programme providing ASM tin miners with basic geological training and equipment has led to more efficient resource extraction and reduced environmental disturbance (Perks, 2016).

7.2. Economic incentives

7.2.1. Key options

Given that economic reasons are the key drivers to enter into artisanal mining, it is likely that artisanal miners are very sensitive to economic opportunities and constraints. Thus, enhanced profits and better access to markets are probably the strongest incentives to improved integration of ESG-goals. In particular, artisanal miners will ask the valid question 'what is in it for me?'. Meeting external ESG-goals entails additional CAPEX and/or OPEX that have to be met by a proportional increase in revenue. Such increased revenue can come from improved market access

and/or a prime paid by Western world downstream actors for raw materials produced according to ESG-goals.

In the area of food production providing economic incentives for change from down-stream in the value-chain has been implemented successfully for several decades by now under the umbrella term of ‘fair trade’. NGOs and other actor have been lobbying end-users to select products that fulfil certain requirements with respect to ESG-goals, such as the absence of child-labour, low environmental production processes, a remuneration of the producers that is considered adequate and others. The strategy is to appeal to the conscience of the end-user to do good and buy peace of mind by spending more on ‘fairly traded’ products. While originally such products constituted only a niche market, important mid-stream actors joined in. motivated by the fear of losing market share or gaining previously sceptical customers. In this way the appeal cascaded upwards and more producers were enticed to fulfil ESG-requirements in order to (re)gain market share.

From the perspective of downstream actors, such processes are termed ‘responsible’ sourcing and comprise two essential elements, namely a process to assure that the upstream producer fulfils the expected ESG-goals and a process to assure that such products and only those arrive at the market for the end-user. The first process would be, for instance, an audit of the upstream producer, while the second process is commonly dubbed ‘due-diligence’ on the supply-webs. Rather than leaving it to the market, the EU legislators are currently working on a new regulation on due-diligence in supply-chains.

7.2.2. Response to due diligence mechanisms in ASM supply-webs

It is conceivable that mechanisms of due-diligence as used on certain food-products (e.g. coffee) would also work in the mineral raw materials value-webs. Such responsible sourcing approaches were first implemented for high-value mineral commodities with relatively simply supply-webs, such as gold, diamonds and gemstones, but also for certain metals with a limited number of producing countries, such as cobalt. These developments became also supported at the political level. For instance, in 2017 the EU put in place a regulation on so-called ‘conflict minerals’ (EU, 2017). Likewise, the OECD developed guidelines for due-diligence assessment of supply-chains in mineral raw materials (<https://www.oecd.org/daf/inv/mne/OECD-Due-Diligence-Guidance-Minerals-Edition3.pdf>).

Various non-government initiatives aim to establish a labelling system that identifies fair and responsible mining operations (e.g. the FAIRMINED standard, see Figure 10, <https://www.responsiblemines.org/en/our-work/standards-and-certification/fairmined-standard/>).

They seem to be focusing mainly on gold with projects in South America and Africa. One needs to look into the applicability to African CRM-related projects. They offer training programmes on the OECD due-diligence assessments ((<https://www.responsiblemines.org/en/project/training-due-diligence/>), funded by the EU and the OECD (Table 7, below).



Figure 10. Example: Fairmined standard for gold

(<https://www.responsiblemines.org/en/our-work/standards-and-certification/fairmined-standard/>)

Organisations such as the Alliance for Responsible Mining (ARM) offer due diligence in risk management of mining organisations in the form of audits of ASM operations to check market compliance for selected criteria on behalf of downstream buyers (<https://www.responsiblemines.org/en/our-services/supply-chains/>):

- National legal and formalization requirements (mining and financial)
- Human rights and Labour conditions
- Environmental compliance
- International norms and regulations such as EU legislation and Dodd-Frank
- OECD DD Guidance Annex 2
- Anti-Money Laundering
- Know Your Customer
- LBMA Responsible Gold Guidance

At the level of artisanal miners, it may be organisationally difficult to have such audits undertaken prospectively, but for small-scale mining operations this would enhance their market position, particularly when undertaken by a high-credibility organisation.

Table 7. Alliance for Responsible Mining training programmes on OECD due diligence

Objective:

To foster a shared understanding of the Due Diligence Guidance among the stakeholders and allow the OECD Secretariat to involve new companies, government officials, and civil society organizations in the implementation of the Guidance.

Beneficiaries:

- Artisanal and small-scale miners
- Large-scale mining companies
- Local refiners, traders, intermediaries, international traders
- Banks
- Central and local government authorities, including the Ministries of Mines, National Mining Agencies, Formalization officials, and the law enforcement officials
- Local civil society, the academic world, and the Human Rights Officials
- Representatives of the pertinent international organization

Activities:

1. Development of training modules and tools.
2. Mapping and selection of participants among the private sector, civil society, and governments.
3. Training organization and management for the selected audience.
4. Periodical follow-up of the activities to keep the training results and encourage continuous use of the contents they encompass.

Expected results:

1. Improve the dissemination and awareness of due diligence practices recommended by the OECD guidance throughout the whole supply chain.
2. Increase the involvement of new stakeholders of the supply chain in the implementation of the OECD Guidance.

Implementing due-diligence along mineral raw material supply-webs can be an onerous process due to their complexities. As noted above, the EU currently plans to put regulatory instruments in place that will force European manufacturers to provide the respective assessments and certificates to their respective end-users. This, however, is fraught with various practical problems. Only in a few cases the supply-chains are direct from a mine to a manufacturer for a given mineral or metal. A major node in most supply-webs are the processors or smelters. Particularly also for metals other than bulk base-metals these smelters obtain raw materials from a variety of sources within their own country or from abroad. This means, that the output of the smelters is a mixture from potentially a large number of sources. Therefore, a due-diligence assessment may stop at the smelter, as for a given quantity the origin cannot be determined unequivocally. Thus, it cannot be ruled out that this quantity contains materials from sources that do not comply with our ESG-goals.

A wide variety of research projects are ongoing that aim to establish an unequivocal link between raw materials source and manufactured products, a process known as fingerprinting. These initiatives employ diverse technologies, ranging from blockchain-based distributed ledger systems to advanced artificial fingerprinting methods. The latter includes innovative approaches, such as the application of quantum dots – nano-sized semiconducting crystals that emit specific colours

when exposed to ultraviolet light – and carbon nano-dots, which can serve as material sensors in fluorescent tests (Wang et al., 2015).

These technologies are being explored for their potential to mark and trace minerals from the point of origin, with the most impactful application potentially being at the mine-gate for both ASM and LSM operations. However, challenges persist, particularly in metal value-webs where smelting processing ores from different sources complicate traceability. Consequently, effective due diligence and responsible sourcing initiatives in many metal value-webs still depend critically on the cooperation of smelter operators and their willingness to participate despite economic constraints. While these technologies show promise, a universally workable solution that can overcome the complexities of metal smelting and provide ultimate assurance about mineral origin throughout the entire supply chain has yet to be developed.

8. Auditing ASM operators with respect to ESG-goals

8.1. Purpose

Auditing ASM actors with respect to ESG goals is crucial for ensuring sustainable practices and responsible resource management. Two main approaches can be employed in this process. The first approach involves using UNFC- and CRIRSCO-aligned resource reporting, which provides a standardised framework for evaluating mineral resources and reserves while considering environmental and social factors. This method allows for a comprehensive assessment of the geological, technical, and economic aspects of ASM operations, as well as their environmental and social impacts. The second approach utilises the Triple-Layer Business Model Canvas, which expands on the traditional business model canvas by incorporating environmental and social layers. This tool enables a holistic evaluation of ASM operations, considering not only their economic viability but also their environmental impacts and social value creation. By combining these two approaches, auditors can gain a comprehensive understanding of ASM actors' performance across all ESG dimensions, identifying areas for improvement and potential risks while also highlighting opportunities for sustainable growth and positive impact.

8.2. UNFC- and CRIRSCO-aligned resource reporting

Potential investors, namely the stock-markets, require a reasonably good assurance that extraction projects are commercially viable and can control ESG-goal related business risks. For this purpose, a standard for reporting on mineral projects has been developed by the Committee for Mineral Reserves International Reporting Standards (CRIRSCO, <https://crirSCO.com/>), which was formed in 1994 under the auspices of the then Council of Mining and Metallurgical Institutes (CMMI). It is a grouping of representatives of organisations that are responsible for developing mineral reporting codes and guidelines in the various regions of the world, including Africa (for South

Africa, SAMREC). The purpose is to assess mineral projects according to their likely viability with respect to extraction (Figure 11).

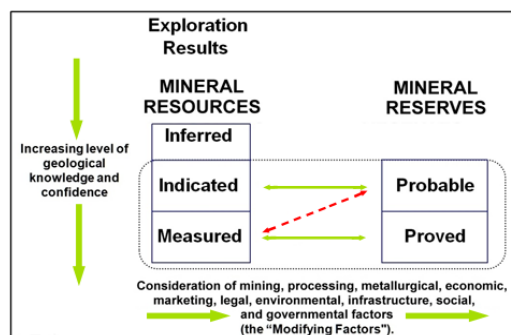


Figure 11. Mineral resources and reserves according to CRIRSCO definitions.

A key aspect that determines, whether a mineral occurrence can become a viable extraction project are the so-called 'Modifying Factors' that include, but are not restricted to, mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, societal, and governance factors. In other words, they are concerned with internalisation of ESG aspect discussed above (cf. https://crirSCO.com/docs/CRIRSCO_standard_definitions_oct2012.pdf).

While CRIRSCO- or SAMREC-compliant reporting focuses on the viability of projects from the perspective of potential investors, the United Nations Resource Management System (UNRMS; UNECE, 2019) provides countries, companies, financial institutions and other stakeholders a tool for sustainable development of energy and mineral resource endowments within the framework of the UN Sustainable Development Goals (<https://sdgs.un.org/2030agenda>). Thus, the UNRMS is designed to be a:

- Global voluntary system for resource management to be used by governments, industry, investors, and civil society;
- Innovative integrated resource management framework for resources such as minerals, petroleum, renewable energy sources, nuclear resources, anthropogenic resources, geological storage and groundwater to support the development of policies and regulations in the sustainable management and advancement of the Sustainable Development Goals (SDGs);
- Comprehensive information framework and methodology to support resource progression applicable for programme, portfolio, project and asset-level management;
- Sustainability framework to aid the financing of resource sectors;
- System for local and indigenous communities for evaluating and assessing projects against stated environmental-social-economic objectives;
- Scheme for long-term considerations of commercial and policy aspects of projects;
- Design of conditions for the industry to harness the integrative dynamic capabilities;
- Support kit for projects to help align with applicable regulations;
- Instrument to support sustainability and financial reporting.

The European Commission has been advocating the use of UNFC in resource-related projects *inter alia* to make classifications compatible with the Raw Materials Information System (RMIS, <https://rmis.jrc.ec.europa.eu>) developed by the Commission's Joint Research Centre (JRS).

In its core principles, the United Nations Framework Classification for Resources (UNFC, <https://unece.org/sustainable-energy/sustainable-resource-management/united-nations-framework-classification>), encompasses a tool for the comprehensive management of all socio-economical, technological and uncertainty aspects of energy and mineral projects. The project maturity and resource progression model of UNFC can de-risk projects from costly failures and thus protect the investments. As UNFC fully integrates social and environmental considerations, it also provides a tool for the assessment of the ESG-compliance of projects. UNFC aims to provide clear and consistent specifications, guidelines and best practices for all energy and mineral sectors. A version tailored to the needs of Africa has been developed under the name of AMREC (<https://unece.org/sites/default/files/2021-10/AMREC%20Presentation%202021.pdf>).

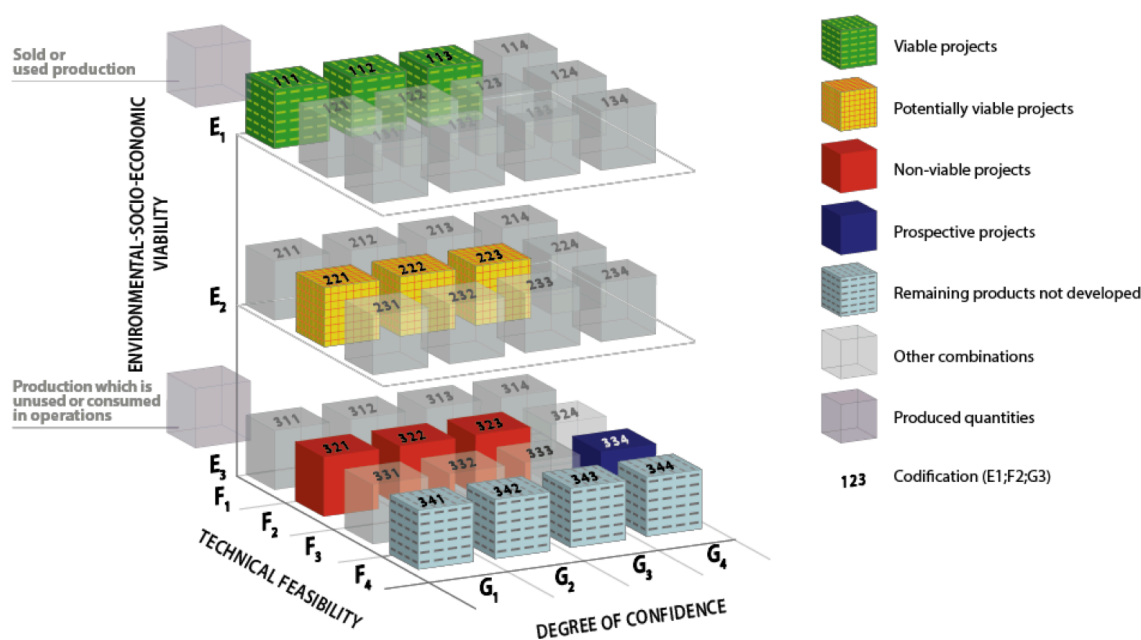


Figure 12. UNFC Categories and Example of Classes.

To help the application of UNFC uniformly worldwide, guidelines on requirements for competency of the personnel who undertake the assessments are included in the system. UNFC is a principles-based system in which a resource project is classified on the basis of the three fundamental criteria (UNECE, 2021) of

- environmental-socio-economic viability (E),
- technical feasibility (F), and
- degree of confidence in the resource estimate (G),

using a numerical coding system. Combinations of these criteria create a three-dimensional system (Figure 12). Categories (e.g. E1, E2, E3) and, in some cases, Sub-categories (e.g. E1.1) are defined for each of the three criteria.

The first set of Categories (the **E Axis**) designates the degree of favourability of environmental-socio-economic and governance (ESG) conditions in establishing the viability of the project, including consideration of market prices and relevant legal, regulatory, social, environmental, and contractual conditions.

The second set (the **F Axis**) designates the maturity of technology, studies, and commitments necessary to implement the project. These projects range from early conceptual studies through to a fully developed project that is producing and reflects standard value-chain management principles.

The third set of categories (the **G Axis**) designates the degree of confidence in the estimate of the quantities of products from the project.

The Categories and Sub-categories are the building blocks of the system and are combined in the form of “Classes”. UNFC can be visualised in three dimensions, as shown in Figure 12 or represented in practical two-dimensional abbreviated versions.

For more details, the reader should consult the Supplementary Specifications for the Application of the United Nations Framework Classification for Resources to Minerals (UNECE, 2021).

It is not conceivable, that a SAMREC- or UNFC-compliant assessment could be applied to *uncontrollable* ASM operations, as its very basis, namely a stable delineation of the ‘mine’ is likely to be missing. This challenge has been recognised by the recently launched UNFC reporting adapted to the Africa, the Pan-African Reporting Code PARC (AMDC, 2023, Appendix Y). This Appendix Y is reproduced in Appendix 1 of this report. Although the guidance for reporting on ASM operations has been greatly simplified in comparison to a full classification according to PARC, it is still likely that for many individual artisanal operators such information will not be available and, indeed, may not be understood by them. The scenario that most likely is amenable to a classification would be delineated ASM zones (cf. Section 3.5.2) within individual countries. Here much of the basic work concerning the assessment of resources and reserves will not have been undertaken on behalf of individual ASM operators, but by the government in order to facilitate and improve the efficiency of ASM activities. Thus, the Section 3 (History), 4 (Geological Setting), 5 (Prospecting Data), 6 (Project Estimation) of Appendix Y of PARC (AMDC, 2023), which could be beyond the capabilities and knowledge of individual ASM operations, could be provided by the responsible government agency. Conversely, data for Sections 7 (Technical Studies) concerning the actual method of extraction would be provided by the ASM operators, describing their way of doing things, to the Competent Person assessing their activities. This in turn would provide a basis for developing business plans and better access to finance.

However, the challenge is to integrate such assessments into ASM business models, the challenges being the greater, the lower the level of formalisation of the ASM operation is.

8.3. Triple-Layer Business Model Canvas

The graphical representation of the various conceptual elements of business models has been first proposed by Osterwalder (2006) and then was enlarged to cover the environmental and societal dimensions by Joyce and Pasquin (2016, cf. Concerning the environmental dimension, in an ASM context, the value proposition would be not so much about creating added value through ‘innovation’, as noted above, but to reduce or avoid lasting environmental degradation from the operation. Given the marginal economic context, this would need to be linked probably to some economic incentives for the operator. As ASMs are usually ‘uncontrolled’ or even ‘uncontrollable’ (see above), sanctions are unlikely to work. Sanctions are only an instrument for ‘controlled’ contexts.

Table 9 illustrates the differences in the TLBMC space between LSM and ASM. Formalised ASM operations, where miners work as a group (family groups, partnerships, associations, cooperatives), serve as the ASM base case.

Table 8 below). They dubbed it the Triple-Layer Business Model Canvas (TLBMC) in reference to the Triple-Bottom approach by Elkington (1994) to assess the environmental and societal sustainability of businesses and projects. The rationale of the development proposed by Joyce and Pasquin (2016) focuses on making businesses more sustainable in the sense that ‘sustainability’ in both, the environmental and the societal sense, becomes part of the value proposition. This may be beyond the scope of ASM operators, who by definition are marginal operations with little scope or let alone ambition for generating value above ensuring a living for those involved. This observation, however, should not compromise the applicability of the TLBMC in principle.

The TLBMC is a tool for structured thinking about the different factors that make up a business. The visualisation into one graphic may make it also accessible to ASM operators to better understand their dependencies and interdependencies. The enlargement beyond the immediate economic dimension to the societal and in particular the environmental dimension may not be so obvious for ASM operators, but the combination with the economic dimension can help them to better understand their contextualisation and feed-back loops. The TLBMC helps to make these interconnections, that are often only understood tacitly, more explicit and, therefore, more amenable to active management.

In the first instance the TLBMC can help stakeholders and ASM operators to identify particular bottle-necks in their value-creation and to visualise which elements should be changed and which elements can be changed. As ASM often is more a way of life, rather than just a ‘job’, including the soci(et)al dimension into the assessment can be very important. The societal fabric can be closely interwoven with the economic dimension, as the ‘partners’ in the economic dimension are often also members of the same family and certainly the same community.

Concerning the environmental dimension, in an ASM context, the value proposition would be not so much about creating added value through ‘innovation’, as noted above, but to reduce or avoid lasting environmental degradation from the operation. Given the marginal economic context, this would need to be linked probably to some economic incentives for the operator. As ASMs are usually ‘uncontrolled’ or even ‘uncontrollable’ (see above), sanctions are unlikely to work. Sanctions are only an instrument for ‘controlled’ contexts.

Table 9 illustrates the differences in the TLBMC space between LSM and ASM. Formalised ASM operations, where miners work as a group (family groups, partnerships, associations, cooperatives), serve as the ASM base case.

Table 8. Conceptualising business models to meet ESG challenges
(Tripple-Bottom Line Business Model Canvas, TLBMC, after Joyce & Pasquin, 2016)

Economics				
Partners	Activities	Value Proposition	Customer Relationship	Customer Segments
	Resources		Channels	
Costs		Revenues		

Environment				
Supplies & Sourcing	Production	Functional value	End-of-Life	Use Phase
	Materials		Distribution	
Environmental Impacts		Environmental Benefits		

Societal				
Local Communities	Governance	Social value	Societal Culture	End-User
	Employees		Outreach	
Societal Impacts		Societal Benefits		

Table 9. Main differences between ASM and LSM business models using the TLBMC
(Orange: ASM; Blue: LSM),

Economics				
Partners	Activities	Value Proposition	Customer Relationships	Customer Segments
<ul style="list-style-type: none">- Family members.- Groups of individual miners.- Cooperatives of individual miners.***- Prospect generators.- Production miners.- Integrated miners.	<ul style="list-style-type: none">- Extraction.- Processing.***- Exploration.- Extraction.- Processing and beneficiation.	<ul style="list-style-type: none">- Low-cost supply of (C)RMs without the need of formal contracts.***- Formal, steady and reliable supply of responsibly extracted CRM, enabling the energy transition.- Trust, based on transparency in operations, pricing, and communication.	<ul style="list-style-type: none">- Informal, cash-based transactions with local buyers.- Direct sale to adjacent LSM.***- Long-term contracts and partnerships, sometimes with customised solutions, stemming from joint R&D or technical support.	<ul style="list-style-type: none">- Local buyers.- Adjacent LSM.***- International buyers, such as smelters and refineries, battery manufacturers, and industrial companies.
	Resources		Channels	
	<ul style="list-style-type: none">- Basic tools.- Shared basic equipment and processing systems.***- Drilling, excavation and transportation machinery, often automated and remote-controlled.- Personal protective equipment, safety and environmental protection systems.		<ul style="list-style-type: none">- Middlemen who act as intermediaries.- LSM open to a convenience relationship.***- Direct sales, including long term contracts, spot market sales and joint ventures and partnerships.- Traders and brokers.- Refineries and smelters.	
Costs		Revenues		
<ul style="list-style-type: none">- Shared cost of acquisition of tools, machinery, and materials.- Equipment rentals and fuel.- Personal protective equipment.- Limited taxation, if any.***- Significant exploration costs.- Significant development costs, often including infrastructure development, requiring large CAPEX.- Significant operational costs, including labour, equipment, maintenance, logistics, marketing and sales, environmental compliance and social programmes, taxes, interest, insurance.		<ul style="list-style-type: none">- Net receipts for individual members.- Gross receipts for cooperatives from mineral sales.***- Sales of ores and concentrates.- Sales of by-products.- Hedging contracts.- Government subsidies and incentives.		

Table 9: continued

Environment				
Supplies & Sourcing	Production	Functional value	End-of-Life	Use Phase
<ul style="list-style-type: none">- Mainly local materials and supplies.- (Small) imported machinery.***- Centralised procurement, aligned with operational goals, focused on cost efficiency and reliability.- Local companies typically supply construction and infrastructure, catering and accommodation, transportation and logistics, security, environmental services, and various consumables.- Equipment and technology are typically sourced in advanced countries.	<ul style="list-style-type: none">- Often deforestation and habitat loss caused by clearing large areas of land for operations.- Mineral washing along riverbeds and discharge of chemicals used in processing.- Typically, limited range of processes and equipment.***- Mining impacts (habitat destruction, soil erosion, water contamination, and air pollution) are typically monitored and minimised.	<ul style="list-style-type: none">- By providing livelihoods to local communities, artisanal mining can alleviate poverty and reduce pressure on natural resources for subsistence living.***- Most LSM companies have Corporate Social Responsibility (CSR) policies that include commitments to supporting local businesses and protecting ecosystems. These policies often lead to reforestation projects, pollution control measures, and rehabilitation of mining sites, providing environmental benefits	<ul style="list-style-type: none">- Abandonment of claims when mined out.- No rehabilitation.***- Implementation of ecosystem restoration and rehabilitation projects/activities.	<ul style="list-style-type: none">- Mineral ores***- Mineral ores and concentrates
	Materials		Distribution	
	<ul style="list-style-type: none">- Hand-tools.- Small machinery.- Fuel.- Explosives.- Water.***- Sophisticated equipment, machinery and consumables (e.g. explosives), often with vibration and noise suppression and dust control capability.- Water for treatment processes.		<ul style="list-style-type: none">- Direct sale to intermediaries, that deal with transportation and logistics.***- Distribution organised according to markets/regions, with embedded professional supply chain management processes.	
Environmental Impacts		Environmental Benefits		
<ul style="list-style-type: none">- Destruction of ecosystems.- Contaminant release.- Stream turbidity.- Disturbed landscapes.***- Destruction of ecosystems.- Disturbed landscapes.		<ul style="list-style-type: none">- Contributions to energy transition and carbon footprint reduction (in developed countries).***- Contributions to energy transition and carbon footprint reduction.		

Table 9: continued

Societal				
Local Communities	Governance	Social value	Societal Culture	End-User
<ul style="list-style-type: none"> - Job opportunity for family/group members. - Increase in prostitution and exploitation of women and children. - Disease outbreaks. - Increase in alcohol and drug abuse. - Social unrest and conflicts in case of community displacement. 	<ul style="list-style-type: none"> - Autonomous “business units”. - Increasing degree of formalisation. - No tax collection. - Limited govt. oversight. - Payment of taxes and royalties. - Variable transparency of government decisions (depending on jurisdictions). 	<ul style="list-style-type: none"> - Immediate impact on poverty alleviation. - Improved public services (health and education). - Diversified job and training opportunities. - Improved infrastructure. - Contribution to energy transition and climate change mitigation. 	<ul style="list-style-type: none"> - Varying itinerant communities. - Culture of individuality and “jungle law”. - Safety and risk management culture. - Compliance with standards and company values. 	<ul style="list-style-type: none"> - Access to raw materials (often at prices that do not fully cover the environmental and social footprint of their extraction). - Access to raw materials and goods that enable/support industrial value-chains and economic development. - Access to technologies that facilitate the energy transition and adaptation to climate change.
<ul style="list-style-type: none"> - Job creation. - Land disputes. - Labour conflicts. 	Employees <ul style="list-style-type: none"> - No employees - Workplace and career opportunities. 		Outreach <ul style="list-style-type: none"> - Relevant activity in many sub-Saharan countries. - International magnitude, ranging from local Corporate Social Responsibility programmes to the global scale of the energy transition. 	
Societal Impacts		Societal Benefits		
<ul style="list-style-type: none"> - Externalisation of community impacts to nation at large. - Breakdown of family and other social structures. - Smuggling. - Funding of illegal activities and conflicts. - Corruption. - Possible substitution of traditional economic activities. 		<ul style="list-style-type: none"> - Income generation/ poverty alleviation in the absence of economic alternatives. - Community development programmes and social investments. 		

8.4. The TLBMC as tool for communication

As noted before, probably the most effective incentive for compliance with ESG ambitions are economic pressure and economic incentives from downstream actors. The economic pressure is exerted by downstream buyers preferring producers that comply with the respective ESG ambitions. The pathway can be ensured through due diligence mechanisms. This requires that ASM actors (or their associations) can reflect in a structured way on their situation with respect to such ESG ambitions. The TLBMC is a tool for such kind of structured reflection.

The graphical representation and the relatively small number of variables/dimensions should make the tool accessible even in an ASM context, at least with some guidance and on the level of associations. One could envisage ‘focus groups’ or similar group events in which the participants are invited to reflect on the different variables of the TLBMC as it pertains to them. This reflection should help ASM actors to place themselves in their socio-economic context more objectively and to indicate to them possible areas for improvement. Similarly, the interlinkage between the three layers, would make more apparent the interrelation between their working practices and the related environmental and societal impacts. The visualisation can help to make explicit facts about their ASM operation that otherwise may only be informally and intuitively understood. Making such facts explicit, helps to address them, if needed. In the of co-operative business models, this analysis makes also more apparent the role, function and interests of the various actors. This in turn allows to identify gaps to successfully fulfil the value proposition. As Joyce & Pasquin (2016) point out, the TLBMC can also be used in a ‘creative’ way to explore in ‘what if’-cases the consequences of varying different aspects of the business.

In the context of AfricaMaVal this can only be an idea that would need to be followed up organisations such as AWIMA, who can work on the ground with stakeholders.

9. Conclusions

- **LSM vs. ASM**

These conclusions summarise the findings from above and are intended as guidance for both, EU and African actors in the various mineral raw materials value-webs with a view to fulfil certain environmental, societal and governance (ESG) ambitions. For EU actors this describes which kind of ‘business model’ to look out for that likely has the potential to satisfy ESG expectations and for African actors to understand what kind of business model would be conducive to fulfil EU expectations of ESG ambitions.

Africa’s mining sector is divided into large-scale and small-scale operations, each subject to distinct regulations. While small-scale gold mining has a long history, especially when conducted sustainably, the mining of critical minerals is primarily carried out by larger-scale operations. Below, the contrasting characteristics of large-scale and small-scale mining in Africa are summarised.

Large-Scale Mining (LSM)

- *Operations:* Structured and formalised, encompassing the entire mine life-cycle from exploration to rehabilitation.
- *Key Departments:* Sustainability departments handle environmental stewardship, social responsibility, compliance, health & safety, resource management, climate change mitigation, stakeholder engagement, innovation, and ethics.

- *Financing*: Planned and scheduled for all operational aspects.
- *Ownership*: Public-private partnerships consisting of multi-national companies, institutional investors, and individual investors. In some countries, such as Ghana, the government holds a minimum free-carried interest. Ownership structures can vary based on regulations, historical agreements, and strategic considerations.

Artisanal and Small-Scale Mining (ASM)

- *Challenges*: Known for its poor practices with negative environmental and safety impacts.
- *Growing Recognition*: Discussions on sustainable ASM practices are gaining traction due to their potential positive environmental, social, and economic outcomes.
- *Ownership*: Legally restricted to nationals in some countries, limiting access to finance but leading to innovative models. (Foreign businesses offer equipment rentals, inputs, and operational cash in exchange for gold payments).
- *Financing Models*: Sponsors (national or foreign) can provide upfront cash to miners in exchange for future gold payments.
- *Challenges and Support*: Lack of sustainable financing hinders the implementation of ESG principles. International donors support governments, NGOs, and training institutions in offering skills training, research, and innovative tools for the ASM sector.

- **Contextualisation: The Global Economic Framework and Raw Material Exports**

The current global economic system favours the export of raw materials from Africa to industrialised nations. This model, while attracting foreign investment and exchange, limits the development of local manufacturing sectors. ASM, often characterised by informal operations, limited resources, and a lack of technical expertise, operates outside the mainstream extractive-based economic model. ASM miners, many of them being women, typically extract small quantities of minerals from uncertain reserves

ASM is a diverse sector with a wide range of business and operational models. These models vary based on factors such as the mineral being mined, location, local regulations, and the needs of the mining communities. In African countries, artisanal and small-scale mining (ASM) is a vital component of the mining industry, providing a significant source of income and contributing to economic growth. Nevertheless, despite these socio-economic benefits, its significance is often overshadowed by concerns about environmental damage, social issues, and unsafe working conditions.

- **Challenges Faced by ASM**

The most significant challenge facing ASM operations is a lack of financial resources, particularly access to bank loans. Without adequate funding, technical skills, and management expertise, miners struggle to conduct thorough exploration and plan for long-term mining development.

Lack of adequate equipment, such as drilling and pumping machines, can lead to the premature closure or abandonment of mining sites. These issues can lead to considerable negative effects on the environment, surrounding communities, and the miners themselves.

- **Growing awareness of ASM's economic benefits**

Recent increases in commodity demand have led to greater recognition of ASM's economic potential in Africa. Governments are responding by developing policies and initiatives, such as the Africa Mining Vision (African Union, 2009), to maximise its benefits. A key focus of these efforts is enhancing government capacity and governance. Legalisation, institutional development, and formalisation are essential for achieving this. However, governments often face resource limitations. Collaboration with the large-scale mining industry, NGOs, (international) development partners, and financial institutions is crucial to address these challenges and effectively support and regulate ASM.

- **Challenges and Opportunities in ASM Formalisation**

Despite progress in formalising ASM in some African countries, significant challenges persist, including financial constraints and the need for improved training and support. Governments, while crucial for ASM development, often lack the capacity to provide adequate support and regulation. However, the collaborative efforts of governments, NGOs, and other stakeholders are essential for addressing these challenges and promoting sustainable ASM development.

These partnerships have focused on key areas such as:

- *Market Access*: Improving access to fair markets for ASM products.
- *Supply Chain Traceability*: Ensuring transparent and accountable supply chains.
- *Occupational Health and Safety*: Providing training and support to improve working conditions.
- *Financing Models*: Exploring innovative ways to finance ASM activities.

- **ESG realities vs. expectations and ambitions**

The country profiles for the different African countries developed under AfricaMaVal (Deliverable D4.1: Awases et al., 2023; Deliverable D7.2: Sewpershad & Tufo, 2024) demonstrate the wide variety of environmental, societal and governance (ESG) conditions across the continent. While it was noted that the majority of African countries seem to have a well-developed regulatory framework for mining in general and in some cases also for ASM activities, its implementation and enforcement in practice seem to meet significant difficulties. This means that business models that correspond to the ESG challenges have to be tailored to their specific conditions.

Mining operations of any scale traditionally have the tendency to exploit weaknesses in governance in order to avoid costs associated with compliance with environmental standards and reducing societal impacts. Due to pressure from downstream actors in the value-webs, namely European and North-American buyers and consumers, large-scale mining (LSM) companies have agreed to complying with voluntary ESG standards through membership in e.g. the EITI (<https://eiti.org>) and ICMM (<https://www.icmm.com>).

Similarly, downstream actor pressure (from consumers, but also from political organisations such as the EU or the OECD) in form of ‘responsible sourcing’ guidelines and standards that aim to prefer such upstream actors that comply with the ESG standards in question. Such pressure, but also development aid, aims at improving the social situation of artisanal miners, while at the same time reducing the environmental impacts from these activities.

- **The risk of too optimistic assumptions**

Looking at the policies at national and international level as well as those of relevant NGOs one notices a widespread tacit assumption that informal and illegal (uncontrolled and uncontrollable) artisanal miners would prefer to become formalised, if they could. Such assumptions, however, ignore the socio-economic and governance conditions that make people to choose to become this kind of artisanal miners. Development programmes typically turn out to be not sustainable as soon as the economic incentives of the programme itself end. People appear to prefer exposing themselves to health risks and risks of extortion over the risks associated with weak governance (e.g. maintaining land tenure rights) or arbitrary taxation by corrupt government officials when being traceable as ‘formal’ miners. Formalisation often appears to be seen as form of undesirable governmental control, rather than as an opportunity to improve the socio-economic situation.

A review of the relevant literature and experience from the field shows that the quality of governance in a state is a pivotal point. However, while most countries reviewed for the country profiles appear to have advanced policies and legislation, their implementation at local or regional level is another matter. A weak or arbitrary governance is an invitation to ignore or circumvent, laws, regulations, and government institutions.

Thus formalisation, the process of the transition from being uncontrolled to become a controlled miner should be the end-point or consequence, rather than the starting point for improving the ESG qualities of mineral raw materials value-webs.

There is ample evidence that individual artisanal miners or those that operate in small family groups do not have the capabilities and lack incentives to move this way. Therefore, other types of business models have be taken into consideration.

- **Strategies for ASM business models**

Economic incentives – Only sustained economic incentives can help to change a situation that in many cases is detrimental to the society, the state as a whole and to the environment. Perhaps the

most promising business models include for the state to delineate artisanal mining areas and LSM to tolerate at their fringes artisanal mining activities, although the latter can also lead to friction. These frictions typically result from the fact that both, LSM and ASM operators are tempted by richer occurrences should these be found on the respective other's allocated territory. Such trespassing can only be prevented by building trust between the different actors that allows negotiations, which in turn requires a certain level of organisation on the side of the ASM operators in order to provide a reliable and consistent counterpart. For the LSM operator it may be in the longer term a cost-effective strategy to build on collaboration, rather than on (potentially violent) confrontation.

The curse of technological improvements - It was noted that technological improvements, while increasing the productivity per operation, often also results in job losses, as certain simple and unskilled occupations may not be needed anymore. However, this is a natural economic phenomenon that occurs in all societies and is currently observed also in Europe. While associations or cooperatives strengthen their collective bargaining power with respect to downstream value-web actors, their collective purchasing power allows to improve their technology, which then can result in the said job losses. It is, therefore, likely that certain ASM groups will be averse to technological improvements in similar way as workers resisted industrial technologies in the 18th and early 19th century in Europe.

Diversification along the value-web – ASM operations in the case of EU CRMs (EU, 2024) only occupy a small part of the mineral raw materials value-web. Depending on the type of mined commodity their output could be just raw ore, but sometimes also concentrates. Downstream diversification will lead to higher quality products and more of the economic activity and, hence, the profits being retained in the community. This is a policy followed at national level by various African countries. Such increased profits can be a sufficient incentive for formalisation, but again not all ASM actors may actually profit from it.

Mineral raw materials clusters – This is promising avenue for the sustainable development of ASM. To harness the potential of clusters, governments should focus on strategic initiatives that integrate ASM into broader industrial ecosystems. These efforts should begin with formalising existing ASM operations and mapping their proximity to infrastructure. Policymakers should then identify potential cluster areas, develop policies to encourage cooperation between ASM and large-scale mining, invest in targeted infrastructure improvements, promote skills development, and facilitate partnerships across the mining value chain.

By concentrating mining activities, clusters can enable more efficient infrastructure development, enhance service provision, promote knowledge sharing, enhance environmental protection measures and governance, and foster circular economy practices.

Limitations due to outside governance conditions – It must be recognised, however, that good governance at all levels of government administration is a key condition to improve the ASM situation. While ASM in principle can fill an important niche in the mineral raw materials value-webs, it is often the symptom of exploitation of weak governance situation.

European policy-makers and NGOs often appear to be perplexed by this situation and tend to forget that it took Europe centuries to emerge from a situation of poor governance and arbitrary exercise of power, while they expect to achieve improvements in the African mineral value-webs within a few years.

- **Financing**

Funding of improved work practices is both, a precondition for more formalised ASM operations and a need once these have been established. On the other hand, there are understandably many obstacles to funding for ASM operators. The root obstacle probably are the risk management approaches of traditional money lenders, such as banks. Banks naturally tend to shy away from risks that they feel unable to judge and control. The typical commercial banker is trained to understand business risks in trade and industry but has no or only limited knowledge of the speculative nature of the mining sector. Therefore, finance in mining comes from other kinds of investors who are prepared to take higher risks, but who utilise risk management instruments, such as CRIRSCO-compliant or UNFC resource assessments. Such assessments are not normally available for ASM operations. To overcome the risks associated with financing and the difficulties in accessing finance, one may consider measures such as:

- Training for money lenders to better understand risks associated with ASM operations,
- Mobile branches of banks and other money lenders to reach ASM operators in more remote areas,
- Money lenders provide equipment, rather than cash to reduce the risk of diversion of fund and security risks associated with cash disbursements.

In addition, associations of ASM operators may constitute collectively a lower risk for money lenders than individual miners. These associations, based on their local knowledge, than may provide micro-credits to individual ASM operators or collectively by equipment that is then loaned to the operators.

- **Integration of ESG goals**

Externalities of ASM operations – It has to be acknowledged that one of the key features that make ASM attractive to many potential operators is, that most of the societal and environmental costs are not internalised in this ‘business model’: ASM operators typically pay no taxes or royalties to help fund the functions and services of the state in which they operate. If from outside of the communities in or near which they operate, they may impact their socio-economic fabric negatively, they do not rehabilitate the land on which mining takes place and mining, and processing methods are chosen on the basis of minimal capital and operating expenditures, rather than with a view to minimise environmental impacts and mining legacies.

Adjusting expectations – On the other hand, downstream actors in Europe expect that these costs are internalised, based on our own ethical expectations with respect to societal and environmental responsibilities. We tend to take these for granted but forget that the societal and cognitive path took centuries to develop. We need to acknowledge that these issues cannot be resolved in a sustained way at the level of a single economic activity, such as mining. The internalisation of environmental and societal goals can only happen in a conducive governance framework.

Responsible procurement challenges – Currently, the most common strategy currently for single economic value-webs appears to be upward pressure by downstream actors in the form of dealing only with upstream actors that comply with a certain set of ESG expectations. This strategy tacitly assumes global cooperation between all respective downstream actors. Competitive behaviour by certain downstream actors or countries will seriously undermine this strategy. It is, therefore, likely that it must be combined with other financial and economic incentives. European downstream actors must be prepared to pay a premium for seeing their ESG ambitions fulfilled.

- **A changing mineral raw materials world**

Naturally ASM operations focused in minerals that have a high value per weight ratio (such as gold, diamonds or gem-stones) on for which a stable and well-developed market exists. There are a few exceptions, such as cobalt/coltan, where one African country is the major world supplier. However, the rapidly changing demand side due to increasing need to ‘electrify’ the developed economies as a means to combat global warming and the ensuing competition for certain minerals may change this situation.

As have been discussed in this report, there are business models that allow ASM operations to move away from the classical (typically illegal) gold-rush-type exploitation to models that integrate them into value-chains for lower value per weight minerals. Thus, structured cohabitation between LSM and ASM seems possible that would increase the resource efficiency, as ASM can work the margins of deposits that may be uneconomic for LSM operators. In addition, the formation of mining clusters that go in hand with the development of transport networks allow market access to ASM-produced lower value per weight minerals.

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11. Appendix 1: Catalogue of ESG challenges

ESG challenges by topical area based on the guidance document for the country profiles developed by AfricaMaVal (Awases et al., 2023).

Table 10. ESG challenge: Mineral and mining policies

Mineral and mining policies
<ul style="list-style-type: none"> - Which laws regulate ownership and group structures? - Are there any requirements in relation to the holding of equity in exploration and mining projects by local people e.g., is an investor required to allocate or cede shares to local owners? - Are there any special rules or restrictions applicable to foreign investors? - Identify any rights that the State may have e.g., does the State have any rights to equity in mining projects? - Are there any requirement for listing on the local stock exchange - Are there any requirements to beneficiate/process minerals mined within the country? - Are there any restrictions on the export of minerals? - Are there any statutory consents required to dispose of rights to explore and mine? - Are there any restrictions on disposals of controlling interests in entities holding exploration or mining rights? - Are there any requirements to periodically renew mining or exploration licenses? - Are there any special laws and policies applicable to specific commodities (e.g., diamonds, precious metals, nuclear fuel cycle elements)? - Are there any special laws and policies applicable to artisanal and small-scale (ASM) mining? - Are there any policy provisions aiming at licensing and formalisation of ASM stakeholders? - How often the policies are reviewed and updated? WEF: not sure this is a good question, as it usually happens, when a perceived need arises, not on a regular basis - Is the country signatory to any international conventions relevant to mineral extraction (e.g., Aarhus-, Basel-, London-, MARPOL-, Minamata-, UNECE Water-, or the UN Conventions on Combatting Desertification and on Biodiversity)?

Table 11. ESG challenge: Governance

Governance
<ul style="list-style-type: none"> - Are there any laws and measures against bribery and corruption? - Are there any specific regulatory provisions for transparency in the mining industry? - Has the country joined EITI, and if not, what are the reasons for not joining? - Which types of disclosures are mandatory? - How are the transparency and comprehensiveness of disclosures assessed? - Are there regulations or requirements on the type of ESG performance reporting and assessment practices (self-reported performance or third-party rating)? - Are there any regulatory provisions for board independence? - Are there any regulatory provisions aimed at considering and balancing interests of stakeholders (different from shareholders)? - Are there regulations that reserve the Government participation into governance bodies (ie. Golden share)? - Are there regulations that favour the participation of local communities in governance bodies?

Table 12. ESG challenge: Mining Regulations

Mining regulations
<ul style="list-style-type: none"> - How are exploration licenses granted, what mechanisms are applied? - How are mining licenses granted, what mechanisms are applied? - Are there administrative appeals in the mining law? - What requirements exist for community and stakeholder consultation during the permitting processes? - Are the mining codes and standards comparable to those in the EU? - Are there assurance and verification systems in place to ensure implementation of the mining standards? - What are the laws, policies, requirements for provisions pertaining to mine closure and remediation, including the provisions of bonds? - What are the law and policies pertaining to mine care and maintenance? WEF: I am not sure that I understand this question, does it pertain to mines in a so-called 'care and maintenance' state, i.e. inactive mines? - What are the instruments and means for monitoring regulatory compliance of mining and exploration operations? - Are there laws, regulations, or rules in place the type of tailings storage or disposal (e.g., dewatered tailings piles, construction of tailings dams)? - Are there any regulations on the use of mercury (Hg), specifically in ASM? What are the means of enforcement? WEF: note that gold mining is not within the remit of AfricaMaVal! - Are there any regulations on wastes and residues containing Naturally Occurring Radioactive Materials (NORM), e.g. Tantalum waste, Tin slags? - Is the regulator for NORM different from the mining or environmental regulator? - What are the means to sanction non-compliance? - Which organisation is responsible for monitoring regulatory compliance? - Are there any legal requirements for the procurement of local goods and services by mining operations?

Table 13. ESG challenge: Taxation and Royalties

Taxation and Royalties
<ul style="list-style-type: none"> - Are there special rules applicable to the taxation of exploration and mining companies? - Is the transfer of mining rights subject to the payment of taxes? - Are there any royalties payable to the State over and above any taxes? - Are there restrictions on repatriating profits for foreign investors? - What systems are in place to administrate and and manage the collection of the taxes? - Is there a set percentage of profits that the mining sector is mandated to reinvest into the sector? - Are there any provisions for (foreign) investors, such as tax exemptions, tax holidays, tax reductions? - What are the regulations or systems in place for the reinvestment of taxes and mining royalties into the local mining communities, for example, reinvestment into local infrastructure enhancements (utilities, roads)? - What are the systems in place for reinvestment of tax revenue into education of local ASM communities and promotion of better and safer mining practices? - What are the tax/royalty rules pertaining to mines under care and maintenance?

Table 14. ESG challenge: Land-use and mineral rights

Land-use and mineral rights
<ul style="list-style-type: none"> - Which are the relevant land-use planning and zoning regulations? - Are maps available that clearly indicate the zoning and protected areas (see below)? - What are the rights of the holder of an exploration right or mining right to use the surface necessary or incidental to an exploration or mining operation? - Are there any native land titles or regulations that have implications for exploration and the mining industry? - Are there provisions for Free Prior and Informed Consent (FPIC) when acquiring land for mining from the people. - Is there a constitution that has an impact upon rights to prospect and mine? - Are there restrictions in place on the use of specific equipment or heavy machinery for ecological or habitat protection reasons? - Are there any land-use restrictions with respect to the type of mining method (e.g., open-pit vs. underground mining)? - Are there any specific regulations that prevent or limit exploration or mining near to or in protected areas (ecological sensitive areas, nature reserves, Natura 2000 sites, cultural heritage sites, etc.)? - Are any sites in the country inscribed on UN World Natural Heritage List? - Are there any regulations which prevent or limit mining rights near to areas of conflict? WEF: I am not sure what conflicts this refers to, war-zones, conflicting land-uses?

Table 15. ESG challenge: Environment

Environment
<ul style="list-style-type: none"> - Which are the relevant laws on the protection of biodiversity including forest protection? - Which are the laws on wetland protection? - If the country is a signatory to certain UN conventions pertaining to the environment (see above), how is compliance monitored and non-compliance sanctioned? - Are there regulatory requirements to have emergency preparedness plans and response programmes in place and are these revised regularly? - Which are the laws on air emissions to the environment (GHGs, particulates, cyanide, Hg, vapour, VOCs, dioxins, PCBs, including emerging substances such as PFAS, etc.) for operations and extractive waste management sites including tailings dams? - Which are the laws on soil protection? - What are the regulations for soil monitoring down-stream from mining activities or around extractive waste management sites, including tailings dams re. contamination by eroded material or dust? - Are there any policies in place on climate change resilience of operational or closed/ remediated sites? - What are the laws and regulations for (hazardous, non-hazardous) extractive waste management (disposal, re-use)? - Are mining operations required to periodically review their environmental and extractive waste management plans? - Which are the policies and regulations on mine-closure and environmental remediation of closed or abandoned mines (mining legacies)? - Are there regulatory provisions for the life-cycle management of extractive operations that cover the long-term management of extractive waste (stewardship) and community sustainability after the end of mining? - Are there regulatory provisions the reprocessing of legacy tailings stored/disposed on site re., for instance, the creation of potentially contaminated dust or releases of contaminated effluents)? - Are there any laws or regulations on energy consumption in mining operations? - Are there any specific regulations related to the use of renewable energy in mining operations?

Table 16. ESG challenge: Water

Water
<ul style="list-style-type: none"> - What are the water resources policies of the country? - How is competition between (prospective) users of groundwater and surface waters resolved to ensure fair use (wetland protection, irrigation rights, clean drinking water for humans and animals, processing waters, etc.)? - What are the laws and regulations on the protection of groundwater and surface water resources? - Are water resources included in the environmental legislation or separate? - Which are the regulations on water emissions (acid rock drainage, heavy metals, arsenic, cyanide, radionuclides, etc.) to the environment from mine operations? - Are there regulations or standards of practice for the environmental monitoring of aqueous emissions (e.g. dissolved constituents such as heavy metals, radionuclides, arsenic, cyanide, and pH) from extractive waste disposal sites, including tailings dams? - Are there any regulations related to the recycling of water in mining sites? - Are there any regulations related to wastewater disposal?

Table 17. ESG challenge: Societal and Community Aspects

Societal and Community Aspects
<ul style="list-style-type: none"> - Is there any legislation on the protection of information (like the EU GDPR)? - What are the regulatory provisions, if any, for public participation in decision-making processes, e.g. permitting, on extractive operations? - Are there any specific regulations related to involvement of local communities in order to perceive economic benefits or incentives to mining activities? - Are there any regulatory provisions for complaints and arbitration? - Is there any artisanal mining and what is the percentage contribution to GDP? - Is artisanal mining integrated into the regular economy or untaxed and unregulated? - Are there data/statistics on jobs (primary/secondary) in the mining sector? - Is there information on social conflicts in the mining areas? - Are there any regulatory provisions for fostering actions that enhance social inclusion, protect the members of community involved in the artisanal mining? - Are there any requirements or programmes to ensure awareness raising and access to information for the local community? - Are there any regulatory provisions for indigenous workforce participation? - Are there any regulatory or policy provisions to encourage mining companies to provide for training in local communities and to encourage their participation in related economic activities? - Are there any regulatory provisions for the protection of the workforce's human rights? - Are there any specific regulations related to female workforce participation (gender mainstreaming)? - Are there any specific regulations related to the prevention of child labour?

Table 18. ESG challenge: Tangible and Intangible Cultural Heritage

Tangible and Intangible Cultural Heritage
<ul style="list-style-type: none"> - Which are the laws and policies on the protection of such cultural heritage? - Are any sites in the country inscribed on UN World Cultural Heritage List? - Are there laws, regulations or standards of practice for what to do should any archaeological or fossil remains be encountered during mining activities?

Table 19. ESG challenge: Operational Health and Safety (OHS) and labour regulations

Operational Health and Safety (OHS) and labour regulations
<ul style="list-style-type: none"> - Is there any legislation on the protection of information (like the EU GDPR)? - What are the regulatory provisions, if any, for public participation in decision-making processes, e.g. permitting, on extractive operations? - Are there any specific regulations related to involvement of local communities in order to perceive economic benefits or incentives to mining activities? - Which are the relevant OHS laws and regulations? - Is there mining-specific OHS legislation? - How is the OHS legislation enforced? - What policies to foster compliance are in place? - Which body is responsible for the implementation and supervision of this legislation? - What is the role of trade unions in the mining industry? - Which are the laws and regulations on the resolutions of labour conflicts, including strikes and walk-outs? - What are the regulations and/or standards of practice or provisions to ensure in particular ASM workers' safety? - Are there requirements and mechanisms for the education of ASM workers on better mining and processing practices, in particular also for gold mining without the use of Hg?

Table 20. ESG challenge: Public Health and Safety

Public Health and Safety
<ul style="list-style-type: none"> - Which is the legislation that covers the protection of the public from emission (e.g. dust)? - Is the mining-related traffic on public roads regulated in any specific way (e.g. road safety codes)? - Are potentially affected stakeholders consulted and involved in the development and maintenance of emergency preparedness planning? - Are there any requirements for public disclosure and access to information, at least for the immediate communities of the possible dangers or health impact in place (should there be e.g. dam failure or a release of contaminated dust or water into the environment, etc)? - Are local community members monitored for potential long-term health impacts and are any specific compensation schemes in place?

12. Appendix 2: Pan-African Resource Reporting Code (PARC) - Minimum Content of an Artisanal and Small-Scale Mining Technical report

CONTENTS

Title page

The report should start with a title page. Include a title page setting out the title of the technical report, the name of the organisation or groups, the general location of the project, the name and professional designation of each Competent Person (CP).

Date and Signature Page

Insert here the title of the document, with the name of the author or authors (CPs) and Professional Group, effective date of the technical report, the CP's signature, and stamp.

Summary

Briefly summarise important information in the Technical Report, including locality, type of mineral, exploration history, operational status and history, geology, mineralisation, sample grades, previous resource estimates if any, plus comment on quality of the resource estimate, grades, etc. The summary should be sufficiently detailed so as to allow the reader to understand the essentials of the project.

Table of Contents

Provide a table of contents listing the contents of the Technical Report, including figures and tables. Table of figures detailing photographs and illustrations also fall under this heading.

1. Introduction

Give a short overview of the ASM activity, type of operation, artisanal mining team, association or cooperative; this may be disaggregated by gender. Source of funding, project development history, current and future situations, and potential growth should be briefly stated.

2. Project Outline

Property description location and accessibility

State the size of the property, type of operating licence, holder and issuing authority, license tenure, status of site validation or government authority. Include a locality map and describe accessibility, climate, local resources, infrastructure. Describe access roads and condition, electricity network, water sources for mining, processing and human consumption, population centers that could supply labour, accommodation, maintenance support. Describe the physiography including site topography climate, rainfall, temperatures, fauna and flora and periods when operations may be negatively affected. Include a photograph of the general topography. If the locality map does not include the infrastructure such as roads, railway, water, and access to electricity, a map should be drafted and presented.

3. History

Provide a short history of the ASM ownership. Also include any previous agreements and tenements. Describe previous prospecting and mining if known, quantity of commodity mined and recovered and by what means or methods. If the previous works of the ASM are not PARC or other international reporting code compliant, just state so in the report. Indicate if the operation is in regions of many other ASM operations and if the operations site is an old mining site. Provide photos of old workings if available.

4. Geological setting and mineralisation

Geological setting

Describe the regional and local geology. Provide a detailed geological map of the area.

Nature and mineralization controls

Describe nature of mineralisation, host rocks, style, type, and alteration.

Deposit Types and mineralisation

State the type of minerals produced and annual totals for each if available. For each mineral, distinguish among tailings, alluvial, eluvial or hard rock deposit. State if the deposit is part of a larger system and provide justification.

5. Prospecting data and Information

Most ASM sites will likely be covered by little or no prospecting. ASM prospectors normally operate at nearby large-scale mines or old workings. If the large-scale mines have available previous exploration data, state this and any prospecting information by the ASM operators. Mining activity on adjacent properties will be useful information. Provide an idea of production, grade, and recovery.

Sampling methods

Any previous records of sampling and information of quantities of materials mined, processed, and recovered should be provided with cautionary note. If no exploration was done, this shall be stated in the report. Provide detailed information on ongoing works about any drilling, trenching, pitting or surface sampling and include a list of coordinates and relevant data logs and maps. The CP shall comment on the prospecting/exploration and sampling process and comment on any deviations from the PARC.

Sample preparation, analyses, and security

The CP shall comment on the sampling methods applied as well as the security and integrity of the samples. A summary sheet with sample numbers, coordinates, shall be included in this report, even if no assay results are available. The CP shall comment on the sampling process and integrity of assay data if available.

Mineral processing and metallurgical testing

Processing and metallurgical testing on ASM projects is rare. If there is any historical or recent information, this should be included, clearly indicating the origin and in the opinion of the CP whether it is reliable. If it is an operational ASM site, describe the process of ore transport, storage, and processing and mineral recovery.

6. Project Estimation

Mineral resource and reserve estimates

Mineral project estimation based on Mineral Resource estimates is important to investors. However, ASM projects rarely have this piece of information that may be compliant with PARC or international reporting standards. Any historical reports of the area with resource estimates may be quoted and commented on by the CP in relation to PARC. If no information is available this should be stated. At production sites quote the tonnes mined and total mineral recovery and grade if reliable. Volumetric calculations on ASM may be misleading and CP should be cautious.

7. Technical Studies

Mining Methods

Describe the mining methods used. Open-pit and surface mining are easy to observe, CP should provide quantitative description. State the mining procedure, distinguishing between manual methods and use of mechanical equipment or combination of both. Any other form of ore mining such as blasting should be described. If the operation is underground, describe the mine layout in terms of shaft, adit, tunnels and stope systems and ore body trends. Provide information on ore haulage and transport and mine-safety. Provide estimates of number of miners on site, governance structure, safety of workers.

Processing and Recovery Methods

Describe the recovery process in detail, including the list of any chemicals used. If processing is done on site or off site, provide details. It is important to provide information on the quantity of the ore processed, amount recovered and overall efficiency of the methods.

Project Infrastructure

Describe infrastructure on and around the mine. This should include road access, electricity and portable water sources, mobile phone and internet access if available. Comment on the distance to the nearest town for supplies and labour, and type and proximity of accommodation.

Market Studies and Contracts

It may be rare for ASM projects to have an economic study of any reliability in accordance with and defined by PARC. If trading contracts exist determine the formality of the contract, ways of transactions, quantities transported and purchased, records of payment and means of payment. Determine if the mineral is sold to government sources, private buyers, or middlemen or any other source. Taxes and amounts or minerals paid to local and traditional authorities may be discussed. If available compare prices with prevailing international rates.

Environmental Studies, Social and Community Impact

Describe any environmental and social assessment undertaken at the mining and processing site. If no third-party assessment exists, provide information of impact of mining on the environment and social activities.

Describe the positive and negative impacts on the community including presence of vulnerable groups at or near the mine site. Comment on the frequency of validation and responsible authority.

Legal Permits

State the statutory legal permits applicable to the ASM. Provide information on the licenses and permits plus their status and expiry date. Include details of community development and local content agreements. Attach the supporting documents.

Capital and Operating Costs

Provide the capital and operating costs if a business plan has been prepared and discuss the planned cost breakdown. For operational mine, provide records of costs and capital items, as well as planned expenditures.

For non-operational mine, the CP's opinion on capital equipment requirements for the project development should be stated.

8. Conclusions and Recommendations

Summarise the relevant results and interpretations of the information and analysis reported. List all the important findings and discuss any significant risks and uncertainties. Discuss any reasonably foreseeable impacts of these risks and uncertainties to the project's potential socio-environmental-economic viability or continued viability. The interpretation and conclusions should be based on the data and should reflect the author's honest opinion of the project.

Based on the CP's opinion, state what actions is required to take the project to the next level of development or to facilitate the suggestions that were offered to correct certain observations made.