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WIDER Working Paper 2021/119

Promoting environmental sustainability in the artisanal and small-scale mining sector in Tanzania

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July 2021

United Nations University World Institute for Development Economics Research
wider.unu.edu

Abstract: This study examines the interaction between formalization of the artisanal and small-scale mining subsector and the regulation of negative environmental impacts in Tanzania. Formalization generally seeks to move the artisanal and small-scale mining subsector to legal status. Using documents, reviews, and interviews with key informants, the study suggests that there is generally no automatic connection between formalization of artisanal and small-scale mining and improvement of environmental protection in Tanzania. The reasons behind this situation include lack of funding, limited capacity, poor coordination, the nomadic nature of artisanal and small-scale mining operations, and using formalization as a revenue-increasing tool. To address this situation, we propose the formation of a well-funded umbrella body that only deals with the artisanal and small-scale mining subsector and formulation of an artisanal and small-scale mining-specific legal framework that delineates responsibilities of different artisanal and small-scale mining regulatory agencies to avoid overlaps and gaps. Moreover, the capacity of artisanal and small-scale mining associations should be strengthened to enable them to promote environmentally sustainable practices and engage meaningfully in stakeholder consultation meetings.

Key words: formalization, artisanal and small-scale mining, coordination, environmental protection, Tanzania

JEL classification: Q52, Q53, Q57, Q58

Acknowledgements: The authors wish to thank anonymous reviewers for their valuable comments that helped to improve this work. They also wish to thank UNU-WIDER for its support, without which this study would not have been conducted.

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This study has been prepared within the project Sustainable development solutions for Tanzania—strengthening research to achieve SDGs funded by the Ministry for Foreign Affairs of Finland.

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ISSN 1798-7237 ISBN 978-92-9267-059-7

https://doi.org/10.35188/UNU-WIDER/2021/059-7

Typescript prepared by Mary Lukkonen.

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The Institute is funded through income from an endowment fund with additional contributions to its work programme from Finland, Sweden, and the United Kingdom as well as earmarked contributions for specific projects from a variety of donors.

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1 Introduction

There are numerous initiatives, among bilateral and multilateral development organizations and governments around the world, to support efforts of artisanal and small-scale miners (ASM) to 'formalize' their systems and practices. Formalization is often intended to improve revenue collection by the state; increase productivity, transparency, and accountability in the sector; improve health and safety conditions; regulate and improve labour standards; reduce conflicts with large-scale mining (LSM) projects; and/or reduce the negative environmental impacts of mining. The latter issue is particularly important in terms of the relevance of ASM to the Sustainable Development Goals. The localized environmental impacts of ASM have long been recognized. In recent years, more emphasis has been placed on managing environmental impacts across the life cycle of a mine site, from planning to closure, including mine reclamation (Mancini and Sala 2019; Agwa-Ejona and Pradhan 2018).

In Tanzania, mining is classified as ASM if the capital investment is less than US$100,000 (Mutagwaba et al. 2018). The extent of ASM in Tanzania is very significant. Tanzania is estimated to currently have between 600,000 and 1.5 million ASMs (Marwa and Warioba 2015; UNECA 2011), which represents more than 90 per cent of employment in the mining sector as a whole (World Bank 2015). Numerous different metals, minerals, and gems are mined across the country. ASM produces at least 10 per cent of total gold production in Tanzania (UNEP 2012), as well as the majority of the production of gemstones, copper ore, construction materials, and other commodities (Kinyondo and Huggins 2020). There is significant diversity in ASM sites, in terms of the geographical size of the sites, number of workers, extent of mechanization, and organizational aspects. Some of the larger ASM sites support significant secondary economies, which provide accommodation, food, and other necessities. The government has in recent years introduced several formalization initiatives, including mineral trading centres (focused on artisanal gold production), demonstration centres (model mines with processing facilities), and 'Centres of Excellence' that include training activities (Kinyondo and Huggins 2020). Small grants were provided to some small-scale miners through the World-Bank-funded Sustainable Management of Mineral Resources Project (SMMRP). In addition, specific equipment and training has been provided for the gemstone sector (Huggins and Kinyondo 2019). The Ministry of Minerals recently recommitted to formalization activities (Mosenda 2021).

Key environmental impacts associated with ASM in Tanzania include deforestation, use of mercury and cyanide in gold processing, dust and noise pollution, generalized water pollution, soil contamination, and failure to properly reclaim mining areas and/or secure or fill in mine shafts (Macháček 2019; Daley et al. 2018; UNEP 2012; Kitula 2006). Furthermore, there are certain mines operating in protected areas that are particularly rich in biodiversity.

There are several legal and policy documents addressing these problems. For example, the National Environmental Policy (URT 1997) includes a section on mining, which focuses particularly on air and water pollution. Nevertheless, the government has acknowledged the challenges of monitoring and regulating the mining sector (cited in Daley et al. 2018). These challenges are in part financial and logistical: the large number of ASM sites across the country, often in geographically remote areas, makes it expensive to systematically monitor and regulate them, and there are few trained personnel to undertake these roles. There are additional challenges posed by a regulatory framework that has been interpreted in different ways by different actors. For example, in the past, pieces of legislation contradicted each other over the need for an Environmental Impact Assessment (EIA) and/or an Environmental Protection Plan (EPP) and put different agencies in charge of the issue (IPIS 2019).

While the attention to environmental issues by the Tanzanian government is likely to be generally positive, there are examples from other countries in which regulations have tended to exclude poorer and less organized or politically connected ASM actors from the sector or had other unintended consequences. For example, in Zimbabwe, environmental regulations for mining became 'perceived by small-scale miners as a strategy for generating revenue for state actors' (Spiegel 2017: 204). Therefore, a phased approach to support and enforcement, combined with regular consultation with ASM stakeholders, may be recommended.

Researchers have recently identified some environmental challenges in the ASM sector (IPIS 2019; Daley et al. 2018); however, more attention is needed to the ways in which the current institutional and policy context might enable ASM actors to minimize the environmental impacts of their activities. This should be a priority, given the wide-ranging legislative changes of recent years and a noticeable policy shift in favour of formalizing and supporting ASM rather than criminalizing it (Huggins and Kinyondo 2019; Kinyondo and Huggins 2019, 2021).

It is in this context that the present study focuses on the interaction between formalization of the ASM sector in Tanzania and the regulation of negative environmental impacts. The focus of the study is not only in line with Tanzania's *Development Vision 2025* but also the *Africa Mining Vision* (AU 2009).

Our main findings show that there is no automatic connection between formalization of ASM and improvements in environmental protection in Tanzania. It is argued herein that because formalization may mean various things, relevant institutions and ASM stakeholders should collectively work to ensure that formalization is designed in a manner that can lead to environmental sustainability in the ASM subsector.

The present study is consistent with various works in the body of literature. It relates with World Bank's (2019) study that proposes for the need to establish and upkeep a central environmental information system that can improve environmental management. It also speaks to a study by Reynolds and Weldegiorgis (2017) that argues for a more active role of regional mining offices and local government authorities in overseeing mining operations in their localities. Similar sentiments were echoed by Mwakaje (2012) who proposed for decentralization of mining regulations. Furthermore, the present study relates to that by Weldegiorgis and Buxton (2017) who called for the need to ensure that EPPs are monitored and enforced. Moreover, this study is closest to one by Kinyondo and Huggins (2021) that suggests that while existing regulatory and institutional frameworks in Tanzania provide an opportunity for improved environmental management, major obstacles, such as lack of coordination and capacity, persist.

The rest of this paper is organized as follows. The next section provides research objectives and questions. It is followed by a literature review section that paves a way for the methods/methodology section. Thereafter, results both from document review and primary data are presented. Results are then discussed before recommendations are shared.

1.1 Research objective and questions

This research provides a snapshot of the current regulatory and institutional context in which environmental regulations in the Tanzanian ASM sector are implemented and an initial assessment of the success of implementation. Specifically, it aims at the following for research questions:

1. How does the current regulatory and institutional context in Tanzania promote and enable environmental management of ASM sites?

2. What are the roles of key environmental stakeholders in monitoring and regulating environmental issues in the ASM sector?
3. How do efforts to formalize the ASM sector interact with initiatives to improve environmental management of ASM sites?
4. What are some of the recommendations of key stakeholders for potential refinement of regulatory, policy, financial, and institutional arrangements in the quest to improve environmental management of ASM sites?

2 Literature review and the conceptual framework

The environmental impacts of ASM have been well-documented but can be described and analysed in different ways. For example, some phenomena (such as mercury pollution) have both environmental impacts and public health/environmental health impacts. They are also an occupational health and safety issue for mine workers. This section of the paper provides a descriptive overview of the environmental impacts associated with the ASM subsector.

2.1 Land-use changes

Land-use change includes sub-categories such as land degradation, deforestation, and failure to properly reclaim mining areas and/or secure or fill in mine shafts and other workings. There are also overlaps between land-use changes and other impacts, such as the effects of land-use changes on hydrological regimes. One study of the literature on mining-induced land-use changes in Africa found that, although the land use change associated with mining is relatively small compared to logging or conversion for agriculture, its negative impacts are long lasting (Festin et al. 2018).

The nature and extent of land degradation depends on the type of ASM being conducted. It is important to differentiate between alluvial mining (e.g., for gold and diamonds), which takes place in and around riverbeds; surface mining, which involves the removal of large areas of topsoil; and deep rock mining, which involves the construction of underground mine shafts. Alluvial mining can be categorized as shallow (where sediment is removed to a depth of a few metres) or deep (where reinforced pits are used to facilitate digging to a greater depth) (Macháček 2019). Alluvial mining often involves the erosion of river channels, as the banks of the river and the riverbed are damaged by the use of equipment and the activities of miners. This can have a localized impact on the course of the river itself, in the case of small rivers that have many meanders (bends). There are major impacts on water quality from such activities, particularly because of the amount of sediment that is disturbed and released into the water.

Surface mining involves the removal of topsoil through mechanical means (such as backhoe loaders and excavators), manual means (digging), or hydraulic methods (washing out material through applying water using hoses or buckets). In terms of the area affected, and the total volume of waste material removed, surface mining tends to have the greatest impacts (Festin et al. 2018). The waste material resulting from mining can be separated into overburden and waste rock, which are not inherently harmful, and tailings material, which has gone through some form of processing (mechanical and/or chemical). Tailings tend to be much more environmentally problematic because of the potential for leaching of chemicals from the chemicals. The engineering dimensions of waste material handling and storage are also significant, as the large-scale alteration of the landscape can result in subsidence, risk of landslides, and other dangers.

Mining may involve deforestation for several reasons. Most obviously, mine sites are cleared of trees and vegetation prior to excavation. Access roads, paths, and other infrastructure may involve

the felling of trees. Mine shafts are often constructed using logs to reinforce and prop up the structures. As mining activities progress, and especially in larger mine sites, informal, temporary, or permanent houses (and retail buildings such as shops and restaurants) may be constructed using timber. Moreover, the economy of a large mine site in sub-Saharan Africa may often depend on the use of charcoal for cooking and boiling water, which is linked to ongoing deforestation. In addition, there may be indirect effects of mining on forest areas. For example, mine sites and associated infrastructure may provide opportunities for commercial logging, charcoal production, and other activities to expand. Some miners may become involved in these activities, particularly when mining opportunities are reduced (e.g., if heavy rain makes mining dangerous).

The process of reclaiming or restoring mining sites (the two terms are often used interchangeably) has become standard practice in large-scale mining in many parts of the world. There are different approaches to reclamation, which may involve physically stabilizing the geology of the area and returning or recreating layers of topsoil; the use of chemicals to reduce the toxicity of the soil and return pH levels to normal; or phytoremediation, which involves the use of plants and microorganisms, along with compost or biochar. Recolonization of the site by trees and plants can be passive (i.e. not facilitated, other than provision of healthy soils) or active (facilitated). Many plants and trees have been identified as bioaccumulators of heavy metals and are therefore useful in decontaminating soils. Reclamation also involves the filling of existing pits, craters, and other depressions to approximately re-create the pre-existing landscape. Reclamation has been done in fewer mine sites in Africa than is the case in other parts of the Global South (Festin et al. 2018). Cases of reclamation exist in Kenya, South Africa, and Ghana and took place on industrial (large-scale) mine sites. Some ASM operators in Ghana have conducted reclamation, using earth-moving equipment to fill pits and relying on passive recolonization by local flora (Bansah et al. 2016). Some experimental reclamation has been attempted on ASM sites in Rwanda (Cao Diogo et al. 2017).

2.2 Water use and water pollution

Water-related impacts are very common, as 'all mining and mineral processing operations require water' (Lynas et al. 2018: 264). For example, alluvial gold mining involves the removal of mineralized material from riverbanks, which is then washed in sluice boxes to separate gold flakes from sand and soil. Deep rock mining and open-cast mining can also involve water in grinding and washing of mineralized materials. Deep rock mining involves the removal of water from underground pits using pumps. Broadly speaking, the impacts of ASM on water can be divided into those that affect the availability of water (quantitative changes) and those that change the water quality (qualitative changes, through pollution) (Barasa et al. 2016). As noted above, mining activities can be differentiated between alluvial mining, which takes place in water sources, and other forms of mining that have different effects. As with other environmental impacts, there are significant overlaps between the environmental impacts and human health and socio-economic effects of degradation in water quality and quantity.

Extensive mining activities, as noted above, may have impacts at the landscape level, including alteration of hydrological regimes. Removal of overburden, construction of pits and underground galleries, blasting using explosives, and construction of transport infrastructure (e.g., roads) can all have an impact on local water flows. Various effects can result, including subsidence and diversion of water flows. Alluvial mining, if practised at a large scale, can result in the sedimentation of rivers and can alter the shape of river valleys, changing the shape and flow regimes of rivers. As ASM is typically conducted without prior geological or hydrological surveys, these changes to the hydrological regime may be unpredictable and unexpected. They can often involve risks for miners, as pits may flood unexpectedly, especially during the rainy season.

When mining activities are extensive, considerable amounts of water may be required for processing (e.g., grinding, washing), reducing the quantity of water available for other uses. Water is often diverted from rivers, surface water, or underground sources using diesel pumps. Once used, the quality of the water is degraded as it contains grit, sediment, and chemicals present in the mineralized material. It is therefore unfit for drinking. When mercury, cyanide, and other toxic chemicals are used in processing, they tend to become widely dispersed within local water sources. In many cases, post-processing water is poorly managed and may flow into other water sources, contaminating them. It can be seen that there is an interaction between quantitative impacts on water and qualitative impacts. The reduction in the quantity of water, as well as the quality, may have impacts on local biodiversity, especially fish and aquatic species.

Particularly in deep rock mines, water may interact with disturbed mineralized material, absorbing heavy metals and changing in alkalinity or acidity before flowing into other water sources (whether through intentional pumping or because of rainfall and other unintended mechanisms). Some of the flows of contaminated water may occur underground and therefore be undetected. For example, in the gold and base metal mining areas of Ghana, 'sulphide oxidation resulting from chemical and biogeochemical processes leads to the production of low pH groundwater that encourages the dissolution of trace metals into the groundwater system in very high concentrations' (Dorleku et al. 2018: 125). In addition to the pollution of water resources through the use of chemicals and the introduction of sediment, the sheer presence of large numbers of miners may also pose a burden on the quality of local water sources. As ASM often takes place in remote areas, and as many ASM sites are equipped with only temporary facilities, sanitation is often a challenge. Water may become polluted with faecal matter. Water flows related to ASM may result in large areas of standing (stagnant) water, which become less aerated over time and may represent a public health risk (e.g., providing a breeding ground for mosquitoes).

2.3 Air pollution

Various activities in and around mine sites may result in various forms of air pollution. Overall, air pollution associated with ASM is less serious than that caused by large-scale mining, as fewer large pieces of machinery are used and the overall scale of operations is lower. In ASM, air pollution is typically quite localized and may primarily be a hazard for miners and others around the mine site, rather than adjacent communities, flora, and fauna. Nevertheless, some environmental impacts are possible. Dust may be produced and moved through the local environment caused by blasting using explosives, construction of roads and other infrastructure, and the use of vehicles, as well as the everyday activities of large numbers of miners and those living in and around mine sites (e.g., restauranteurs). It is unlikely to have a major impact on the local environment except in the case of particularly sensitive environmental features (e.g., spawning or breeding sites). Dust contained and concentrated within mining pits and shafts is particularly damaging to the health of miners, most of whom lack access to masks, goggles, and other personal protective equipment (PPE). Silicosis, a very serious lung disease, is a health hazard for miners, particularly those involved in hard rock mining involving explosives (Ralph et al. 2018; Agwa-Ejona and Pradhan 2018). Naturally, dust is much more harmful if it contains particular elements that are themselves dangerous (e.g., radioactivity). The movement and hence the impacts of dust in the general mine site area can be reduced if some vegetation, particularly trees and bushes, is left in the vicinity (LUC in association with GEUS & Matrix Development Consultants 2013).

Localized particulate air pollution associated with the frequent use of diesel or petrol engines might occur in some of the bigger ASM sites. These are unlikely to have a major environmental impact. Miners may be vulnerable to the health impacts of such fumes, particularly as fumes are heavier than the surrounding air and can sink into mine pits and shafts. The resulting concentration of carbon monoxide and other chemicals can be fatal.

2.4 Noise pollution

As with air pollution, noise pollution is less common and less serious in ASM than in large-scale mining, as fewer large pieces of machinery are used and the overall scale of operations is lower. Nevertheless, the combined effects of large numbers of people congregating in and around a mine site, and the use of explosives (in hard rock mining), diesel generators (i.e. powering compressors to pump air or water), and vehicles, may generate unusual amounts of noise. Particularly when ASM takes place in remote areas where local fauna are not used to human activity, such noise may cause animals to leave the area or disturb breeding patterns.

3 Methods/methodology

It was initially planned that this study would have desk-based and field-based components. Key informant interviews were to be conducted in Dodoma and Dar Es Salaam to identify the roles of key stakeholders, such as the Mining Commission, the National Environmental Management Council (NEMC), regional ASM associations, Regional Mining Offices (RMOs), and district authorities, in monitoring and regulating environmental issues in the ASM sector. Key informant interviews and site visits were to be conducted at a mine site in North Mara and Geita. These interviews and visits were to be analysed to indicate areas of institutional cooperation, overlaps, and any gaps in the monitoring and regulation framework.

However, the COVID-19 pandemic made it unsafe to conduct face-to-face interviews. Instead, interviews were carried out by phone. A total of 13 interviews were conducted. Of these, six participants belonged to government agencies in the mining sector, three respondents belonged to civil society organizations (CSOs), three were scholars, and one was a small-scale miner. The results of this primary data collection are summarized in the next section of this report.

In addition to phone interviews, a thorough literature survey was conducted to identify (a) all regulations, policies, and programmes related to environmental management in the ASM sector; and (b) recent experiences from other countries in improving environmental management in the ASM sector. Content analysis was used to identify, summarize, and synthesize environmental dimensions of the various documents identified. Coding of interview transcripts was largely deductive (i.e. codes, or key terms for analysis, were applied based on the research questions noted above); however, inductive means were also used (i.e. new codes were developed based on themes in the transcripts). Reliability and validity of the study was assured through triangulation of primary and secondary data (Yin 2009).

4 Results

4.1 Overview of key regulations and policies

Tanzania's mining regulations and policies have addressed environmental impacts since the 1980s. However, until relatively recently, the focus of regulations was on large-scale mining. Over the past decade, increased emphasis has been placed on ASM. However, awareness of some regulations remains low, and implementation is very patchy.

The National Environmental Policy, 1997, included a section on the mining industry (URT 1997: 17). It specified the overall management of the mining cycle to prevent adverse environmental

effects such as water and air pollution; it sought to control the use of mercury and establishes regular environmental audits.

Efforts were made, on a project-by-project basis, to encourage the use of retorts and to improve mercury handling. However, none of the literature on mining in Tanzania suggests that many of the other policy goals were followed with more specific policies and actions. For example, reclamation and restoration of land and air pollution measures require further definition in order to be translated into action. It is clear, as well, that environmental audits were not conducted in ASM mine sites.

The Mining (Environmental Protection and Conservation) Regulations, 1999, were the first mining laws to expressly address environmental issues in ASM. They sought to protect water sources from contamination from mineral washing and settling ponds and pit latrines and from removal of vegetation from riverbanks; ban use of mercury without retorts; ban use of cyanide leaching without written permission and require PPEs for use of such toxic chemicals; require proper disposal of tailings; and require the backfilling or fencing of abandoned mines. Once again, few of these requirements have been implemented or enforced. Moreover, the regulations ignore many issues, such as the quantitative aspects of water use, air and noise pollution, and removal of trees and vegetation (other than near riverbanks). The requirements for mine closure were also minimal.

The 2017 amendments to the 2010 Mining Act strengthen the environmental dimensions of Tanzania's legal framework. It stipulates that the Environmental Management Act (URT 2004) applies to the mining sector. It requires mineral rights' holders to prepare annual reports that include environmental issues, particularly those prioritized by the local authorities. An entire section (VIII) was added on *Environmental Principles and Liabilities*. This section focuses on the transport, treatment, storage, and disposal of waste in the mining sector, which is likely more relevant to the LSM sector than ASM. The section also establishes the 'polluter pays' principle, making mining operators responsible for the costs of remediating pollution or environmental damage.

The 2017 amendments to the Mining Act also make the Mining Commission responsible for monitoring and auditing environmental management plans and activities. RMOs are mandated to conduct regular inspections of mine sites and include environmental issues in their responsibilities (IPIS 2019). Other agencies with environmental responsibilities include the Occupational Health and Safety Agency (OSHA).

The first EIA in Tanzania was conducted in 1980. At this time, there was no clear legal framework for EIAs (Sosovele 2011). Nevertheless, between 1980 and 2004, about 100 were conducted on large-scale projects in various sectors, 'mostly to fulfil donor requirements' (Mwalyosi 2004). At this time, the government organization responsible for environmental assessment was advisory, without any legal powers, and coordination of EIA processes was poor (Mwalyosi 2004).

Coordination improved with the Environmental Management Act No. 20 of 2004 (URT 2004), which gave NEMC responsibility for EIAs. EIA and audit regulations were introduced in 2005, which listed extractive industries including mining as industries requiring EIAs (LUC in association with GEUS & Matrix Development Consultants 2013). This led to an increase in the number of EIAs in Tanzania. Between 2005 and 2009, about 112 EIAs were conducted, of which 18 per cent (about 20) were in the mining sector (LUC in association with GEUS & Matrix Development Consultants 2013). Limited data are available on the nature of these EIAs, but it is unlikely that they were conducted at ASM sites. Emphasis was instead placed on LSM.

Under the 2004 Environmental Management Act (URT 2004), primary mining licenses (PMLs) had to register with NEMC, which was responsible for determining whether a full EIA would be needed. It is not clear how many PMLs actually registered with NEMC.

The 2010 Mining Act contradicted the 2004 Environmental Act. It required that the 'Holder of Primary Mining Licence shall, before commencing mining operations, conduct a baseline environmental investigation and social study with regard to human settlement, burial sites, cultural heritage sites, water, vegetation, animals and soil, and submit a report regarding the outcome of the investigation and environmental protection plan to mitigate the environmental effects to be caused by mining operations in the licenced area' (Ministry of Energy and Minerals 2010: Section 3, Part II). Again, there is limited information available on how many PML holders actually conducted an environmental and social assessment. The Mining Act required PMLs to report to the Ministry of Energy and Minerals in regard to environmental impacts.

This contradiction was resolved in the 2017 amendment to the Mining Act, which gives precedence to the National Environmental Act and hence gives overall responsibility to the NEMC.

One study of EIAs in Tanzania from 2011 found that knowledge of the regulations amongst government officials was low and that many construction projects in Dar Es Salaam, for example, were implemented without them, even though they were required (Sosovele 2011). The same study concluded that NEMC was unwilling or unable to play an effective enforcement role because of its complete reliance and general lack of independence from the government. NEMC is under the overall control of the Division of Environment within the Vice President's Office (World Bank 2019). This has resulted in NEMC being unwilling to make 'unpopular decisions, for fear of being seen as anti-development' (Sosovele 2011: 130). This institutional situation is similar to that in other East African countries (Marara et al. 2011). However, it should be noted that political influence is most common in large-scale projects that become part of political campaigns and commitments (Alfred 2014). This may not be such a major issue in the ASM sector.

An Environmental Action Plan 2011–16 for the Minerals Sector was published by the Ministry of Energy and Minerals in 2011 (LUC in association with GEUS & Matrix Development Consultants 2013). This identifies the following key challenges within the mining sector, which should be addressed in all of the Ministry's policies and strategies:

- water and soil pollution;
- land degradation;
- air pollution;
- disturbance of biodiversity;
- climate change;
- earthquakes, flooding, and landslides;
- radioactive minerals;
- unsecured mine closure liabilities.

Once again, these elements were not fully defined or mainstreamed in policies.

Although 'leaching and elution plants and those ASM projects with a large environmental and social footprint require an EIA under the 2004 EMA', researchers argue that 'very few, if any, have done so' (Schoneveld et al. 2018: 48).

Knowledge, awareness, and implementation of environmental regulations in the ASM sector

As mentioned above, it has proven challenging for Tanzania's government and other organizations to implement environmental policies in the mining sector and enforce regulations. There are many reasons for this, including insufficient funding for various organizations, which often translates into limited capacity. Coordination between state agencies is at times problematic. Another challenge is the informal (and often seasonal) nature of mining work, which often takes place in remote rural areas, making it difficult for authorities to regularly communicate with artisanal miners. This means that various actors may not have comprehensive knowledge or awareness of mining laws, policies, and regulations.

4.2 Chemical pollution: the Minimata Convention on mercury and the cyanide code

Tanzania is one of the most significant African countries in terms of volumes of mercury emissions. Tanzania's National Action Plan for Mercury Management was published in 2009, and in 2013 Tanzania became a signatory to the Minamata Convention. A grant of US$500,000 was approved in recent years by the Global Environmental Facility (GEF) to fund the development of a National Action Plan for Artisanal and Small-Scale Gold Mining in Tanzania, though the action plan is still under development.

A survey was recently conducted in Northwest Tanzania that quite comprehensively documented the use of mercury (IPIS 2019). It found that '3 of the 4 worst practices, set out in the 2017 Minamata Convention on Mercury, are widespread in the region' (IPIS 2019: 7). Prior to that research, Human Rights Watch conducted research in 11 mining sites in 3 of 12 major artisanal and small-scale gold mining (ASGM) areas: Geita district (Geita region), Kahama district (Shinyanga region), and Chunya district (Mbeya region). It detailed the risks and likely impacts of mercury use not just on miners but also on community members, including children.

To date, some training has been conducted around mercury use in Tanzania. For example, in 2006, the government partnered with UNIDO (the United Nations Industrial Development Organization) to conduct training (IPIS 2019); in 2010 a non-governmental organization (NGO) called Agenda for Environment and Responsible Development (AGENDA) conducted training involving both regional ASGM associations and zonal mining officers (UNEP Global Mercury Partnership 2010). Another NGO, the Organization for Knowledge Opportunity and Aid in Tanzania, carried out a small project in the Mwanza region between 2017 and 2018 (GEF 2019). However, many of the most dangerous and polluting forms of mercury use are still widely practised at ASGM sites across Tanzania, indicating that training to date has not fundamentally changed practices.

In addition to training and sensitization activities, other approaches in Tanzania have included the promotion of retorts (which allow for mercury to be captured and recycled during burning) and the construction of protected amalgamation ponds (IPIS 2019). Mercury abatement activities were planned within the World-Bank-funded SMMRP, but it appears that they have not yet been carried out. A number of centres for training in ASM techniques have been established over the past year, and it was originally intended that they would include training on mercury reduction and safe use (Kinyondo and Huggins 2020). However, it is not yet clear from any official or media reports whether this is in fact the case as reports focus only on tax revenues accruing from the centres (Materu 2019).

Tanzania signed up to the international Cyanide Code in 2006, and state mining officers are obliged to provide guidance to all registered ASM gold operations on how to follow the code. Nevertheless, awareness remains low, especially at unregistered gold mining sites (Nyanza et al.

2017). A study of artisanal and small-scale gold mining in the Geita district, which surveyed 238 miners and mine managers, found that 'more than 60% of the mine workers and more than one third of the mine managers were not knowledgeable about the requirements of the Cyanide Code' (Nyanza et al. 2017: 8). The same study found that 'all cyanide containers and other associated chemicals at all of the 19 SGM sites in Geita had labels written in English' and recommended that 'the Tanzanian government should require that all containers and materials come with bilingual labels (English and Swahili) and pictorial representations' (Nyanza et al. 2017: 10).

4.3 Implementation of environmental laws and regulations

There are more than 30,000 approved PMLs in Tanzania, but fewer than 10 per cent are estimated to be operational at any particular moment (Schoneveld et al. 2018: 47). This makes systematic inspection and monitoring of environmental regulations challenging for state agencies. In general, 'Reports from SGM [small-scale gold mining] mining areas in Tanzania suggest a lack of enforcement of environmental safety regulations, as well as occupational health and safety regulations' (Nyanza et al. 2017: 6). Through a study of mine sites in Geita, one Tanzanian expert found that the regulatory framework was not well suited to the needs or capabilities of the ASM sector, governance of environmental issues in ASM was overly centralized, and awareness amongst miners of their environmental responsibilities was low (Mwakaje 2012).

NEMC has insufficient capacity to effectively monitor the ASM sector. For example, in 2009, the government stated that there were only 20 environmental inspectors for the entire country (Lauwo et al. 2020), and a recent study found that NEMC only employed four technical staff in the Northern Zone, who were responsible for all sectors (not just mining) across three regions (Schoneveld et al. 2018: 48). The number is significantly less than the World Bank's recommended figure of 1,000 inspectors (World Bank 2019).

Where EIAs were conducted, NEMC did not always involve its zonal NEMC staff or district environmental management officers in processes of reviewing EIAs and granting permits because of a perception that zonal staff lacked the technical knowledge or objectivity to be involved (Schoneveld et al. 2018: 52). At the same time, there are indications that the government is planning to allow for provisional environmental certificates that will let projects commence even while an EIA is being conducted. According to critics, this suggests a willingness to sacrifice rigour in the process for economic growth (Schoneveld et al. 2018: 71).

While an EPP may be submitted by some miners, 'in practice, the EPP is merely a formality and poorly scrutinised, and in some zones also poorly enforced' (Schoneveld et al. 2018: 49). More generally, 'relevant environmental regulations—relating to management of waste, effluent and toxic gasses, protection of forests and riverine areas, and reclamation of land following decommissioning—are rarely adhered to' (Schoneveld et al. 2018: 46).

Coordination between different state agencies has been an issue in monitoring and enforcement of environmental regulations. This is part of a broader pattern in Tanzania. For example, a recent report observed 'poor information sharing between government departments with different roles in land planning' (Weldegiorgis and Buxton 2017: 19). There is also 'unresolved tension' between the Ministry of Mines and NEMC over responsibilities for environmental regulations (Schoneveld et al. 2018: 49). In some cases, the Ministry apparently ignores NEMC regarding environmental matters in the ASM sector (Schoneveld et al. 2018).

One issue is the involvement of local government authority (LGA) officers. The LGA committees are found at district, ward, and village levels, as well as at municipal level for urban areas. Specific committees and officers may exist for land, environmental management, forestry, community

development, and investment. However, these committees may not always be able to coordinate effectively with state agencies. 'District Environmental Management Officers expressed their concerns about the lack of information on implementation of EPPs that are managed by the MEM [Ministry of Energy and Minerals] to control environmental impacts of ASM' (Mutagwaba et al. 2018: 70).

4.4 Thematic primary data results

Agencies regulating environmental issues in the ASM subsector

According to informants, the agencies with environmental responsibilities include NEMC, OSHA, the Mining Commission, RMOs, and district and village councils. That NEMC is regarded as the main agency, which is not surprising as it is mandated by the Environmental Act of 2004. Respondents from the government add other agencies (e.g., STAMICO, FEMATA, the Ministry responsible for land and the Ministry of Minerals).

The legal framework for environmental protection in the ASM subsector

The legal framework, particularly both the EMA and Mining Act 2010, is relatively clear. PML holders are required to submit an EPP prior to commencement of mining. The majority of respondents from the government argued that this aspect was functional.

The existing legal framework treats the mining sector as homogeneous. While it somewhat captures some of the environmental issues for the ASM sector, it is generally intended to address environmental issues within an LSM setting. As one of the respondents aptly put it, 'This generally makes it harder to follow-up and address the critical environmental issues prevalent in the ASM sector when the existing framework appears to be LSM-centred'. The existing environmental laws and regulations could thus be more effective if customized to become ASM-specific.

Dissemination of the legal framework for environmental management could be improved. Indeed, 75 per cent of respondents stated that dissemination is inadequate. The few who think dissemination is adequate either said so because laws are available somewhere at the Ministry and website or because small-scale miners and LSM must adhere to environmental regulations before being given licenses, meaning they must have read them before applying. However, artisanal miners do not go through that formality. Moreover, completing forms does not have to mean having access to relevant information.

There are isolated efforts to disseminate information especially during training of some ASM operators. However, such efforts, as one academic respondent put it, 'cannot be said to have been consistent, neither can they be said to constitute an effective dissemination of a legal framework to all stakeholders'. A familiar recommendation was given that perhaps it is time to have an agency fully dedicated to ASM, as STAMICO (being a mining company itself) has not been able to perform its custodian duty to ASM as it should.

Institutional roles

Institutional responsibility for environmental protection in the ASM subsector could benefit from more clarification. While NEMC assumes the overall mandate for environmental management as stipulated by law, STAMICO seems to do the same within the ASM subsector. Moreover, OSHA plays a role in ensuring that there is safety among miners. The Mining Commission also has a role. Meanwhile, local government authorities play the 'watch dog role', trying to protect communities

from potential and/or actual adverse impacts generated in mining sites. There are therefore challenges in ensuring that all these institutions work in a coordinated manner.

There are also questions of conflicts of interest. STAMICO is supposed to be a custodian of ASM and has the mandate to ensure environmental protection in the subsector through, among other means, training of ASM workers. However, miners see STAMICO as a competitor, as it is also engaged in commercial mining activities. Moreover, the Mining Commission, while having a responsibility to enforce environmental regulations, also issues mining licenses. There are risks that checks and balances could be compromised through this combination of roles. In addition, with the exception of NEMC and perhaps OSHA, it is clear that environmental protection is only one of the many responsibilities of these agencies. As a result, the environment is not currently a priority.

Respondents almost unanimously described coordination between government agencies as limited. Agencies work in silos, with little information shared across related institutions, and at times duplicate similar roles. As one respondent put it, 'NEMC can stop operation of polluters without consulting local authorities and other organs' and so may not prioritize coordination. Respondents working in ASM pointed out that government agencies visit them separately in an uncoordinated manner. Some respondents argued that the problem is exacerbated by the tendency of authorities to focus on LSM and ignore ASM.

Furthermore, coordination between central government agencies and local government authorities in ASM issues (as well as overall extractives governance) is limited. As one academic put it, 'a major weakness in Tanzania's extractive sector governance is that much of the governance decisions and initiatives are centralized. Local governments have, practically, limited roles to play in the management of extractive processes'. There is thus little coordination between central and local governments when it comes to EPPs. The few instances when central government agencies link up with local authorities normally occur during crises when they need local authorities to address conflicts. This situation is consistent with results from World Bank's (2019) study that cites incomplete legal frameworks, lack of coordination, and funding as the main impediments to environmental management in Tanzania.

Explaining institutional disconnects

IPIS (2019) provides several reasons behind the challenges of institutional coordination. For example, unlike other state agencies (i.e. on land, the environment, and forestry), the Ministry of Minerals has no local government representation. This makes coordination with village councils, district councils, and regional administrators more challenging. Moreover, different institutions have different kinds of incentives in place. The RMOs are essentially tasked with promoting mining and growing the sector and therefore have little to benefit from enforcing regulations that might slow down production. In contrast, village councils can gain direct financial benefits from imposing fines (especially 'informal' fines or taxes) and therefore might prefer ASM to remain informal and are subject to ongoing forms of local taxes or fines rather than ASM formalizing and paying fees to centralized state agencies.

Schoneveld et al. (2018) point out that the former Ministry of Energy and Minerals (MEM) ensured that mineralized areas could be transferred to larger mining operations whenever possible instead of facilitating technological advances in ASM. They argue that 'the tendency of mining officials to emphasise maximisation of mineral output instead of improved distribution of costs and benefits is foremost a product of prevailing incentive and accountability structures within MEM' (Schoneveld et al. 2018: 54). They identify institutional key performance indicators as part of the issue because performance indicators often focus on financial aspects.

The Ministry of Minerals is responsible for overseeing policy making, guidance, and general functions of agencies under it including STAMICO. While some respondents think that tensions between these two organizations are a thing of the past, the insufficient coordination and clarity on roles and responsibilities in the Ministry are problematic. Half of the government respondents believe that tensions between the two are palpable. Meanwhile, an academic suggested that the Ministry has institutional incentives to allow ASM to take place without environmental protection and mitigation, for the sake of gaining votes from miners. If true, this would impede STAMICO in executing its mandate.

EIAs, EPPs, and the ASM subsector

There is intent to make EIAs more socially responsive. This is evidenced by the positive change of concept from EIA to the Environmental and Social Impact Assessment (ESIA). However, while the ESIA framework is quite comprehensive, there is a very limited focus on social issues in corresponding reports. Reports lean towards the technical side of environmental impacts, with limited social issues coverage. Half of the respondents from the government thought that ESIA only moderately considers social issues. The situation seems to be even worse in artisanal mining sites where no EIA is usually conducted.

Capacity to undertake EIA seems to be limited. Respondents pointed out that most of it resides in Dar Es Salaam, particularly with private companies. This is because only private companies registered by NEMC are the ones undertaking EIA in mines. The implication is that costs to undertake EIA are high and access to registered companies in Dar Es Salaam is limited. It is not surprising that the majority of respondents consider EIA to be too expensive for ASM.

We note, however, that ASMs are not required to undergo a comprehensive EIA, despite being responsible for a considerable amount of environmental degradation. They are instead required to submit EPPs. These are less demanding than EIAs but, nevertheless, may be difficult for some artisanal miners to afford (Bryceson et al. 2020). The general opinion is that very little follow-up on environmental impacts is conducted in the ASM subsector as EPPs are not as comprehensive as EIAs (Weldegiorgis and Buxton 2017). Moreover, it seems that ad hoc follow-ups are usually done when there is a problem that demands the attention of authorities. This is particularly because NEMC has resource constraints (both human and financial).

The majority of the respondents suggested that PML holders are solely responsible for maintaining environmental standards. Yet one respondent pointed out that it is the mining site managers who are responsible for environmental standards in their mines. However, the Environmental Management Act (URT 2004) stipulates that any person involved in mining operations is responsible for maintaining environmental standards. This is other evidence that more education and training on this aspect is needed.

Many respondents are of the view that transparency is adequate. The processes, procedures, and requirements for executing EIA and EPP are quite clear and transparent. Applications can be done using an online tool or through NEMC's regional offices across the country. However, a few respondents had reservations about the process. For instance, an academic was quick to point out that bribes can become an issue when preparation of EIAs and EPPs are conditions for providing grants (as was the case a few years back) or any other assistance. This assertion was supported by a few ASM respondents.

The Minimata Convention on mercury

The Tanzanian government introduced a Mercury Code of Practice in 2008 to complement pilot programmes on improved mercury handling (UNEP 2012). Respondents agreed that the Government Chemist Laboratory (GCLA) is responsible for the necessary tests. NEMC is responsible for collecting samples and monitoring chemical use including mercury. OSHA monitors safety within the workplace. The roles of the Mining Commission, STAMICO, and the Ministry of Minerals are not as clear-cut, but these agencies have also been mentioned as being responsible for monitoring mercury use.

Village land-use planning (VLUP)

The connection between ASM and VLUP seems to be a relatively unexplored area, though it has been briefly mentioned in some reports (e.g., Weldegiorgis and Buxton 2017). Almost half of the respondents thought that ASM is currently not considered in VLUP. Reasons behind this included the capacity of villages to execute strong plans and their limited access to geological information. As for those who thought VLUP considered ASM, they stated that ASM is included in villages where ASM *predates* the VLUP process. Villages lack the necessary capacity to determine the presence of minerals in their backyards and hence rely on serendipitous discoveries before they can plan for land use.

5 Formalization of ASM

Formalization of ASM is on the agenda of many African governments and is emphasized in the Africa Mining Vision (AU 2009). Formalization of ASM can refer to various processes, including clarifying or allocating rights to land and minerals; legalization (through reforming laws and/or ensuring compliance with laws); technical and technological improvements; improved organizational governance (especially in terms of transparency and accountability); and capitalization and scaling up of operations. Efforts to formalize ASM in Tanzania have taken place for many years. For example, the Mining Act of 1979 enabled citizens to apply for prospecting licenses for artisanal mining, and a 1983 small-scale mining policy paper also legitimized the sector (Chachage 1995). During the 1980s and 1990s the policy emphasis was on attracting foreign large-scale mining firms, but formalization has gained impetus recently. One of the main instruments of formalization is the PML: from 2000–19, approximately 29,000 mining licenses were distributed by the government (Reid et al. 2019).

The 2009 Mining Policy states that ASM operators will be provided access to capital and extension services. The World-Bank-funded SMMRP, operational between the late 2000s and 2019, included several ASM formalization aspects including demarcation of mineralized areas reserved for ASM, capacity-building activities, a small grants programme, support to value addition (such as gem cutting and polishing), and the construction of demonstration and training centres [known as Centres of Excellence (COEs)]. In 2014, the responsibilities of STAMICO were extended to include coordinating the formalization of ASM. Specifically for the tanzanite sector, formalization has involved requirements that mining companies issue a contract to every miner, pay salaries (rather than operating through production-sharing agreements where miners are given a proportion of the gems found), and crack down on smuggling (Kinyondo and Huggins 2019).

In order to encourage ASM operators to pay fees and operate more formally, the government consulted with regional ASM associations in 2019 and established a royalty and fees regime specifically for ASM. The government has also established various mineral trading centres across

the country to encourage miners and dealers to sell gold and other minerals, gems, or metals officially rather than on the black market. The strengths and weaknesses of such approaches have been debated (see e.g., Jacob 2017; Huggins and Kinyondo 2019; Kinyondo and Huggins 2019, 2020, 2021; Pedersen et al. 2019; Reid et al. 2019). This article does not attempt to discuss all the pros and cons but rather to describe and conceptualize the ways in which formalization efforts address (or otherwise) environmental impacts of ASM.

Note that while the law only recognizes small-scale miners (SM) through sanctioning of the PML, its corresponding policy does recognize artisanal miners (A). It comes as no surprise then that one overall critique of many formalization approaches in Tanzania is that they have focused particularly on the PLM holders (SM) rather than the artisanal (A) mine workers (who represent by far the majority of those involved in ASM) (Merket 2018). More particularly, some of the formalization projects assume that PML holders and other ASM miners more generally are entrepreneurs, keen to scale up and formalize (Kinyondo and Huggins 2020). This 'scaling up' assumption leads to a reliance on technology adoption: the idea that ASM operators, if they have access to capital, will adopt more efficient technologies (e.g., for processing), which are often more environmentally friendly. However, this is not necessarily the case. Some miners may prefer to remain smaller scale and less formal, using cheaper equipment. Miners may prioritize being smaller and more mobile to avoid paying fees, royalties, and taxes. More generally, the organizational structures of ASM are quite complicated. The priorities of ASM workers are likely to be different from those of PML holders.

There are some existing links between formalization approaches and environmental protection. For example, one of the criteria for an application for credit under the SMMRP loans scheme was an environmental management plan approved by the Zonal Mines Office. The COEs have vat-leaching gold processing systems, which (if used properly) result in much lower emissions of mercury and other toxic chemicals to the environment than mercury amalgamation (Kinyondo and Huggins 2020). There are hopes that miners will not only use the processing systems at the COEs but also purchase vat-leaching systems for themselves. However, in general, formalization approaches have emphasized state revenue collection and have tended to pay less attention to environmental aspects.

5.1 Formalization of ASM in Tanzania: stakeholder perspectives

Respondents were unanimous in agreeing that gold is prioritized when it comes to environmental monitoring. This is mostly because, unlike gemstones, gold production involves heavy chemicals for processing. Moreover, gold comprises the single largest ASM subsector in the country, and hence, the corresponding level of environmental damage from gold production is the highest among ASM operators. Moreover, gold production has a longer value chain, which necessitates for the presence of many people. However, while there is an argument for prioritizing gold in monitoring environmental standards, other minerals should not be neglected.

Environmental monitoring requires capacities in research and equipment. The majority of respondents pointed out that there is a huge financial constraint at different levels of the government that curtails effective environmental monitoring, regulations, and improvement in ASM. The government seems to give environmental monitoring, regulation, and improvement of ASM priority or at least sufficient attention. However, rhetoric does not always translate into reality. As one academic put it, 'when push comes to the shove, funds budgeted for environmental protection could easily be diverted to other "pressing" matters'.

The majority of respondents agree that ASM operators who are organized into cooperatives or associations generally have more capacity to manage environmental issues than those that remain

completely informal. However, respondents stated that ASM operators lack the motivation and means to engage collectively in environmental protection.

The general view is that regional ASM associations exert pressure on ASM operators to improve their environmental management practices. However, the respondents said that this pressure has been too soft. Lack of legal mandate for these associations to enforce regulations on operators could be the issue here.

Note that the majority of respondents, including those in government, do not think there is evidence that mining areas with lots of government intervention have better environmental management. Again, there is almost a unanimous view among respondents that the recent increase in attention to ASM by the government is mostly driven by its desire to maximize fiscal benefits rather than improve ASM. As one NGO respondent put it, 'I gravely doubt whether formalization has anything to do with improvement of ASMs... formalization makes government control of ASM possible'. Similarly, another respondent claimed that the primary interest of government is in getting ASM operators to pay taxes so the state can expand its tax base. He went on to term the government's approach towards ASM as 'extractivist', as the objective is to extract more revenues from the ASM subsector without necessarily investing in improving mining operation conditions.

While several respondents contended that initiatives such as trading centres are meant to ensure maximum revenue collections by the government, the majority of the respondents thought that COEs could help in improving environmental standards in ASM sites. Training on various environmental and technical issues is, for instance, prioritized in COEs.

It is interesting to note that the majority of respondents, including government officials, stated that they see no evidence that revenues generated from ASM are pumped back into the ASM subsector to facilitate monitoring and regulation of the environment. This is mainly because such revenues go to the central basket of funds and hence are used for the government's priority activities, which according to one academic may not necessarily include monitoring and regulating the environment. There may thus be a need to ring-fence part of the revenues for improving environmental standards rather than having all the revenues put into a consolidated fund.

6 Discussion: formalization of ASM and environmental sustainability

The preceding sections, based on secondary literature as well as primary data, have demonstrated that there is not an automatic connection between formalization of ASM and improvement of environmental protection in line with the work by Kinyondo and Huggins (2021). This is because formalization can mean very many different things and can have many different intentions. In order for formalization activities to have positive environmental impacts, they must be designed to do so. This paper has identified systemic, long-standing challenges that will have to be overcome if environmental improvements are to take place. Some of these challenges are particular to the ASM sector (e.g., lack of a specific ASM policy) while others are very common across different sectors (e.g., lack of inter-agency coordination).

At the moment, it does not appear that reduction of environmental impacts from ASM is a main government priority. The first step would be strong statements from key government agencies and figures, insisting that environmental improvements are essential. Environmental sustainability could be mainstreamed through all formalization activities. The pro-environment message should be shared at all levels of government, including district and ward levels. The message should be carefully calibrated to avoid a purely punitive approach (which might be counterproductive).

The second step would be to work towards improved institutional coordination, including through better delineating the responsibilities of different agencies, to avoid overlaps and gaps, and to ensure that each agency is sufficiently well-funded to take on its environmental responsibilities. Once inter-agency coordination is improved, as a third step, the key agencies in the mining sector could work together with other stakeholders to develop plans for addressing the most serious types of environmental impacts based on existing regulations, policies, and laws and focusing on different ASM actors (i.e. some focusing on PML holders; some focusing on workers) and different categories of ASM (e.g., ASGM; alluvial miners; deep rock miners). These plans could be explicit about the social, technical, and economic prerequisites of the improvements. In some cases, the plans would build on existing activities but provide more detailed analysis of the assumptions underpinning them and the potential strengths and weaknesses of the approaches. Obviously, plans that do not require miners to invest large amounts of capital are likely to be more feasible. Key non-governmental stakeholders to be part of these discussions include regional ASM associations, dealers and brokers in the ASM sector, representatives of local government authorities from areas with lots of ASM, and NGOs working in the mining sector and the environmental management sector.

Implementation of the plans, which might be piloted in select districts before a broader roll-out, should be matched by a feasible monitoring system. While it would be optimal for mine sites to receive regular visits from different stakeholders responsible for environmental issues, in reality it is unlikely that agencies and other stakeholders will have the funding to make many site visits. Therefore, agencies could share information and attempt to make mine visits as useful as possible, covering different kinds of environmental issues simultaneously.

Moreover, formalization strategies could be responsive and adaptable. The government could be ready to modify its approaches based on monitoring and consultation with stakeholders.

7 Recommendations to improve the environmental management of ASM sites

7.1 Regulations

Respondents thought regulations need some improvements, especially ones to do with making regulations specific to the ASM subsector rather than using a blanket of regulations that assumes that the mining sector is homogeneous. Moreover, regulations might seek to differentiate between artisanal miners (e.g., without mechanization) and small-scale miners (e.g., using some mechanization). The artisanal aspects of ASM must be enshrined in regulations because not every small-scale miner holds PML. Such regulations must be backed by means to enforce them, as good regulations mean nothing if they cannot be enforced. As other studies have recommended, NEMC and other stakeholders should ensure that implementation of EPPs are monitored and enforced (Weldegiorgis and Buxton 2017). Finally, such regulations have to be updated regularly to make them relevant.

It may also be useful to include ASM sites in land-use planning processes, from the village level all the way up to the national level. This may improve coordination by making the location of mine sites known to a large number of stakeholders and encourage greater coordination and planning between stakeholders.

7.2 Policies

While respondents generally think policies are clear, the need to have ASM-specific policies has been raised by many respondents. Such policies must be aimed at improving productivity in the ASM subsector and widely shared to the ASM community so it may be aware to them. Environmental committees at the local government level should include ASM operators. Policies, as well as dissemination and training activities, should emphasize the interlinkages between the environment, public health, and health and safety of miners to demonstrate that it is in the best interests of miners and their families to improve environmental management.

7.3 Laws

There should be a separate law specifically covering the ASM subsector. This could further clarify that ASM operators require an EPP rather than an EIA. Alternatively, Mwakaje (2012) recommended that EIAs could be conducted for entire designated mining blocs (rather than for individual mine sites), and regulation could be further decentralized. Such laws could be decentralized so that the RMO and local government authorities have powers to oversee the ASM subsector in collaboration with the central government.

Legislation for LSM could stipulate that plans for LSM mine site closure should include EIAs for ASM activities, which are often practised on closed mine sites (Morrison-Saunders et al. 2015).

7.4 Financial instruments

Financial mechanisms could include a performance bond/fund, fines, and fees (as already applies to the LSM subsector). Such funds could be ring-fenced to prevent reallocation to other uses. The government could consider bringing back subsidies to the ASM subsector. Moreover, the government could ensure that ASM operators have access to consistent provision of credit to promote their financial and technical capacity. A special fund for ASM may be created to make this happen. ASM operators could be incentivized to promote environmental protection through a variety of measures including, for example, making credit provision conditional on effective environmental protection or lowering taxes and fees to ASM operators who perform well in environmental protection as per agreed standards. PML should cover mineral land titles and should be long-term (as is the case with LSM licenses) to enable ASM operators to access credit.

7.5 Institutional arrangements

The roles for each institution involved in ASM governance could be further clarified. NEMC and other relevant agencies working on ASM could create specific sections/departments for ASM issues. Recruitment of additional environmental inspectors, as recommended by other organizations (World Bank 2019), should earmark human resources for ASM. ASM departments could be established in district councils where ASM activities take place for coordination between central and local governments and for timely and regular environmental monitoring. This would have significant financial implications but is justified because ASM is a key economic sector that deserves adequate attention and service. There could also be improved coordination among agencies regulating the ASM subsector. Previous studies have recommended 'empowering regional mining offices and local governments to more active roles in environmental management and overseeing mining operations in their areas' (Reynolds and Weldegiorgis 2017). Moreover, the capacity of ASM associations could be strengthened so that they can do more to promote, monitor, and enforce environmentally sustainable practices. ASM stakeholders could also collaborate with LSM companies to benefit from technical expertise, as ASM often occurs near LSM concessions.

7.7 Political 'messaging'

Recent government rhetoric (under the late President Magufuli) is very much pro-ASM. However, there seems to be a gap between rhetoric and reality. All political calls must be followed through to ensure implementation. Environmental protection, and by extension the sustainability of mining, must be a permanent agenda for politicians, without showing restraint in enforcement for political gains. Messaging must be geared towards motivating ASM operators to rethink their approaches. It follows that political messaging must necessarily reflect reality on the ground with a view to improving ASM operations.

In the end, the ASM subsector can only be built based on decisions made through engaging all stakeholders. So far, the subsector has been accorded ad hoc and inorganic consultations. Consultations could raise key issues to be keenly followed for implementation—practical proposals based on the realities in the ground—and should be flexible to accommodate the realities of the subsector.

7.6 Information systems

The World Bank has recommended 'establishment and upkeep of a centralized environmental information system' and strengthening field-based monitoring networks (World Bank 2019: 130). ASM-specific indicators and components should be included as part of any such effort.

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Appendix: National Environmental Policy, 1997

The National Environmental Policy, 1997, provides for the following:

- that the overall project cycle of mining (including reclamation and restoration of land after use) is to be adequately managed to minimize adverse environmental impacts;
- that mining discharges to ground and water are to be controlled;
- that preventative and clean-up measures for accidents are to be formulated and implemented;
- that air pollution from mining areas are to be controlled;
- that strict regulations are to be put in place to control the use of mercury in mining activities;
- that regular and periodic environmental audits are to be maintained to ensure the adoption of environmentally sound practices.