Environmental Degradation under Artisanal and Small-Scale Mining in Tanzania: Can Innovations in Institutional Framework Help?

Agnes G. Mwakaje

Institute of Resource Assessment, University of Dar es Salaam, Tanzania

amwakaje@udsm.ac.tz

Abstract- **Artisan and small-scale mining (ASM) plays an important role in employment and livelihoods in Tanzania. Estimates suggest that over 1,000,000 Tanzanians are engaged in mining, more than 90 percent of whom are in ASM. However, most ASM activities are taking place using rudimental technology causing negative impact on the environment and human health. Despite having laws and regulations in the mining sector in the country, the enforcement at the ASM has remained ineffective. There is a concern that the institutional framework governing the Mining Sector is not suitable for ASM and innovations are required to effectively governing the ASM activities. This study is a contribution towards achieving this goal. The study conducted a review of the institutional framework governing ASM, focusing on the gold subsector. It also undertook a comprehensive review of literature on ASM. In addition, about 100 ASM operators were interviewed in Nyarugusu area, Geita district. The study intended to highlight the strengths and weaknesses of the current institutional framework for ASM operators and suggests innovations to inform the policy and decision making process on how best ASM could enhance livelihoods without degrading the environment. It also adds to the body of knowledge on the current debate of environmental degradation under ASM through publication. The major conclusion is that the current institutional framework is not conducive for ASM activities and innovations are necessary for ASM operators to comply. Most of the decision making and compliancy regulatory bodies are centralised, a high number of ASM operators are not aware of the existing institutional framework and most of the regulations are not compatible with the ASM activities. These include the requirement for ASM operators to register their activities at the head quarters of the Ministry, the condition that each ASM operator to undertake environmental impact assessment (EIA) in his/her plot, insufficient involvement of local authorities at village and district levels to regulate the ASM activities, poor working technology and lack of ASM organisations/associations. The following innovations are recommended: decentralising ASM regulations to village and district levels including capacity building at these levels, introducing block EIA and management plans to accommodate a number of ASM operators and for joint responsibilities, strengthening cooperatives and associations, facilitating ASM operators access to credit and link ASM with medium/large scale mining and providing friendly formalisation processes.**

Keywords- ASM; Environmental Degradation; Institutional Framework; Innovations

I. INTRODUCTION

A. Mining Liberalisation and ASM in Tanzania

Tanzania liberalized mineral markets in the 1980s. This involved the licensing of private gold and gemstone dealers, thus offered new legal channels for ASM activities. Between 1989 and 1997 the number of mineral dealers' licenses increased from 17 to 2,000. This, along with efforts to encourage local investment in mining, resulted in a steep increase in mining activity, mostly in ASM. Between 1990 and 1995 the number of registered claims increased from 1,998 to 4,123 and more than 4000 were registered as ASM companies' workers [20]. Parallel to the increase of miners in registered ASM, the number of illegal miners has also increased dramatically. Current estimates place the number of Tanzanians engaged in mining to be over 1,000,000, more than 90 percent of whom are engaged in the ASM [20]. A single mine might employ between 100 and 1,000 or more workers, almost exclusively men[9].

The liberalisation of mineral activities has boosted investment in the sector tremendously. Investment at medium and large scale mining has been dominated by foreign multilateral companies. Up to 15% of Africa's exploration expenditure has been spent in Tanzania [20]. However, artisanal and small scale mining is almost exclusively Tanzanians. Diamonds, gold, nickel and gemstones have been the flagship minerals in Tanzania's growing minerals industry [19]. The mining industry grew by 27% in 1999, a major increase from the previous years' 17%. In 2004 the mining sector contribution to GDP was 3.5% and projections suggest that the sector will reach 10% by 2020 [20].

From 1999 to 2005, gold production and export increased from 4,890 kg to 52,236 kg, enabling the country's export earnings to increase from USD 39,760m to 643,640m [8]. Currently, minerals make up over 52% of the country's exports, of which a large part comes from gold [3]. Tanzania is currently the third-largest gold-producing country after in Africa South Africa and Ghana [19].

At micro level the contribution of the mineral sector to the poverty alleviation is also significant. A typical day's labour will produce from a half to one gram of gold, yielding around US$ 2 - US$ 2.50 in income for the miner, which is sufficient to keep the family above the poverty level [30].

While economically, mineral deposits are seen to have a significant impact through GDP, employment) and on livelihood of ASM entrepreneurs, studies on the environment in mining areas show that ASM is a cause of great concern [27], [5], [4], [17], [14], [13]. The ASM is largely

informal, operating outside a legal framework [6]. It is conducted on very rudimentary level using basic tools such as picks and shovel, and occasionally, mechanized equipment [15]. There is high level of mercury concentration in river sediments and soils within gold mining and processing centres. Heavy metals concentration in the sediments are said to increase with decreasing distance from the shoreline of mining areas [14]. Other concerns include loss of landscape aesthetics and pollution to ecosystem health, whereby these miners work in hazardous conditions, with little or no regulations or standards. Toxic materials are released into the environment, posing a major health risk to the miners, their families, the surrounding areas and the environment. Although, there are policies, laws and regulations governing ASM, they have not been effective in controlling environmental pollution in the ASM sub-sector. There is a concern that the malpractices in ASM are caused by both ineffective institutional framework and low capacity and, therefore, need for innovations in the current institutional setup.

The question is why the laws and regulations have failed to be enforced under ASM? This is a research area which has not received due weight. This study intended to fill this information gap by investigating how innovations in the institutional framework in the mineral sector could redress environmental degradation caused by ASM in Tanzania. Specifically, it focused on how appropriate innovations on regulations complemented with capacity building could solve most of the problems caused by environmental degradation under ASM with the focus on the gold mining sub-sector. The choice of ASM was purposive. ASM is a growing sector at an unprecedented pace and mercury contamination associated with ASM gold mining and processing represents a major environmental and human health concern in Tanzania.

The main work in this study was on reviewing the mining related policies, laws and institutions with the purpose of highlighting their strengths and weaknesses. There was also stakeholders' consultation and ASM interviews at Nyarugusu village in Geita district in Mwanza region. The choice of the district was based on the high number of ASM operators and therefore the consequential threat to the environment and human health. Geita district has over 15 ASM mining centres. It is estimated that there are over 150,000 ASM in the district. Being subsistence miners, ASM activities are highly unregulated, resulting in dangerous mining practices and significant environmental destruction, not least of which is the increased mercury pollution and extensive deforestation. Geita district covers 7, 825 km and 1, 050 km, most of which is the water of Lake Victoria which plays a key role in marine diversity including endemic, rare and endangered species. The lake also plays a significant role in fishing both small and large scale levels. Geita district also hosts the largest gold mine in Tanzania, the Geita Gold Mine (GGM).

It is hoped that this study will shed light on the subject for policy makers, planners, academics and the international community on how best ASM could sustain livelihood without causing environment degradation.

B. Conceptual Framework

There are a lot of similarities and some differences between artisanal and small scale mining. According to [22] the broadest distinction is that artisans may involve only individuals or families and is purely manual, while small scale is more extensive and partly mechanized. In some instances, small-scale miners have legal titles to the land that they work, which is recognized by the authorities. In other cases, they work on land they have traditionally inhabited but without any recognition of land rights from the state, or they may be working on land informally and regarded as illegal squatters by local and state authorities. Of the two groups, artisanal miners are more likely to be working without a legal mining title.

However, artisanal and small-scale miners also share many characteristics including exploitation of marginal or small deposits, lack of capital, being labour-intensive, low rate of recovery, poor access to markets and support services, low standards of safety and health, and; significant impact on the environment [22]. Most of these ASM operators are men, women, or children and are rural and poor.

Quite often ASM activities start abruptly. Many people can suddenly be drawn into mining following the discovery of new mineral reserves, as with gold or diamond 'rushes' during which, thousands of new people hope to make their fortunes. Such ASM activities require an innovative institutional framework that suits the characteristics of the sector.

C. Definition and Concepts of Institutional Framework

North [23] defines institutions as the rules of the game in society or, more formally, which are the humanly devised constraints that shape human interaction. Institutions are widely understood to be the rules, norms, or strategies that create incentives for behaviour in repetitive situations [7]. Institutions could be formally described in the form of a law, policy, or procedure, or they may emerge informally as norms, standard operating practices, or habits. Alone or in a set of related arrangements, they are mechanisms for adjusting behaviour in a situation that requires coordination among two or more individuals or groups of individuals [12].

Sometimes the terms "institution" and "organization" are used interchangeably [25], but an organization can be thought as a set of institutional arrangements and participants who have a common set of goals and purposes, and who must interact across multiple action situations at different levels of activity. Like institutions, organizations may be formally or informally constructed.

Additionally, an institutional framework refers to a law or other formal provision that assigns primary responsibility as well as authority to an agency for implementation, enforcement and monitoring [24]. States need to ensure that appropriate policy, legal and institutional framework are adopted to achieve the sustainable and integrated use of natural resources.

D. Institutional Framework Governing ASM Mining in Tanzania

In Tanzania, the mining sector is governed by a number of policies, laws and institutions. Policies are formulated to influence and determine decisions, actions, and other matters related to the mining sector. Laws, on the other hand, are systems of rules set to maintain order and protect harm to persons, property and environment while institutions are the implementing agents of the policies and laws. The purpose of having such an institutional framework is to enhance the contribution of the mineral sector to the economy and protection of environment.

However, achieving this goal will depend on the suitability of the institutional framework in place. The framework could either facilitate environmental protection or lead to environmental degradation. An example of an unsuitable institutional framework for ASM would be top-down developed, non-participatory, centralised, and unresponsive to ASM needs. Such an institutional framework is likely to fail to regulate and enforce ASM activities and will lead to environmental degradation. Studies elsewhere in Africa have shown that regulation of informal mining activities has been, more often than not, exceedingly bureaucratic, providing individuals with little incentive to operate within the legal domain [2]

On the other hand, a suitable and/or appropriate institutional framework for ASM activities would be an innovative one, responding to ASM needs and leading to environmental protection and sustainable livelihood (Figure 1). Evaluation of the current institutional framework for the mining sector in Tanzania in terms of suitability to regulate the ASM activities was the main objective of this study.

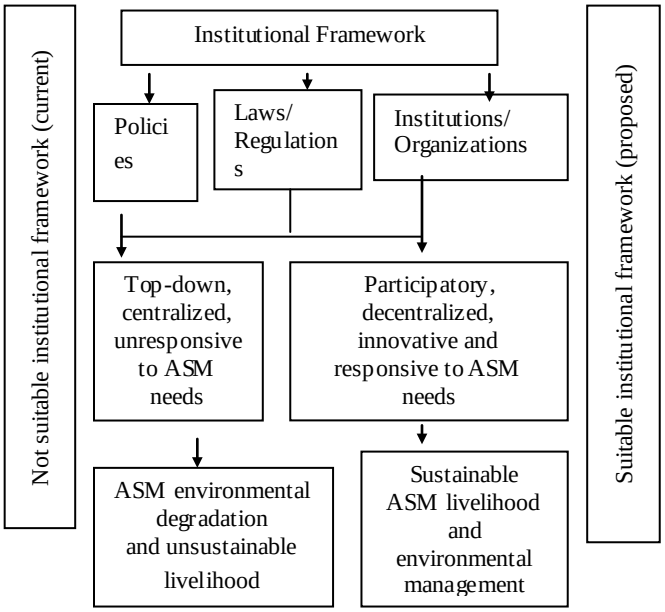


Figure 1 ASM, institutional framework and environmental pollution in Tanzania

II. MATERIALS AND METHODS

This study based on both of reviewing the existing policies and laws related to the mineral sector and primary data collection through conducting interviews with policy makers and ASM operators.

This study was carried out in May 2011. The study began by reviewing available secondary data. This was done through reviewing mining related policies, laws and institutions governing the mining sector in Tanzania, with the purpose of highlighting their strengths and weaknesses. There was also a comprehensive review of the literature on ASM.

Stakeholders' consultations were then undertaken in the Ministry of Minerals and Energy (MEM), Division of Environment under Vice President's Office (VPO), Ministry of Lands, Ministry of Water and the Ministry of Natural Resource and Tourism (MNRT). The purpose of consultations was to get an understanding of the implementation of the current policies, laws and regulations. Furthermore, ASM interviews were conducted at Nyarugusu village in Geita District in Mwanza Region.

A total of 50 respondents in each category of artisan and small scale miners (100 in total) in the Nyarugusu area were selected randomly and interviewed to find out if they were conversant with the policies and laws governing the environment and mining activities as well as the constraints experienced and their opinion on their effectiveness. Capacity and technology available under ASM were also investigated and documented. Checklists and structured questionnaire were used to gather the information.

III. RESULTS AND DISCUSSION

A. The Profile of the ASM Respondents

The 100 ASM respondents were all men with the age between 14-64 years. Majority were young miners of 14-35 years because only boys or small men called *nyoka* (snakes) are able to work in the deep and narrow spaces [9]. Workers descend underground using ladders and ropes.

ASM has low investments, based on informal operational organisations. The mining technology applied is rather rudimentary and carries with it a high risk. In this study each of the ASM operators had a simple torch, a hammer and chisel in the pits, which were up to 80 feet deep and had poor ventilation and lighting. Often, after a short period in one mine, the miners move to other sites in other regions of the country without rehabilitating the destroyed environment [9].

The ASM operators recover gold using mercury, with gold smelting or amalgam being burned in the open air, within the home or in processing areas. Miners use their bare hands when handling mercury, exposing them to risk both from vapour and from direct contact with the liquid form. The estimated amount of mercury lost to gold produced is 1 to 1.5 [8]. In Rwamagasa, 30kg of mercury was released into the environment every year [8].

Given the intensity of ASM activities and the primitive technology of mining used, the adverse impact on environmental and human health is high. There was uncontrolled mercury use during amalgamation with the

tailings being discharged in or near water bodies and air. According to [30] the mercury released into the air in the form of vapour or lost in the rivers and soil has been the cause of growing concern of the long-term impact on the habitat and human health. A study by [14], [17] revealed an elevated mercury concentration in the environment, river sediments and soils within gold mining and processing centres. Drainage water from mining operations contained metals and toxic substances that could contaminate water bodies' and the land surface [15]. ASM has also been destroying landscape aesthetics and polluting the ecosystem.

In the absence of personal protective gear, the ASM operators were at high risk of developing diseases. Since ASM operations are often subsistence activities, they tend to focus more on immediate gains than the long-term consequences of their activities. This is compounded by the fact that in many cases, governments do not attempt or lack the capacity to monitor or control these activities, which often occur in remote and inaccessible locations (MASD, 2002).

Findings from this study show a low level of education for the majority of the ASM operators. Most of the respondents had a primary education (70%) but only 30% had secondary education and post secondary training. Such low level of education does not only limit livelihood opportunities, but it also exposes them to risky and low paying activities such as ASM.

The main source of capital for most ASM was from own saving. Eighty percent and 70% of the respondents from the artisan and small scale mining categories started their business from own savings (Figure 2). Accessing funds from institutions like commercial banks and saving/credit cooperative societies (SACCOS) were insignificant. Lack of credit not only affected their mining performance but also forced them to adopt poor and risky mining and processing technologies, practices that also had a negative impact on the environment.

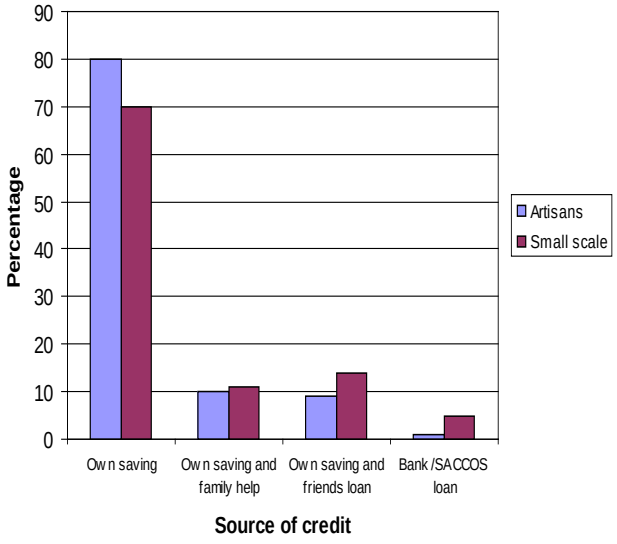


Figure 2 Source of capital for mining activities

Source: Survey data 2011

B. Individualistic Mining Activities

Groups and associations are critical for ASM development. They enhance bargaining power; facilitate access to credit, technology transfer and collective environmental management. Unfortunately, most of the ASM activities are working individually and scattered. This not only has denied the ASM from accessing credits but also caused the regulation of the sector more complicated.

C. Analysis of the Institutional Framework Governing the Mining Sector in Tanzania

The principal regulatory bodies for the mineral sector are: (i) the Ministry of Energy and Minerals (MEM); (ii) the Commissioner for Minerals; and (iii) the Mining Advisory Committee (MAC). The Ministry of Energy and Minerals is the overall supervisor of the minerals and energy sector. The Commissioner for Minerals within the Ministry of Energy and Minerals supervises and regulates the proper and effectual carrying out of the provisions of the Tanzanian Mining Act. Both the Minister and the Commissioner are appointed by the President of the United Republic of Tanzania.

The MAC is constituted pursuant to the provisions of the Tanzanian Mining Act and has the responsibility of advising the Minister on matters concerning the mining sector generally. It comprises a chairman, who is appointed by the President, and six other members coming from the Ministry of Finance, Division of Environment in the Vice President's Office, Ministry of Lands, and two from MEM. Others are the Attorney General and a representative from the Ministry of Industries and Trade. Applications for prospecting licenses are sent to the Minister, who may, on behalf of the United Republic, enter into a development agreement with the holder or applicant of the mining right.

The strength of the MAC is that it consists of educated and well informed people in the mining sector. It also involves key persons in policy and decision making processes. However, for ASM, the MAC is a very high level of administration and indeed is not representing the interests of ASM. For many ASM operators, this organisation is unreachable. In this study a high proportion of the respondents (90%) did not know what MAC was and its role was completely unknown by the ASM respondents. Because of this, it is likely that most of the decisions made by MAC are top down with very little (if any) participation of the ASM sub-sector. Having a local advisory body (e.g. district or ward level advisory committee) could be more appropriate. ASM should then be adequately represented in the MAC at the national level through the local advisory committee members.

D. Policies and Legislative Instruments

1) The Mining Policy (2009):

This policy highlights the importance of the ASM sub-sector to the economy and livelihood. The policy also acknowledges the role of ASM in discovering mineral occurrences, mineral production and the creation of employment and incomes in rural communities. According

to the policy, the government is committed to supporting the small-scale mining sub-sector by facilitating the transformation of the present artisan mining activities into more organised and modernized small-scale mining units and by promoting modalities of mineral marketing which encourage transparent business transactions and discourage smuggling.

TABLE I STRATEGY FOR ENVIRONMENTAL MANAGEMENT FOR ASM MINING ACTIVITIES BY THE GOVERNMENT

Strategy	**Status of Implementation**
Demonstrate and encourage the application of environmentally sound technologies and mining methods.	Little has been done
Prepare and distribute booklets and handbooks in Kiswahili on acceptable mining practices and the environmental obligations for mineral title holders and legal consequences of non compliance	Done but not reached all ASM
Improving environmental awareness through the media	Impacted only a few
Building partnership with non-government organizations (NGOs) private companies and individuals to ensure better environmental awareness and managements	Little has been done
Strategy	Status of implementation
Establish stricter environmental standards in densely mined areas	Done but with limited implementation
Strategy	Status of implementation
Empowering mining extension offices or designated agents to regular monitoring	Very little (if any)
Specifying environmental control measures such as pollution taxes, fines and other penalties based on the polluter pays principle	Done but little (if any) enforced
Establish proper authority structures, especially miners' security units in mining camps to uphold law and order and facilitate enforcement of health and safety regulations.	Not done

The strength of the strategy is that it captures important issues for regulation and monitoring environment under ASM (Table 1). However, as indicated in Table 1, a high proportion of the strategies formulated in 1997 have not been implemented. A number of reasons have contributed to this implementation failure, including insufficient human and financial resources. Also the nature and characteristics of the ASM sub-sector which operates in remote areas with poor infrastructure greatly hinder the implementation of these strategies. This point came up very often during stakeholders' consultation. Also the complexity of ASM sub-sector related activities makes the monitoring of the sector difficult. It starts abruptly and ends quickly. A mere rumour of mineral deposit could bring a large number of ASM operators in an area without legal recognition or permit. This makes the task of regulating ASM activities to become difficult indeed.

Furthermore, most of the strategies in Table 1 seem to be unsuitable for ASM activities. For example, the strategy of raising awareness through the media has had only a limited impact because many ASM operators are in remote areas where the media is not easy to access. Demonstrating and encouraging the application of environmentally sound technologies and mining methods have failed because most of the ASM operators do not have enough capital to purchase the equipment. The policy needs to be reviewed or modified to suit the sector. Establishing an appropriate policy framework such as linking ASM with large scale miners for technology assistance could help.

ASM needs to form trade associations with larger mining enterprises such as the Tanzania Chamber of Mines. Such a linkage would have a number of advantages including assisting ASM to formalise their activities, supporting mining technologies as well as offering a channel through which the government and other bodies could communicate with and support ASM. For example, the South African Chamber of Mines is exploring ways of accommodating the interests of such miners and helping with the formation of ASM associations that could then become associate members of the Chamber [22]. Tanzania could also learn some of these best practices initiatives from the South Africans and other countries for its ASM sub-sector.

2) Mining Act (1998):

The Act was formulated to implement the Mining Policy (1997). In the Act ASM application guidelines for mining activities are very formal. Sections 66-72 describe the procedures for mineral operation application by different levels of investors. An application for a Primary Mining License (PML) [1] is granted by the Commissioner of Minerals and is valid for a period of 3 years and may be renewable at Zonal Mines Offices (Section 69) with prescribed fees. Of course, the renewal is not guaranteed.

The strength of the Act is that if well implemented it could curb illegal mining and trading, address environmental issues, assist small scale miners to operate in a more organised manner, will provide formal small scale miners with technical support, and promote viable small-scale mining activities [29]. However, coming from remote areas to the Commissioner in Dar es Salaam City for processing their applications is an obstacle which many ASM cannot overcome. A high proportion of ASM have no confidence to travel all that way to meet the commissioner in a city which most of them have never been there and do not know even where to start given the complexity of the city.

[1] A licensing category where ASM fall

Section 14 of the Act gives the Minister responsible for minerals in consultation with the Mining Advisory Committee the right to "designate any vacant area as an area exclusively reserved for prospecting and mining operations", if he/she determines that it would be in the interest of the public [33]. However, the interest of the public is sometimes controversial. Quite often land under ASM operators has been regarded as no man's land because of lack of legal recognition and as a result, it has been transferred to large scale mining operators. This has created conflicts between large and small scale mining operators. Villagers and/or small scale miners who disagree with mining concessions seldom have enough resources to use the court system [18].

The law further requires an ASM applicant to fill in form number MRF 8 for a Primary Mining License with an application fee of Tshs 10,000. The applied land should not exceed 10 ha for all minerals, except for quarry mining. The area for a PML should include geographical coordinates for location identification. If the PML applicant cannot provide geographical coordinates, he or she is advised to hire the services of mineral officers in the respective region at a fee not stated in the regulations. The area will be inspected by the responsible officers before the application is sent to the Commissioner of Minerals for approval or disapproval. The approval of the application will only be granted after an assurance that there is no other application for the same plot. The license is valid for 5 years and is transferable.

While the application fee of Tshs 10,000 is fairly reasonable and most ASM actors can afford it, the process of acquiring the licence is too long and time consuming given the desperate and/or urgent nature of ASM. Shortening these procedures could facilitate ASM operators to comply by licensing their activities. Also the condition of providing geographical coordinates is very unlikely to be undertaken by ASM operators. Having coordinates for thousands of the ASM operators' in one area is almost impossible. Block coordinates could be a more appropriate innovation for the ASM operators to comply.

The difficult conditions of acquiring licenses by ASM operators partly explain why only 10% of ASM respondents had licences for their activities while the remaining 90% did not (Table 2). The reasons for not having licences were many, including the long of travelled in order to get licences (66.4%), overly bureaucratic procedures (63%), not knowing where to get them (28.4%) and high cost (18.5%).

Regarding land ownership, 60% of small scale miners had customary ownership compared to only 2% of the artisan miners.

TABLE II ASM WITH MINING LICENCES AND REASONS FOR NOT HAVING LICENCES (%)

	Artisan	**Small Scale**	**Total**
ASM with licences	0	20	10.0
ASM with licences, title deeds or customarily recognition	2	60	31.0
Reasons for not having licences, title deeds	%		
Very far where the licences are issues	56	76.7	66.4
Too bureaucratic procedures to get it	56	70.0	63.0
I do not know where to get	40	16.7	28.4
Too costly	24	13.0	18.5
No response	1	0	0.6

3) Regulations for Environmental Management and Protection under ASM:

The legal requirement for environmental management under ASM (Mining Regulations 1999) is comprehensive. However, very little (if any) of these legal requirement has been implemented by ASM operators and the enforcement by the regulators has failed to a large extent (Table 3A and Table 3B). Also the regulations are mainly for those with PML. Unfortunately, most of the ASM operators do not have PML. The environment situation under ASM is appalling and requires urgent action. Also there is no environmental impact assessment (EIA) undertaken by ASM operators, a situation that worsen the environmental performance of the sector.

TABLE III-A MINING REGULATIONS OF 1999 FOR ENVIRONMENTAL MANAGEMENT FOR PML HOLDERS

Activity	**Legal Requirement**	**Compliance Rate**
Settling ponds	Ensure washing or settling ponds are constructed, provide washing and sluicing and no such washing and sluicing shall be done along or close to any water bodies.	Very little
	Where a settling pond is used as part of the mine drainage system, all channels discharging into the river system must be cultivated and slopes protected from erosion.	Very little
Vegetation clearance	No vegetation clearing within 20m from any stream or river bank.	Moderate
Use of retort	No heat mercury amalgam or recover the gold without using a retort.	Very few
No cyanide leaching	No use leaching without the written approval of the chief inspector.	Very few
Abandoned workings to be backfilled or fenced	No commence development of new workings in his/her PML area without backfilling or fencing the abandoned previous workings developed himself or his agent.	Few for small scale comply but almost none for artisan

Damaged area to be inspected	Prior to the commencement of mining in any area that may have been previously environmentally damaged the PML holder shall request an inspection of the same area by an inspector to confirm environmental disturbance.	Very few

TABLE III-B MINING REGULATIONS 1999 FOR ENVIRONMENTAL MANAGEMENT FOR PML HOLDERS

Activity	Legal Requirement	Compliance Rate
Tailing disposal	The holder of a PML shall ensure that tailings are disposed of a proper place in a manner approved by the inspector.	Very few
Children not to be employed	No children below the age of 16 to be employed or be engaged in any mining or processing operations in his PML are.	Moderate
Pit Latrine to be constructed	Ensure that pit latrines are constructed and maintained at a distance of not less than 100m inland from any water source other than washing or settling ponds.	Very few
Use of Protection Gear	Ensure that each employee is provided with protected gears and no person shall handle any toxic substance without using appropriate protective gears.	Very few
Offences	Any person who contravenes any provision under this part shall guilty of an offence and shall be liable on conviction to a fine not exceeding T.sh 50,000 or imprisonment not exceeding three months or both.	Very few charges. In this study non were ever charged

In this study respondents were asked about environmental management compliance. Only 10% said they do comply, 27% said they occasionally comply, and 63% said they do not comply at all. Those who did not comply had several reasons, including lack of understanding about the regulations (14.5%), inadequate time to undertake proper environmental management (22.1%) and lack of capital to comply with the regulations (62.5%). These findings are consistent with those of [2] who reported that the regularisation of informal mining activities has been an exceedingly bureaucratic procedure in Africa, providing individuals with little incentive to operate within the legal domain.

Also findings from this study reveal that many operators under ASM are not conversant with the policies, laws and institutions governing the mining sector. Results indicate that less than 2% and 16% of artisan and small scale miners, respectively, are aware of these institutions. The exception was on by-laws in which the operators themselves had participated in formulating. Awareness of such by-laws was 30% and 84%, for artisan and small scale miners, respectively. With such lack of understanding of the institutional framework, the sustainable environmental management under ASM is almost impossible.

4) The New Mining Bill 2010:

The New Mining Bill was passed on 23rd April 2010 by Parliament. The Bill addresses most of the economic issues which have disappointed Tanzanians for so many years, namely that while the sector was booming it provided an insignificant contribution to the economy. The revised Mining Act 2010 also bans the issuing of any new gemstone mining licenses to foreign companies and calls for the government to set aside specific areas for artisanal miners to operate in.

However, the Bill still does not explain explicitly how it is going to address the weaknesses of the current institutional framework. Issues of licensing and enforcement have remained centralized making one doubt whether it is going to address the weaknesses existing under ASM.

5) The Land and Village Land Acts, 1999:

The Land Act of 1999 is the basic law in relation to land other than the village land, the management of such land, settlement of disputes and related matters. The Land Act was passed in 1999 and it has been effective from 2001 [32]. The Act made it clear that there would be no land reform in Tanzania. All land would remain public land, vested in the President. The land is administered by the Commissioner for Lands on behalf of the President. The Land Act confirms tenures that were introduced under colonialism: granted right of occupancy, customary tenure, and leasehold estates. Customary tenure applies to village land, general land, reserved land as well as urban and peri-urban land.

In common with the Land Act, the Village Land Act No. 5 was also passed in 1999. The particular objective of the law was to enforce Section 4.2.2 (iii) which stipulates that village councils shall administer village land. Section 5.2.1 of the Act provides for demarcation of village boundaries and resolution of village boundary disputes, while Section 4.2.2 provides guidelines for titling of individual parcels of land in village land.

The Ministry of Land, Housing and Human Settlements Development is in-charge of administering the implementation of the National Land Policy (1995) and the Land Act, while the Local Government will be the implementors of the Village Land Act. The titling of individual parcels in village land is meant to increase people's economic empowerment [19].

The strength of the National Land Policy (1995) is that it intends to ensure that the existing customary land rights are legally secured. It also provides an opportunity for villagers to participate in land administration and puts a provision for gender balance in land administration [31].

The weaknesses of the National Land Laws are that up to now, there has been slow progress in the implementation of the laws [1]. The Village Land Act, in particular, has simply not been implemented, and the Acts have not changed the way that land is administered at the local level [26]. Part of the problem is that the land sector is not a priority in most District Councils, and there is, therefore, an acute lack of budgets for different land activities. Policy implementers at the local level have not yet received training in the new procedures for administration and titling that the Village Land Act provides for [31]. Consequently, land encroachment for mining activities by ASM has remained a chronic problem. Quite often encroachment is done in ecologically sensitive areas such as forests, water bodies and wetlands.

6) Tanzania Investment Act (1997):

Land bank is managed by Tanzania Investment Centre (TIC). TIC is a government agent that was established to coordinate, encourage, promote and facilitate investment in Tanzania and to advise the Government on investment related matters. While TIC seems to be attractive to investors, the Tanzania Investment Act, 1997, is seen detrimental to the local people, including the pastoralists [28] and ASM operators.

The government allocates land to investors through the Land Bank. Land that lies under villages is assigned to the Land Bank, and there is general fear that the compensation offered is inadequate. The major concern is the fact that the court system is inaccessible to ordinary people like those from ASM, since it is so expensive (Clark *et al*., 2007) [16]. We have witnessed ASM operators being evicted from areas they have discovered mineral deposits to pave way for large scale mining investors without adequate compensation. This has created endless conflicts in areas such as Mererani in northern Tanzania.

7) Forest Policy (1998):

The overall goal of the Forest Policy of 1998 is to enhance the contribution of the forest sector to sustainable development of Tanzania and conservation and management of her natural resources for the benefit of present and future generations. In practice this means that forests have to be managed in terms of socio-economic, ecological and cultural sustainability. Statement 5 of the Policy stipulates the need for sustainable management of forests on public lands. The Policy also promotes allocation of forests and their management responsibility to villages, private individuals or to the government. Statement 39 of the Policy emphasizes local communities to participate in forestry activities. However, experience shows that most of the forests under village or open access are degraded by ASM [10]. The reasons are that such forests are on communal land and therefore open to use by anybody. But also ASM sometimes overpowers regulators because the operators come in large numbers working day and night.

8) The Environmental Management Act 2004:

Section 81 of the Environmental Management Act (EMA, 2004) compels developers to undertake EIA prior to development activities if these activities are taking place in classified areas that require EIA. Item 1 of the First Schedule in the EIA Regulations (2005) provides further information that any mining project EIA is mandatory. Conducting EIA has become part of the project approval process for development projects in the country.

Government has remained active in enforcing EIA and a corresponding Environment Management Plan for large-scale enterprises. However, no EIA is undertaken for ASM activities. Conducting individually/plot based EIA is expensive and far beyond the reach of most ASM operators. All the same, it is almost impossible to regulate thousands of ASM operators to undertake EIA for their activities. Decentralising EIA regulations to the district level and moving from individual EIAs to block EIA could solve some of these challenges.

Although the institutional framework for EIA management is in place and covers all levels nation-wide (i.e village to national level), there is no capacity to enforce it. Also an attempt to improve environmental management under ASM through economic incentives under the so called "Presidential Award for Environment Management Excellence" has had no success. A high proportion of the ASM operators are not aware of the initiative and quite often they are told to participate at short notice. But also the cost of improving environmental management by ASM operators is quite high deterring many from participating in the competition. Another limitation is the award itself. Only one person out of many competing will win and be awarded USD 2000. Unless, the award for winners is equal or greater than the environmental management cost, many ASM operators will continue to shy away from participating in these competitions. The number of winners also needs to be increased. One approach could be to develop different award categories for a considerable number of ASM operators. For example, the winning categories could include: the overall winner, the 2-5 rank winners, the 6-20 rank winners and the 21-50 rank winners. Source of funds for these awards should come from different stakeholders, including large scale mining companies, government and the international community.

9) The Water Policy (2000):

The Policy objective is to develop a framework for beneficiary participation in planning, construction, operation, maintenance and management. Also, a framework for sustainable development and management of water resources has been integrated into the Policy. The Policy acknowledges that water is one of the most important resources underpinning the achievement of sustainable development. One of the Policy statements is that water is required for all humans to maintain human health, and to restore and maintain ecosystems functionality. However,

ASM operators have been blamed for polluting water sources in Tanzania [27], [14], [13], [11]. This confirms the earlier observation that enforcing laws under ASM is difficult.

Inappropriate institutional framework for ASM is the major cause of environmental degradation. ASM operators are interested in benefits while environmental cost is not of immediate concern it is an externality to them. The government has been unable to carry through its own policies, and there is too much ambiguity in the laws. It is also worrying that so much power is vested in the Commissioners of Mining and Lands whose interaction with ASM operators has proved to be difficult. Unless institutional framework is changed, environmental degradation under ASM will continue to be a challenge.

IV. CONCLUSION AND RECOMMENDATIONS

The ASM is a significant sector for people's livelihoods and the national economy. Yet the impact on the environment and human health is a big concern. The technology used in extracting gold through the use of mercury is creating a lot of pollution to the environment which affects water bodies and biodiversity. ASM also poses a great health risk to the people in the sector as well as those in surrounding areas. The poor performance of ASM is caused by many factors, including inappropriate institutional framework, inadequate resources to establish good practices and poor understanding of mining malpractices and environment degradation.

First, formalisation of ASM activities is necessary and this should be done through providing user friendly regulations and procedures. There should be a decentralization of ASM regulations to villages and districts and capacity building at these two levels is imperative.

Second, access to credit by ASM operators should be facilitated through promotion of SACCOS and linking them to commercial banks. In the long run ASM should also have their own bank funded by different stakeholders, including the operators themselves, large scale mining companies, government, the international community and NGOs.

Third, introducing of block EIA and environmental management plans for ASM activities and strengthening of by-law formulation and enforcement will save costs and create a collective responsibility for environmental management.

Lastly, ASM groups should be encouraged to form cooperatives and national ASM associations for information sharing, access to credit, training and lobbying for the sector.

ACKNOWLEDGEMENT

The author would like to thank all those who have contributed both directly and indirectly to the publication of this paper. Special thanks go to the Gender Centre of the University of Dar es Salaam for financial support to undertake this study. The author is particularly grateful to the Institute of Resource Assessment of the University of Dar es Salaam for granting permission to undertake this study.

REFERENCES

[1] Adams, M, and. Palmer, R. (2007). Independent review of land issues, Volume III. Eastern and Southern Africa. http://www.oxfam.org.uk/what_we_do/issues/livelihoods/landrights/.Accessed on 20-03-2012.

[2] Banchirigah, S.M. (2006). How have reforms fuelled the expansion of artisanal mining? Evidence from sub-Saharan Africa. *Resources policy.* 31 (3), 65-171.

[3] Bitala, M.F. (2008). Evaluation of Heavy Metals Pollution in Soil And Plants Accrued From Gold Mining Activities in Geita, Tanzania. *A Dissertation Submitted for the Degree of Master of Integrated Environmental Management of the University of Dar es Salaam.*

[4] Bratveit, M. 1., Moen, B. E. Mashalla, Y. J. S. and Maalim, H. (2003). Dust Exposure during Small-scale Mining in Tanzania: A Pilot Study. *Annals of Occupational Hygiene.* 47(3), 235-240.

[5] Bridge, G. (2004). Contested Terrain: Mining and the Environment: *Annual Review of Environment and Resources,* 29, 205-259.

[6] Buxton A (2011): Fair-trade and formalisation for small-scale miners. IIED http://www.iied.org/blogs/fairtrade-and-formalisation-for-small-scale-miners. Accessed on 6th March 2012.

[7] Crawford, S and Ostrom, E. (1995). A Grammar of Institutions. *American Political Science Review.* 89(3), 582-600.

[8] GMP. (2007). Final Country Report for Tanzania*: Project EG/GLO/01/G34 Removal of Barriers to Introduction of Cleaner Artisanal Gold Mining and Extraction Technologies Global Mercury Project.*

[9] Goergen, A. A. Mohamed, E., Mhando C. H. & Mlay A. (2001). Artisanal and small-scale mines: ticking bombs in need of workplace HIV/STI interventions: *Sexual Health Exchange 2001.*

[10] Hamza K. F. S and. Kimwer, E. O (2007): Tanzania's Forest Policy and Its Practical Achievements with Respect to Community Based Forest Management in MITMIOMBO. Working Papers of the Finnish Forest Research Institute 50. References and further reading may be available for this article. To view references and further reading you must purchase this article.

[11] Hilson G. Hilson CJ and Pardie S (2007): Improving awareness of mercury pollution in small-scale gold mining communities: Challenges and ways forward in rural Ghana. Environmental Research, 103 (2), 275-287.

[12] Hurwicz, L. (1994). Economic Design, Adjustment Processes, Mechanisms, and Institutions. *Economic Design,* 1(1), 1-14.

[13] Ikingura J. R. and Akagi H. (1996). Monitoring of fish and human exposure to mercury due to gold mining in the Lake Victoria goldfields, Tanzania: *The Science of Total Environment.* 191 (1-2), 59-68.

[14] Ikingura J. R. Mutakyahwa M. K. D and. Kahatano J. M. J. (1997). Mercury and mining in Africa with special reference to Tanzania. *Water, Air and Soil Pollution,* 97 (3-4), 223-232.

[15] Kambani S.M (2003): Small-scale mining and cleaner production issues in Zambia.Journal of Cleaner Production 11 (2003), 141–146.

[16] Kelsall, T., S. Lange, S. Mesaki, and M. Mmuya. 2005. Understanding patterns of accountability in Tanzania. Component 2: The bottom-up perspective.

[17] Kishe M. A. and Machiwa J. F. (2003). Distribution of heavy metals in sediments of Mwanza Gulf of Lake Victoria, Tanzania: *Environmental International*, 28 (7), 619-625.

[18] Lange S (2008): Land Tenure and Mining in Tanzania. CMI Report. CMI. CHR Mechelsen Institute.

[19] Mbendi. (2007).*Tanzania Gold Mining Overview*. http://www.mbendi.co.za/org. (accessed 10 March, 2010).

[20] MEM. (2006).Mineral Sector overview. The United Republic of Tanzania. Ministry of Energy and Minerals. http://www.mem.go.tz/minerals/index.php. (accessed 20 April 2010).

[21] URT. (1998). The Mining Act. United Republic of Tanzania, Dar es Salaam.

[22] MMSD. (2002). Chapter 13 Artisanal and Small-Scale Mining: Part III: Challenges: Draft Report for Comment: http://www.artisanalmining.org/UserFiles/file/AMS_finalreport_13.pdf (accessed 22 May 2010).

[23] North, D. (1990). Institutions, Institutional Change, and Economic Performance. Cambridge: *Cambridge University Press*.

[24] OECD. (2006). Institutional Framework.: http://stats.oecd.org/glossary/detail.asp?ID=6120 (accessed 2 May 2010).

[25] Poliski, M.M and Ostrom E. (1999). An Institutional Framework for Policy Analysis and Design. W98-27.

[26] Sundet G (2005): the 1999 land act and village land act: A technical analysis of the practical implications of the Acts. Working Draft. Unpublished.

[27] Taylor H., Appleton J.D., Lister R., Smith B., Chitamweba D., Mkumbo O., Machiwa J.F., Tesha A.L. and Beinhoff C. (2005) Environmental assessment of mercury contamination from the Rwamagasa artisanal gold mining centre, Geita District, Tanzania. *The Science of Total Environment*, 343 (1-3), 111-133.

[28] Tenga, R., ND. Legislating for pastoral land tenure in Tanzania: The Draft Land Bill (accessed 15.06.07), http://www.whoseland.com/paper8.html.

[29] Tesha, A., L. 2000. Cooperation between small-scale and large-scale mining. Paper presented at the 'Growth and diversification in mineral economies Regional Workshop for mineral economies in Africa', Cape Town, 7-9 November.

[30] UNIDO. (2001) Artisanal Gold Mining without Mercury Pollution: Vienna, Austria.

[31] URT. 2007. An overview of Village Land Act, no. 5 of 1999. Presented at a Workshop on Tanzania's Property and Business Formalisation Programme, Handeni, 15.05.07.

[32] Wily, L.A. (2003). Community-based land tenure management. Questions and answers about Tanzania's new Village Land Act, 1999. Issue paper No. 1.



Agnes Godfrey Mwakaje is an Associate Professor at the Institute of Resource Assessment University of Dar es Salaam, Tanzania. She got a BSc in Agriculture at the Sokoine University of Agriculture in Tanzania in 1991. She then pursued MSc and PhD in Agricultural Economics at the Universities of Reading and London, respectively between 1994 and1999. Agnes has also got a diploma in Environmental Management from the Gallillee College in Israel which she obtained in 2003. Professor Mwakaje has conducted wide range of research and consultancy in the areas of agriculture and environmental economics as well as natural resource and rural development. Over recently she has also been involved in climate change studies and consultancies. Professor Agnes Mwakaje has published widely in international peer reviewed journals and presented various papers in international conferences.