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Available Legal Regime and The Use of Mercury for Small-Scale Gold Mining in Ghana

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ABSTRACT

The aim of this study was to examine the effects of mercury (Hg) and available laws to regulate its use in the Artisanal and Small-Scale Gold Mining (ASGM) Community in Ghana. Research shows that the use of Hg in the ASGM causes damage to the cognitive and neurological function of the miners, as well as to the physical and mental disabilities to children in the ASGM communities. Furthermore, number of publications also shows that the use of Hg causes significant damage to water bodies and the environment in most mining communities. Additionally, in an attempt to protect the environment from these high levels of Hg in these mining sites and beyond, has led to some conflict and military intervention. Even though, Ghana has adequate laws to regulate Hg use by reducing and where feasible eliminate the use of Hg for small-scale mining. However, due to some legal limitations to the current situation there is the need to amend some of these laws to help address these challenges. In addition, certain policies, technological and educational initiatives taken to address the use of Hg in our environment, have proven largely ineffective. The results of this study shows that the implementation of mining regulation without careful analysis of mine community dynamics, the organization of activities, operators' needs and local geological conditions has resulted in some challenges. However, significant improvements can only be achieved in this area if the state and the organs of government tackle the illegal mining "galamsey" menace; introducing cost-effective techniques for the reduction of the use of Hg in mining; effective government sponsored participatory training exercises as mechanisms for communicating information about appropriate technologies and the environment; and strengthening compliance and enforcement of existing laws.

In conclusion there is the urgent need to properly regulate the use of Hg in mining communities in Ghana.

Keywords : Contamination, Galamsey, Mercury, Mental Disabilities, Neurological function, Environment.

I. INTRODUCTION

The Artisanal and Small-Scale Gold Mining (ASGM) sector is very important to the Ghanaian economy. A properly regulated ASGM sector provides employment, increase earnings of people in the local and surrounding communities, alleviates poverty, generates revenues for local Assemblies, and contributes towards community development through implementation of Corporate Social Responsibility (CSR), among other benefits.

In Ghana, elementary Hg is used in ASGM. Hg metal is used to extract gold from ore as a stable amalgam. The amalgam is then heated to evaporate the Hg and isolate the gold. Hg is abundant and inexpensive, and can be obtained from a variety of industrial supply chains or mined directly from cinnabar, making it a readily available tool for mining gold. Mine operators depend on Hg to amalgamate gold but generally discard it freely into the natural environment.

Mercury (Hg) use in ASGM has become a growing crisis in environmental and human well-being. Hg causes damage to human health and to the wider environment. The tailings in ASGM are also a major source of Hg pollution. After the amalgam is isolated from the trommel, the leftover crushed ore, water, and unrecovered Hg are either released directly into the environment or processed further in large tanks containing aqueous sodium cyanide. When cyanide leaching is used to process tailings, the final waste stream is typically dumped in rudimentary tailing ponds or released into waterways; often the same water sources used for irrigation, drinking and fishing. Because significant amounts of Hg are also made water soluble by complexing with cyanide, this practice results in substantial release of highly toxic and mobile Hg species into aquatic environments, which leads to Hg methylation by bacteria and bioaccumulation of methyl Hg.

In ASGM, the amalgamation process and gold recovery from the amalgam can result in substantial release of Hg into the environment. During the amalgamation process, substantial amounts of Hg can be lost in the tailings. In particular, milling ore and Hg in trommels can result in the formation of tiny Hg droplets that become finely dispersed in the tailings. This “Hg flour” is especially problematic because it can be easily washed away with water and transported far from the mining site. In cases in which the tailings are released directly into the environment, the Hg contaminates water and soil. The release of Hg from tailings into soil and water is a serious hazard to human health because it can compromise food safety and contaminate drinking

water. Hg contaminated water used for irrigation also leads to contaminated food crops, such as rice.

Heating mercury–gold amalgams to vaporize Hg is another major source of Hg emission in ASGM. Hg gas is harmful to the lungs, kidneys, liver and nervous system, so these emissions are especially dangerous.

In Ghana, emphasis has been placed on finding technical solutions to mining processing problems, with little attention being paid to the underlying economic, labour and social issues, an approach which has proved inappropriate environmentally. The government and donor agencies have repeatedly designed and implemented costly technologies and educational programmes that have yielded marginal improvements. In addition, there has been failure to analyse community dynamics and consider miners concerns in the decision-making processes has perpetuated the mercury pollution problem in Ghana's ASGM sector.

Officers at ILO have stressed the importance of implementing site-specific solutions to mining problems, namely, interventions which best reflect the culture and backgrounds of target populations. Few, including Ghana have embraced these ideas. Donor organizations and international experts continue to promote "effects-based" Hg contamination work that provides minimal added value. In addition, there has been a fixation on implementing generic technologies and support programs, as opposed to site-specific solutions that best reflect local conditions. The need to analyze local community dynamics before devising solutions to the Hg pollution problem has become increasingly evident: centralized processing facilities, effective solutions in countries with localized gold deposits, have proved unsustainable where activities are comparatively more chaotic and gold is widely dispersed; sophisticated training exercises, perhaps appropriate strategies for literate mining populations, are inappropriate in locations characterized by high levels of illiteracy; and mass implementation of mercury retorts is bound to be less successful over the short-term in countries with numerous widely dispersed marginal gold deposits, and therefore, scattered mining populations. The heterogeneity of small-scale gold mining in terms of the skills levels, literacy, operating conditions and geology makes the application of generic solutions inappropriate.

An analysis of the main prevailing laws on Hg show that Ghana has adequate legislation to regulate Hg, however, there is need to strengthen compliance and enforcement of existing laws. This paper discusses the effects of Hg pollution on the environment and the prevailing laws available to regulate Hg use in the ASGM sector of Ghana.

A. Objective

The main objective of this study is to determine the effect of mercury pollution on human health and the environment. In addition, to examine the available legal regime to regulate the use of mercury in the ASGM communities of Ghana, and the extent to which these laws are effectively enforced by the regulatory agencies.

II. METHODS

The research employed two comprehensive data collection methodologies and statistical analytical tools. The first source of data collection methodology was interviews, conducted with randomly selected participants at various mining communities in Ghana. Secondly, the paper also relied on qualitative research design by utilizing texts of existing primary and secondary sources of information on mining in Ghana. These included international treaties, conventions and protocols, the Constitution of Ghana, relevant domestic legislation and subsidiary legislation, and legislative instruments and case law. In addition to information from textbooks, professional journals and periodicals, research papers and conference materials, official government and policy papers, the internet and online library materials. All information and data were collated, coded, analyzed and interpreted to clarify issues, to answer the relevant questions and finally provide the basis for recommendations and the way forward.

III. Results and Discussion

A. Presentation of Results

A total number of 30 participants took part in the interview conducted with their educational background (**Table 1)** ranges from: First Degree, Master's Degree and PHD. Most of the people interviewed were first degree holders. Additionally, the interviewees professional qualification (**Table 2**) includes, Civil servants (Directors & Assistant Directors), academics, lawyers, lecturers, scientists and Environmental law experts and environmental activists. All the participants worked in their current position **in organizations** between 5 to 25 years.

Table 1: Educational background of participants

Educational background	Number of participants	Percentage Distribution
BSC/BA	3	10
MSC/MPHIL	9	30
PhD	9	30
Others	9	30
Total	30	100

Table 2: Professional Background of Participants

Profession Background	Number of participants	Percentage Distribution
Civil Servants	6	20
Academics	3	10
Lawyers	3	10
Scientists	6	20
Environmental law experts	9	30
Environmental Activist	3	10
Total	30	100

Table 3 represent the awareness and knowledge of participants regarding the available mercury laws in Ghana. Out of the total of 30 participants 25 people said yes, 3 said not too much or limited laws and 2 people said no.

Table 3: Knowledge of Mercury Laws

Mercury Laws	Yes	Not too much	No	Total
Knowledge of available Mercury laws	25	3	2	30
Percentage Distribution. %	83	10	7	100

Table 4 shows the adequacy of mercury laws in Ghana of which 27 people responded yes, 3 participants said not too adequate.

Table 4: Adequate Mercury Laws

Mercury Laws	Yes	Not adequate	No	Total
Are mercury laws adequate	27	3	0	30
Percentage Distribution. %	90	10	0	100

Table 5 represent the response to the question of effective implementation and enforcement of mercury laws by regulatory institutions in Ghana: 18 people said yes and 12 said not effectively implemented. The reasons of these include the fact that most small-scale miners are illegal miners and the lack of adequate human capacity by the regulatory institutions.

Table 5: Implementation and Enforcement of Mercury Laws

Mercury Laws	Yes	Not effectively	No	Total
Is there effective implementation and enforcement of mercury laws by regulatory institutions	18	12	0	30
Percentage Distribution. %	60	40	0	100

Table 7: **Adequate compliance of mercury laws**:

Mercury Laws	Yes	Not adequate compliance	No	Total
Is there adequate compliance of mercury laws	5	5	20	30
Percentage Distribution. %	16.7	16.7	66.7	100

Table 8 provided information on the available sanctions for no-compliance being enforced: 8 people said yes, 22 people say no. The reasons for these include the political will to prosecuted culprits in courts, some regulatory officials are complicit; regulatory institutions lack adequate human capacity to enforce mercury laws).

Table 8: **Available sanctions for no-compliance**

Mercury Laws	Yes	Sanctions not effectively enforced	No	Total
Are available sanctions for no-compliance being enforced	8	0	22	30
Percentage Distribution. %	27	0	73	100

B. Discussions

Mercury (Hg) poisoning is a tremendous burden to human health, especially in ASGM communities. Hg gas, such as that encountered in ASGM amalgam processing, is readily absorbed in the lungs and then further transported to other organs. Elemental Hg is able to cross membranes including the blood–brain barrier and the blood-placenta barrier, posing a threat to neurological function and fetal development, respectively. Acute Hg exposure can lead to tremors, memory loss, respiratory distress and even death. Chronic exposure to Hg gas may lead to renal failure, tremors, movement disorders, and various psychosis and memory impairment. Inorganic Hg, formed through oxidation of mercury metal lost during ASGM may contaminate water and also lead to kidney damage if consumed. Conversion of mercury pollution from ASGM into methyl Hg also poses a tremendous risk as this highly toxic form of Hg accumulates in food supplies, such as fish, crustaceans and mollusks. Consumption of methyl Hg is particularly harmful to

the central nervous system, causing nerve and brain damage. Kidneys are also affected and methyl Hg presents an extreme risk to fetal development.

Another troubling consequence of Hg pollution from ASGM is the effects on embryos, fetuses, and children. Hg levels in women of child-bearing age near ASGM activities are often high due to consumption of mercury-contaminated water, seafood or rice; direct handling of Hg in mining or other gold-related processing; or through exposure to Hg gas during amalgam processing. Because maternal transfer of Hg to the fetus is efficient for elemental and methyl mercury, it is perhaps not surprising that children in ASGM communities have high incidence of physical and mental disabilities.

While the human cost of Hg poisoning in ASGM is the most important and immediate concern, Hg pollution also damages the wider ecosystem; compromising food chains and biodiversity. Hg emissions can adversely affect algal growth; crustacean health; fish growth, brain function, and reproduction; and amphibian larval health and survival. It is also known that Hg bio-accumulates in fish, which then poses a threat to any bird or mammal that consumes it, including humans. It is also common for the people living near these ASGM areas to eat fish as a major source of dietary protein, which leads to high Hg levels even in non-miners. In this way, Hg pollution threatens food security.

Aquatic plants are bio accumulators of Hg and uptake of the heavy metal may, in some cases, compromise plant health. Inorganic Hg in water, for instance, can lead to decreased chlorophyll content and protease activity for floating water cabbage *Pistia stratiotes*. Likewise, the pond weed *Elodea densa* presented with abnormal mitotic activity upon exposure to methyl mercury.

Regarding crop contamination, mercury uptake in rice in ASGM communities has been documented. In these cases, rice paddies were irrigated with mercury contaminated water, resulting in mercury levels as high as 1.2 ppm in the edible grain - more than 10 times the limits recommended by the World Health Organization (WHO). While mercury uptake into crops is clearly undesirable, mercury uptake into non-edible plants may be a useful way to remediate mercury pollution in water and soil due to ASGM.

International Regulation of Mercury

As a response towards the effects of Hg to human health and the environment, the Minamata Convention was adopted in 2013. The objective of the convention is to protect human health and the environment from anthropogenic emissions and releases of Hg and Hg compounds. The Convention addresses Hg use in ASGM among other forms of Hg pollution. Ghana signed the Convention on 24th September 2014 and ratified it on 23rd March 2017.

The Convention does not require a ban of Hg use in ASGM; rather, Article 7 of the Convention requires signatories to take steps to reduce, and where feasible eliminate, the use of Hg and the emissions and releases to the environment of Hg from, mining and processing. Countries must also submit a National Action Plan that describes how they will achieve Hg reductions. There are also specific provisions for member nations to help educate miners and promote research into sustainable, Hg-free mining. Annex C of the Convention, requires that further actions are prescribed that include the elimination of four especially problematic activities: whole-ore amalgamation, open heating of amalgams, heating amalgams in residential areas, and the use of cyanide to extract gold from Hg-rich tailings.

ASGM is considered an “allowable use” under the Convention, which means that Hg can be imported and exported for use in this sector. However, there are restrictions on this trade. Exporting countries must

notify and receive consent from importing countries. The convention presents challenges, particularly for developing countries like Ghana. It is quite complex to implement and this will take time. There main challenges to implementation are: the large number sectors concerned, the many stakeholders involved and the high cost of replacing Hg.

Ghana and many other countries have not yet done their assessments or estimated the costs of replacing Hg. The Convention mentions financial support, technical assistance and technology transfer to countries with economies in transition and developing countries. Two international funds are earmarked for this purpose: Global Environmental Facility Trust Fund, set up in 1992, which is already supporting Hg projects in countries; and an international programme to be set up by the United Nations Environment.

Without vital international support, Ghana and many implementing countries in Africa and Asia could run into severe difficulties. The cost of phasing out the use of Hg could be a reason why some African countries are hesitating to join the Convention.

Ghanaian Regulation of Mercury

An analysis of the main prevailing laws in Ghana show that there is adequate legislation for the implementation of the Minamata Convention. The Mercury Law (PNDCL 217) requires that Small-Scale gold miners observe good mining practices in the use of Hg. Small-scale gold miners can buy from licensed Hg dealers a reasonable quantity of Hg that can be shown to be necessary for their operations. Any small-scale miner who does not observe good mining practices in the use of Hg for his mining operations, sells or deals in Hg, possesses excess Hg, commits an offence and shall on conviction be liable to a fine or to imprisonment or to both. Any person who imports Hg into Ghana; possesses or buys, sells or transfers Hg without a license to another person, commits an offence and is liable to a fine or term of imprisonment or to both. The Minister for Trade may issue a licence to a person to import, possess, buy, sell or deal in Hg. However, the Minister may cancel a license if the licensee breaches any term of the license, the Hg Act or if it is not in the national interest a court may order the cancellation and forfeiture of a licence if a licensee is convicted under the Hg Act.

The Minerals and Mining Act, 2006 (Act 703), requires small-scale miners to buy from an authorized Hg dealer quantities of Hg that may be reasonably necessary for mining operations. The Minerals and Mining (Health, Safety and Technical Regulations) requires a person who wants to use Hg for small-scale mining to use a retort to apply for written permission of the Chief Inspector of mines. In addition, a holder of a small-scale mining license must ensure that the environment within the mine does not expose workers in the mine to environmental hazards.

The Environmental Protection Agency Act established the Environmental Protection Agency (EPA) as the leading body responsible for the protection and improvement of the environment in Ghana. The EPA is responsible for issuing environmental permits and pollution abatement notices for controlling wastes discharges, emissions, deposits or other source of pollutants and issuing directives, procedures or warnings for the purpose of controlling noise. The EPA has the authority to require an EIA, is responsible for ensuring compliance with EIA procedures and is the lead EIA decision-maker.

The Environmental Protection Agency Act, provides for the establishment of a multi-stakeholder Hazardous Chemicals Committee, comprising representatives from key government organizations with an interest in chemical management, to monitor and advice the EPA on the importation, manufacture, distribution, sale, use and disposal of hazardous chemicals; to advice the EPA on the regulation of hazardous chemicals, and; to

perform any other functions relating to chemicals that the EPA may direct.

To perform its duties under the Act, the EPA through its Chemicals Control and Management Centre (CCMC), collects information on all chemicals imported into Ghana. The CCMC's primary objective is to protect human health and the environment from possible effects of chemicals. The CCMC issues chemical clearance permits to importers of industrial chemicals like Hg. It is mandatory for applicants to submit an application form and copies of the Material Safety Data Sheets (MSDS), which provide technical information on the chemicals. The documents may also suggest disposal options of such chemicals as well as information about toxicity.

The EIA process is legislated through the Environmental Assessment Regulations, the principal enactment within the EPA Act. The EIA Regulations require that all activities likely to have an adverse effect on the environment or public health must be subject to environmental and issuance of a permit before commencement of the activity. Schedule 2 includes mining (both small-scale and large scale). The Regulations define what is to be addressed within the EIA, how the EIA process should involve the public and outlines the steps to be followed within the process.

The Standards Authority Act, provide facilitation for examination and testing of commodities and manner in which they may be manufactured, produced or processed; to assist industries in setting up and enforcing quality assurance and environmental management systems and procedures. The Act mandates the Ghana Standards Board to ensure the health, safety, environment and general welfare of the people of Ghana. The Act can be used to directly control Hg added products as provided for in Article four of the Minamata Convention.

The Food and Drugs Act 1992, (P.N.D.C.L. 305B) was enacted to control the manufacture, import, export, distribution, sale, use and advertisement of foods, drugs, cosmetics, household chemicals and medical devices. The Act provides for the efficient and comprehensive regulation and control of food, drugs, medical devices, cosmetics, herbal drugs and poison. The Act can be used to implement Article 4 of the Minamata Convention on Hg – added products and its subsequent Part I of Annex A, which calls for the phasing down of the use of cosmetics (with Hg content above 1ppm).

The objective of the Water Resources Commission Act is to ensure that Ghana's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account the prevailing principles. The Act prevents water pollution of water resources and calls for preventive measures to avoid any such pollution from occurring, continuing or recurring. The strict enforcement of this Act may help reduce activities around water bodies that cause pollution by use of Hg. Enforcement of this provision is provided for under the Minerals and Mining Act, which mandates all mineral right holders to apply for a licence from the Water Resources Commission before commencing mining activities.

IV. CONCLUSION

In conclusion, Mercury (Hg), although useful in many ways, its harmful effects to human life and existence, and the environment are far damaging than the benefits derived from its use. The use of Hg is considered to be an economic problem as it is easily accessible and cheap, therefore a political solution alone will not solve the problem as Hg functions as a financial 'tool' for impoverished miners in producing income from gold mining quickly and cheaply.

Although Ghana has enacted various laws to deal with the use and disposal of Hg waste. Whereas these laws show the political will of the governments to control the use of Hg there still remains a question of enforcement of these laws. Ghana must enforce its laws. The various institutions must engage those in small scale mining, educate these primary stakeholders; teaching and making available to them improved ways of mining.

Ghana has sufficient laws to regulate Hg by reducing and where feasible elimination the use of Hg. However, minor amendments are needed in some of the laws in place. There is also the need to raise more public awareness on the effects of Hg to ASGM; strengthen compliance and enforcement of existing laws; and ensure effective collaboration between EPA (the coordinating institution) and Key Ministries, Departments and Agencies (MDAs) that constitute the various committees aimed at sound management of chemicals, like Hg in the ASGM.

In addition, the international community can help to address the challenge of reducing, or where possible eliminating the use of Hg in ASGM through funding education programs, financial mechanisms for investment in better technologies, and support to government to create enabling policies to support the miner's participation in the formal sector.

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