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Research Article

Managing the impacts of mining on Ghana's water resources from a legal perspective

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Abstract
Recent floods in Ghana are largely blamed on mining activities. Not only are lives lost through these floods, farms and properties are destroyed as a result. Water resources are diverted, polluted and impounded upon by both large-scale miners and small-scale miners. Although these activities are largely blamed on behavioural attitudes that need to be changed, there are legal dimensions that should be addressed as well. Coincidentally, a great proportion of the water resources of Ghana are within these mining areas thus the continual pollution of these surface water sources is a serious threat to the environment and the development of the country as a whole. The environmental laws need to be oriented properly with adequate sanctions to tackle the impacts mining has on water resources. The Environmental Impact Assessment (EIA) procedure needs to be streamlined and undertaken by the Environmental Protection Agency (EPA) and not the company itself.

Keywords
Mining—Water resources—flooding environment—Ghana

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Contents

1. INTRODUCTION

Ghana is fairly endowed with rich mineral resources. It was formerly called Gold Coast because of the abundance of large quantities of Gold in most parts of the southern sector such as Obuasi, Tarkwa and Pristea. Although the name is now Ghana following the attainment of independence in 1957, the extraction of gold and other resources still continues and contributes enormously to the economic development of the country [1].

Mining accounts for about 9.1% of Ghana's GDP [2] and serves as a source of employment for about 260,662 [3] citizens formally. Despite this role played by the mining sector to the socio economic development of Ghana, the adverse impacts of mining activities are on the rise. These impacts are often viewed with different spectacles depending on the level of impact and the area of interest. With regards to the environment, water courses are usually turned into reservoirs for the disposal of dangerous chemicals such as cyanide and mercury.

Flooding is now a ritual in some mining communities during heavy rains resulting in the loss of property and lives. Recent floods caused by illegal mining activities in July, 2011, killed five (5) people, rendering over 10,000 others homeless and massive destruction of farms [4].

1.1 Ghana's Water Resources

The water resources of Ghana can basically be classified into surface and underground sources. The surface water sources include major river systems such as the Volta River with its tributaries (red, black and white) and river Oti [5]. Other rivers include the Bia, Tano, Ankobra, Pra, Todzie, Aka, Densu, Ayensu and Och-Nakwa all draining the southern sector of Ghana. The Volta River is shared by five other countries namely: Togo, Cote d'Ivoire, Burkina Faso, Benin and Mali. The Volta River, occupies nearly 70% of the country's catchment area and the largest single river that drains the northern and southern sectors [6]. The remaining rivers are all limited to draining the southern sector and drains about 30% of the country [6]. Three main geological formations exist in Ghana [6] with varying quantities of ground water. An average annual rainfall of 2000 mm/yr, 950 mm/yr and 800 mm/yr occurs in the South West, Northern and South Eastern parts respectively [5]. A combination of these makes Ghana fairly rich in terms

of water resources.

The surface water sources mainly find use in the areas of industry, domestic, transport services and tourist purposes while the groundwater sources are the main sources of rural water supply systems. Within the industry sector, mining is a major user of water and this is usually diverted from nearby rivers and streams for the purposes of mining operations. Emphasising on the quality of these water sources therefore becomes imperative for human survival and poverty alleviation.

This paper uses desktop studies and available literature and seeks to outline the negative impacts mining operations have on Ghana's surface water resources and how these can be effectively managed from a legal perspective. The various legislations governing the mining sector and the environment are considered based on their ability to dealing with these impacts.

2. WATER RESOURCES MANAGEMENT IN GHANA

2.1 Customary Water Resources Management

Before independence, traditional norms and customs served the basis for protection water resources from human intrusion and pollution. Water bodies were considered the preserve of gods and ancestral homes and thus were kept sacred. An interview conducted by Agyenim and Gupta [7] revealed that the following rules were among other practices used to protect water resources: prohibition (a) of people from farming close to river banks which were considered the abode of river gods; and

(b) of human activities in certain sacred forests and groves. [7]

These practices extended beyond the boundaries of protecting watercourses/bodies to the conservation of biodiversity and other species [8]. Fishing and hunting were done under controlled circumstances. Fishing was banned on certain days and seasons and hunters prohibited from hunting pregnant animals(See Table 1).

Shrines were usually sited near watercourses/bodies. This instilled in the local folks the spirit of alertness when farming, mining or undertaking any activity around these areas. The citizens feared they would displease the gods should they do anything that degrades the natural environment. These practices varied from one ethnic group to the other and were informed largely by the origin and social structure of ethnic groups [9]. They all however were hinged on the principle of protecting and sustaining the environment.

These laws were backed by sanctions and enforced by the priests in consultation with the gods and the ancestors themselves. Some of these sanctions included ostracism [10], labour work or even summoning individuals to answer queries before the elders. It is argued that these customary rules were usually unsustainable [11] as they lacked institutional arrangements as well as non-enforceability in legal terms. However, they formed the basis for community participation in water management and conservation issues. Modern trends and constitutional regimes however find this outmoded and thus the traditional setting for water conservation is now null and void.

2.2 Legal Aspects to Water Resources Management in Ghana

Colonial rule and the introduction of Christian beliefs into traditional settings rendered traditional practices and customs less potent but did not fade off completely [6, pp. 341]. Chiefs dominating influence on water and land management issues were overpowered by the Governors.

Legal efforts to managing water resources actually started in 1903 following the enactment of the Rivers Ordinance (CAP 226) to regulate the use of certain rivers regarding dredging and diversion of water for various uses [12]. Under this enactment, it is stipulated that, diversion, pumping or any act that causes water to flow out of the natural course of a river for the purposes of farming and industrial uses without a licence from the minister is illegal [12, Sec 10]. There was however no regulations to back this enactment and thus it was overtaken by time following which other legislations were made [13]. These follow-up enactments were targeted at mandating agencies and departments to perform some distinct functions.

Following independence in 1957, water resources management was given considerable focus and attention considering the paucity of enactments relating to water resources that were enacted. Some of these enactments and their specific functions are shown in Table 2. While some had some customary norms informing their enforcement and implementation mechanisms, others frown at the existing traditional practices that managed the respective water sectors [5, pp. 341].

Until in 1996, when legislatures perhaps taking inspiration from the fact that the 1992 constitution of Ghana made provisions for the establishment of commissions to oversee, regulate and co-ordinate policies relating to the utilisation and management of some natural resources such as minerals commission and the fisheries commission [14, Sec 269(1)] established the Water Resources Commission (WRC), water resources were fragmentally managed.

The WRC since its establishment is tasked to perform the following functions:

- Regulation and management of the utilisation of water resources as well as co-ordination of policies relating to them.
- Propose measures for the improvement of water resources.
- Issuance of water rights.
- Water resources' data and information dissemination.
- Monitoring and evaluation of programs for the maintenance of water resources.

- Advising pollution control agencies on the matters concerning the management and prevention of water resources pollution. [15, Sec 2(1&2)]

Currently, the WRC is the commission that oversee water resources utilisation in Ghana and coordinates the activities of other agencies and departments within it ambits.

3. MINING IN GHANA

3.1 Historical Perspectives

Alluvial gold extraction and winning activities actually started in Ghana as far back as the 7th and 8th centuries AD, which attracted Arab traders into certain areas of the country [16]. These activities were strategically located along rivers such that sediments believed to contain deposits of gold were washed repeatedly to separate the gold particles [17]. This was the source of wealth of these communities and the individuals engaged in it. As time went on, it was discovered that deposits of iron, limestone, kaolinite and other clay minerals do exist in various quantities [18].Gold however was and is the dominant mineral extracted and contributes to more than 90% of the minerals extracted [18, pp 24] and thus Ghana was tagged the 'Gold Coast'.

Although Ghana's economy was predominantly agricultural base, many individuals (small-scale miners also referred to as 'Galamsey' operators) flourished and depended on the mining and smuggling of these minerals for sale outside the country for their livelihood [19]. The activities of these individuals were mainly done to accomplish their own economic gains without considering any adverse social, political and environmental impacts of their actions.

Currently, Ghana is second to South Africa in Africa in terms of gold exploration, third largest manganese and aluminium and a major producer of bauxite and diamonds [20]. Despite the long years of extraction of gold and related mineral resources, there are still large prospective areas in Ghana that these ores can still be found (see Figure 2).

As clearly shown in Figure 2, most of the coastal rivers are networked within these prospective mining areas and thus considering the fact that the operations of mining companies and 'galamsey' operators rely on these rivers as will be discussed later, there are increasing threats on the status of these rivers.

3.2 Types of Mining

The differences in modes of extraction, legality of operations, quantities extracted as well as the extractive capacities, splits the mining sector of Ghana into two major methods: large-scale mining (Legal) and small-scale mining (galamsey).

3.2.1 Small-Scale Mining

As stated earlier, mining was taken up initially by local indigenes that traded it for their livelihood. This was done at individual level and mostly by the poor with very little technical know-how and machinery. It is estimated that over 10 million people are directly engaged in small-scale mining activities, with another 80 to 100 million people directly or indirectly dependent on the production from these activities for their own survival [21]. Most of these people are not miners by choice but out of necessity.

Small-scale mining is viewed with different spectacles by different groups of people and countries. The International Labour Organisation (ILO) considers small-scale mining as one that is less intense and with basic or low level machinery used in operations [22]. Responses to questions as to what small-scale mining is varied along the lines of the level of employment, level of production, capital investment, size of the company, mechanisation and the extent of regulation [22].

In Ghana, small-scale mining means 'the mining of gold by a method not involving substantial expenditure by an individual or group of persons not exceeding nine in number or by a co-operative society made up of ten or more persons.' [23, Sec 21] While this definition did not link small-scale mining to the machinery used in operations, most small scale miners use very little machinery. Most of them rely on basic tools powered by their labour force.

The mining process itself takes the form of amalgamation in which mercury is added to the deposits suspected to contain minerals and mixed to form an amalgam. This mixture is then washed continuously with water to separate the precious minerals from the rocky debris. This process of extraction largely informs the choice of site for small scale mining operations: the nearness of the site to a source of water.

Although a few small-scale miners acquire permits for their operations which makes their activities legal, majority of the small scale miners operate illegally and haphazardly thus small scale mining in Ghana is commonly referred to as illegal or 'galamsey' mining.

3.2.2 Large-Scale Mining

Large-scale mining also known as legal mining generates more than 95 percent of the world's total mineral production and employs approximately 2.5 million people across the world [24]. In Ghana, there are about 19 large mining companies operating about 16 gold mines, one bauxite mine and a manganese mine [18, pp. 23]. These companies are largely owned by private companies with a 10 percent free share and an optional 20 percent share for the government [18, pp. 25].

The government of Ghana is focused on promoting the interest of large-scale mining companies as their operations are considered to be legal [25]. However, some of the operational standards and behavioural conducts have negative impacts on the environment and the rivers surrounding such mines. These companies take advantage of their legal status to the detriment of the environment.

The operations of these companies take three stages: mining, processing and mineral conveyance and so is the water use in this sector classified too [26, pp. 51]. Large-scale mining involves the complex use of machinery and water is used for cooling the cutting edges and also inhibiting friction-induced-ignition [26, pp. 52]. The water is often transported from nearby watercourses to serve these purposes. Surplus

mine water could either be treated for reuse or discharged back into source [26, pp. 50]. However, due to the high cost of treatment, most of these companies resort to discharging the already chemicals infiltrated water back into rivers.

3.3 Impacts of Mining on Ghana's Water Resources

Regulatory frameworks for the mining sector do not properly address the impacts of mining activities on the environment and water resources. This situation is exacerbated by the weak capacity of the agencies and departments responsible for the enforcement and problems arising from asymmetric information [27]. Even the regulatory sanctions are not strong enough to deter mining companies as well as 'galamsey' operators from negatively impacting on rivers and water bodies. Some of these impacts are discussed below:

3.3.1 Water Pollution

A study conducted by the Commission of Human Rights and Administrative Justice (CHRAJ[1]) in 2007 revealed that 'many rivers and streams which hitherto, provided water for the [mining] communities have been destroyed, polluted or either dried up.'[28]. Illegal small-scale mining has been identified as a major factor militating against sound environmental practices in the mining industry through the discharge of mercury and other suspensions into streams and rivers [19, pp. 137]. However, the 'reckless spillage of cyanide' [27, pp. 26] by large mining companies contributes enormously to the pollution of rivers and streams within these areas thus posing threats to human existence and aquatic life.

3.3.2 Destruction of Banks of Water Courses

Landscape restoration once mining is over causes problems to streams and rivers [21, pp. 4]. Small-scale miners usually operate along the banks of rivers thus destroying the river banks (see Figure 2) and making them prone to overflows after heavy rains.

This situation has been the source of recent flooding in the mining communities (see quote in [44]). The flow of water becomes unguarded and thus flows into neighbouring homes and vicinities, destroying property and human life.

> Illegal mining should be blamed for recent floodings that killed five people in the country's Eastern Province, a senior Ghanaian official said Monday. Speaking to local press during an inspection tour to the flooded areas, Regional Minister Kwesi Appea-Kubi said illegal mining, known as "galamsey" locally, had caused the Birim River to overflow its banks. Eight communities in the Eastern Province, 85 km northwest of the capital, were flooded following four days of torrential rainfall last week. The minister, who accompanied President John Evans Atta Mills to visit the disaster zones, pledged to take measures to clamp down on illegal mining in the region to save lives and property in future. The worst hit areas include the Atiwa, Kade and the Fanteakwa districts, with a number of victims there forced to climb up coconut and other tall trees and onto roof tops while waiting for evacuation. At least five people have been confirmed dead by the police and 5,000 displaced. "As a people, and as a government, we need to ensure that this illegal mining business that is going on is stopped. Don't let us combine it with politics," the minister said. Appea-Kubi lamented the destruction of vegetation by miners, lumbermen and wood-cutters looking for fuel, and the blocking of river paths as a result. "If you go to the Akyem Abuakwa area that has been extensively mined, the rain just hits the soil, it removes the soil, and where does it go? Together with the rain water, it goes straight into the nearest stream," the minister said.
>
> **Source**: [44]

3.3.3 Stream Diversions

The natural courses of most rivers and streams are diverted and in some situations blocked to give way for successful mining operations. While stream diversions in the formal large scale mining sector takes into account environmental considerations, the extent of these considerations is questionable. Admittedly, some stream diversions are necessary for development but factors such as the maximum probable flood event, diversion channel dimensions and the flow considerations should be accounted for [29]. These are not strict requirements by the regulations as will be seen later. Diversions by small scale miners are altogether ad-hoc and haphazard.

3.3.4 Disruption of Ecosystem Processes

Ecological integrity is protected when the compositional and structural diversity and natural functioning of affected ecosystems is maintained[30]. Aquatic organisms like humans like to dwell in their natural environments undisturbed. Mining activities disrupts the chemical, physical and biological make up of rivers that serve as habitats for organisms such as fish and other aquatic organisms. Due to diversions made on streams and rivers, sediments are eroded into these waters by rain thus disrupting the reproductive life cycles of some aquatic organisms. This endangers the survival of these animals and their reproductive cycles thus creating a deficit of human needs and services derived from such organisms. Consequently, some species are lost as a result and many more relocate to newer habitats that are less susceptible.

Individuals who earn their livelihood through fishing are rendered jobless thus further increasing the number of illegal miners as they still must live. The relocation of other species

[1] The Commission on Human Rights and Administrative Justice (the Commission) is Ghana's National Human Rights Institution, established in October, 1993 following the return to civilian rule to support the new democratic process and foster a culture of respect for fundamental human rights and freedoms in Ghana.

also reduces the tourist attraction to these areas. Many other economic activities are thus halted.

4. REGULATION OF THE MINING SECTOR

Large mining companies operate through various forms of agreements entered into between them and the government of Ghana. For example, AngloGold Ashanti operates under an investment agreement called 'stability agreement'[2]. This agreement also serves as the legal instrument for the operations, development and production. Newmont Ghana Gold Limited (NGGL) also entered into a similar agreement which requires it to follow generally accepted standards and procedures of mining. Despite the fact that portions of such agreements makes provisions for environmental sustainability, they are still demanded to comply with existing environmental laws of the country [31], perhaps owing to the insufficiency of such agreements to effectively addressing environmental impacts.

This chapter seeks to identify some of the legislations that govern the operations of mining, and since this paper is about the impacts of mining on water resources, the focus will be on the environmental related legislations and how they effectively address the negative impacts mining operations impose on water resources. These are considered with regards to the impacts as follows:

The Minerals Commission (MC) is a government department established to serve as the regulatory body for the mining sector [32]. It is responsible for 'policy formulation for the exploitation of minerals in the interest of the national economy and monitoring of implementation of Governments policies within this sector' [33, Sec 2(2)(a&b)]. It is also mandated to ensure compliance of mining companies with the mining and environmental laws. Although the Environmental Protection Agency (EPA) is the lead regulator of the environment, non-adherence to prudent environmental practices by mining companies can be held against the commission. This is established in the Centre for Public Interest Law Vs. Bonte Gold Mines[3]case. The plaintiff among other things demanded that the MC pay similar damages claimed against the EPA because of its statutory obligations [31, pp. 10]. The commission is thus the umbrella that houses all mining related issues. The minerals and mining Act 2006, is enacted to 'revise and consolidate' the law regarding minerals and mining and for the purposes of connectivity [34, preamble].

Prior to the take-off of any mining and mineral exploitation activity under a mineral right, the holder of such right is required to obtain approval from the Forestry Commission and the EPA. This is to ensure that other natural resources are protected, public health secured and the environment sustained [34, Sec 18(1)]. Further to this problem is the entitlement to divert, impound, convey and use any water resources that are within the land area to which the mineral right applies [34, Sec 17]. Under these provisions, the right to carry out mining activity is granted before the acquisition of the necessary permits for environmental issues, thus serving as enough grounds for the skipping of these permits. To further complicate matters, the only disqualification to the grant of a mineral right is non-incorporation of a person or body under the companies' code or the private partnerships code [34, Sec 10]. Thus acquiring a mineral right is not linked to willingness to comply with environmental standards. The application process itself only considers the financial and technical resources, the proposed mineral operations and the willingness to employ and train Ghanaians without environmental considerations [34, Sec 1(a-d)]. The draft National Mining Policy (NMP) addresses this lapse by stating that 'mineral activities can only commence after environmental and other permits have been obtained' [35, pp. 16].

EPA is mandated to issue environmental permits and serve notices relating pollution and discharge of wastes as well as hazardous chemicals into water resources [36, Sec 2(h)]. Attaining this is hinged on strict compliance with the Environmental Impact Assessment (EIA) reports produced by such companies prior to operations as required by law [36, Sec 12(1)]. However, the EIA reports are contested on various grounds.

The processes leading to the adoption of EIA reports makes them non-reflective of the realities and this is said to be initiated by [37]:

- The inability of local communities to understand and make their inputs on such statements during public hearings and
- The inability of the EPA to supervise and or monitor the public hearing processes leading to the adoption of the EIA report.

According to Akabzaa and Darimani [18], confidentiality clauses restricting public access to Environmental Audit Reports (EAR) and the fact that mining companies are not under any obligation to adhere to recommendations of EARs appears to narrow down the EIA reports to merely 'the submission of a report' [18, pp. 38].

The enforcement and control mechanisms of the EPA are tied and hinged to a more realistic and working EIA [36, Sec 12]. Thus these flaws in the EIA process provide a leeway for mining companies to pollute water resources and impact adversely on the environment.

Consequently, the Water Resources Commission Act prohibits the pollution of water resources and assigns sanctions to it. It however associates the level of pollution that is unacceptable to the EPA's prescribed standards [15, Sec 24]. But the EPA has no defined water pollution standards and its work is largely based on the EIA reports.

For small-scale miners (legal), the source of pollution of water resources is inherent in the use of mercury. However, they are at liberty to directly purchase this from authorised

[2] Stability agreement here means a longer term of engagement from March 5 1994 until March 4 2054

[3] A high court suit against the Bonte mines for noncompliance to environmentally related regulations.

dealers to carry out their operations [23, Sec 14]. It is unclear who an 'authorised dealer' of mercury is, as it is not defined in the small-scale gold mining Act. Notwithstanding, the act mandates the establishment of Small-Scale Mining Committees (SSMC) in every designated mining area to regulate the activities of small-scale miners [23, Sec 10]. These SSMCs could serve as the legitimate source of to the small-scale miners to prevent proliferation and abuse of use which not only pollutes water resources but also give entry points to illegality in this sector as there is easy access to mercury.

Interference with or altering of the flow of rivers and streams is prohibited under the WRC Act [15, Sec 24(a)]. The buffer zone policy seeks to ensure the establishment of stripes of vegetation along surface water resources to improve water quality and control the activities along the banks of these water resources [38]. Even though this policy is yet to be implemented, one of the greatest challenge it is bound to face is, striking a compromise between the right of mining companies to divert and impound any water resources within the area the minerals right applies and the overall objective of the policy.

On the conservation of ecosystems, the draft buffer zone policy has as an objective the target of protecting the ecological integrity, the geomorphologic and the ethical values of buffer zones [38, pp. 7]. For the realisation of this, the policy prohibits the clearing of vegetation along the buffer zones, disposal of wastes in such areas and the use of fertilizers, pesticides and other chemicals that have the tendency of seeping into nearby waters thus posing threats to aquatic life [38, pp. 8]. The Fisheries Commission in relation to the protection and conservation of fish life tries to correlate other water uses including mining with particular focus of non-interference with the food chain processes of rivers, lake and lagoons along the coast [39, Sec 2(2)(i)].

Although small-scale mining activities are well known to be more environmentally unfriendly, small-scale miners are exempted from the payment of income tax and royalties during the first three years of their operations [23, Sec 15]. This incentivises others to go into it and hence further deepening the stress on water resources and the environment as a whole.

While the impacts on water resources by legal mining operators can be traced to weak regulations or non-enforcement of policies, illegal mining is a long standing issue and its firm stance sterns from the historical perspectives of mining in the country. Factors often mentioned as the promoters of this activity include: unemployment in local communities and poverty. Others suggest the process of acquiring a licence is too expensive and involves a lot of bureaucratic procedures [40]. Justice Dotse (a Supreme Court Judge), addressing the opening session of a three-day workshop for judges to sensitise them on the negative impacts of illegal mining in Accra (Thursday June 23, 2011), associate the situation to the relaxed nature of sanctions issued by the courts. He called on other Judges to 'improve on court decisions to deter such illegal activities' [41].

Apart from the legal dimensions to this issue, education

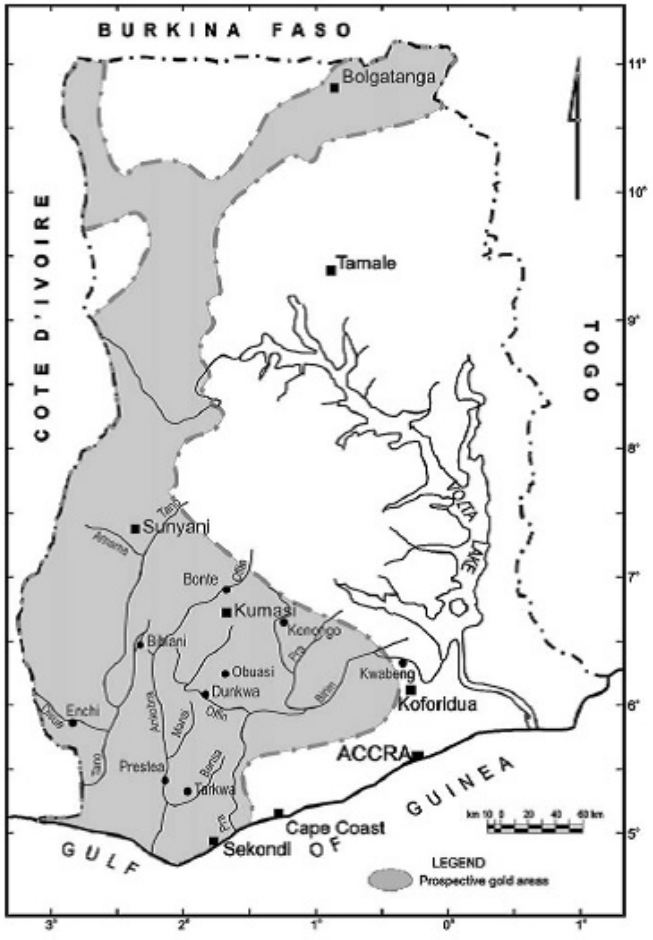

Figure 1. Prospective Gold Mining Areas in Ghana
Source: [17, pp. 14]

is an all important tool to rectifying this situation. It is unfortunate that most of the people who engage in these activities actually migrate from other communities to these mining areas to undertake such acts and are thus not directly affected by such impacts. However, communities must be educated and empowered on the impacts imposed on them and perhaps bonuses should be ascribed to persons who report such activities.

Table 1. Some Customary Practices For Biodiversity Conservation

Area of activities	Practices
Ecosystem preservation	Trees that are regarded for housing spirits: odum, African mahogany, tall palm trees, sacred animals: black and white colobus, mona monkey, totem animals and associated species
Water	Vegetation cannot be cleared along a strip of 30m at both banks of streams and rivers
Farming	Traditional, 10 year bush fallow period traditional crops as cocoa and vegetables
Fishing	Days and periods of banned fishing
Hunting	Periods of banned hunting Do not hunt pregnant females
Herbal medicines	Use of herbs to prevent and treat (common) diseases in humans, animals and plants

Source: [42, pp. 24]

Table 2. Enactment Laws and Departments

ERA	YEAR	DEPARTMENT ESTABLISHED OR LAW PASSED	RESPONSIBLE FOR
Colonial	1928	Public Works Department (PWD) (development began with a piped system in Cape Coast)	Urban and rural water supply
	1945	Department of Town and Country Planning	Designing plans and controlling settlements
	1948	Rural Water Development Department	Rural water supply
	1949	Forest Ordinance-Cap 157 of 1949	Conservation and management of forest areas
Post-Colonial	1957	Meteorological Services Department (MSD)	Atmospheric water resources assessment
	1958	Water Supply Division of Public Works Department	Drinking water supply - urban and rural
	1961	Volta River Authority, Act 46 of 1961	Electricity supply; industrial, commercial, domestic
	1965	Water Supply division under PWD transfed into Ghana Water and Sewage Corporaton, Act 310	Driking water supply and sewage management/services
	1969	Water Resources Research, NLCD 293 of 1969	Research in water resources
	1969	Institute of Aquatic Biology, NLCD 293 of 1969	Research in water resources
	1970	Volta Lake Transport Company; Registered under Company Code of 1970	Transportation on Volta Lake
	1974	Forestry Commission; NRCD 239 of 1974	Regulation of forest resources
	1977	Irrigation Development Authority Supreme Military Council Decree 85	Development and management of irrigated agriculture
	1986	Minerals and Mining Law, PNDC Law 153	Regulation of mineral prospecting and mining
	1987	Irrigation Development Authority Regulations; L. I. 1350	Regulation of irrigated agriculture projects
	1988	Local Government Law; PNDC Law 207	Decentralisation and governance of local resources
	1994	Environmental Protection Agency; Act 490	Regulation/enforcement of environmental implications of water treatment and usage
	1996	Water Resources Commission; Act 522 of 1996	Coordination of water resources management
	1997	Public Utilities Regulation Commission (PURC), Act 538	Regulation of standards of utility services, tariff setting by Ghana Water Company Limited
	1998	Community Water and Sanitation Agency; Act 564	Rural water delivery and management

Source: [7, pp. 342]

Figure 2. Mining Operations Along River Banks
Source: [43]

5. CONCLUSION

[hbt] Many mining states are sustained by the economic gains of mining activities and thus an indispensable promoter of economic and physical growth of such economies. Many agree that despite the economic benefits, it has adverse impacts on the economies as well. However, such impacts are often viewed with social spectacles. Others say indigenes are impoverished by mining as the sector overthrows all other sectors of growth in those areas [45, pp. 411], and yet some argue that multinational mining companies take undue advantage of the economic status of the citizens to over exploit them in terms of the labour output and what they get in return [46, pp. 26].

However, this paper considered the impacts of mining activities on water resources and how those impacts could be managed properly from a legal perspective. The fact that most of Ghana's surface water resources are coincidentally situated within the major mining areas is also established.

There are myriad of environmental impacts of mining especially on streams and rivers and these include: pollution, diversion of stream courses, destruction of river banks leading to flooding, and the disruption of ecosystem processes.

The challenges of legally managing these impacts range from insufficiency of environmental regulations, long standing historical practices, high unemployment rate, ill capacities of regulatory agencies to enforce strict environmental laws, complex and bureaucratic ways of acquiring licence by prospective small scale miners which informs the so much illegality in the small scale mining sector, unrealistic EIA reports and weak sanctions to deter people from encroaching and impounding water bodies.

Mining rights are granted to large scale miners before seeking environmental permits which often is an EIA report prepared by the mining companies and approved by the EPA. These reports often do not reflect the situation on the ground and do not usually reflect the views of local communities. These companies discharge large volumes of cyanide and other chemicals into water bodies thus posing danger to not only local dwellers but to aquatic organisms as well. In the interest of making the EIA process reflective of the real issues on the ground, it is appropriate for the public hearing processes to be supervised by the EPA with relevant operational guidelines outlined and a clear commitment on the part of the mining companies to adhere to them even before the mining right is granted.

Small-scale mining is the most environmentally unfriendly and results in flooding of local communities in most cases. However, it plays a major role in reducing the unemployment level of the country. Apart from the wealth it creates for people, it contributes at least 23 percent of the total gold production of Ghana [46, pp. 27]. Consequently, sub-marginal mineral resources normally abandoned by large-scale miners because of the advanced techniques used, are usually exploited by small-scale miners thus promoting the efficient and full recovery of these resources [47, pp. 431]. These significant roles played by small-scale miners make it very difficult for policy makers as well as politicians to adhere to strict enforcement of laws especially considering the fragility of political situations in developing countries.

Licencing procedures for small-scale miners needs to factor into it comprehensive environmental training to ensure environmental sustainability. The SSMCs created in mining communities should be strengthened in terms of human and technical resources so as to enhance their capacity of informing and guiding others on processes that inures to the benefit of the environment. The unregulated purchase of mercury by small-scale miners for their operations should be assigned to these committees so as to reduce the proliferated usage and curb the pollution of waters.

Conclusively, managing the impacts of mining on water resources needs to consider the strict enforcement of environmental legislations and streamlining of the EIA processes and tying it up to the licence and mineral right acquisition itself. Communities must be properly educated on the impacts illegal mining activities have on them and their future generations. EPA must be strengthened to routinely monitor mining sites and ensure compliance.

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