



## IMPACT OF ILLEGAL MINING ON WATER RESOURCES FOR DOMESTIC AND IRRIGATION PURPOSES

Amankwah Emmanuel

Department of Agricultural Engineering, Wa Polytechnic, UWR, Ghana

E-Mail: [amankwah60@gmail.com](mailto:amankwah60@gmail.com)

### ABSTRACT

This paper reviews the impact of illegal mining on water resources for irrigation and domestic application in Ghana. It was carried out by reviewing literature and media information as well as interviews and observation of small scale mining activities in mining communities especially illegal mining popularly called *galamsey* in Ghana. It was observed during the process that the mining activities are quite lucrative and offer jobs to many of the youth as well as women who sell at these mining communities across the country. The small scale mining also contributes significantly to GDP in Ghana. However, the activities of the small scale mining have affected several water bodies especially Pra, Ankobra and Birim Rivers as well as smaller rivers in the mining communities. Many of these water bodies have also been polluted to the extent that it is difficult for communities to rely on for domestic and irrigation purposes. Forest reserves, farms and agricultural lands have also been affected negatively. Many lives have also been lost over the years and continue to be lost through illegal mining. The research also outlined the challenges associated with illegal mining activities, potential impact on water resources and the environment, and suggested possible mitigation measures which if considered could help address the issue of illegal mining activities in the Ghana.

**Keywords:** illegal mining, water resources, pollution, irrigation, deforestation.

### INTRODUCTION

Ghana is endowed with many natural resources such as gold, manganese, bauxite and diamond. According to Coakley (1999), Ghana places an enviable position in the mining sector in Africa being the second largest gold producer apart from South Africa, the 3<sup>rd</sup> largest producer of aluminium metal and manganese ore and produces appreciable amount of bauxite and diamond. However, the sector has not been without challenges especially illegal mining. Illegal mining popularly called *galamsey* has been a major concern in recent times in Ghana. There has been series of reported incidents of illegal mining over the last couple of years resulting in the lost of many young lives. According to Dr. Toni Aubynn, the CEO of the Ghana Chamber of Mines, about 300 people lost their lives in 2011 through illegal small scale mining activities. It was also reported that in a single incidence over 100 illegal miners died when the pit in which they were operating caved in near Dunkwa-on-Offin in the Central region. There has been series of reported cases of collapse mining pits in the media including a collapse of mining pit (loose) which trapped and killed about 15 people in Aboso and another collapse of embankment in Akyempim near Dunkwa claiming several lives of which only 17 bodies were able to be removed by the rescue team. Children have also lost their lives by accidentally falling into abandoned pits especially in communities closed to the areas where these illegal miners operate.

Besides such unfortunate incidents, illegal miners have caused and continue to cause irreparable havoc to the environment especially waters bodies which serve as sources of water for domestic, industrial and irrigation purposes. Pollution of soil and water bodies with mercury, sludge and other chemicals, destruction of farms and farm lands, degradation of land and vegetation, deforestation,

lost of biodiversity, encroachment of forest and game reserves among others have been the order of the day due to illegal mining. For instance, it is reported that the Birim and Densu Rivers in the Eastern region which serve as a source of drinking water for several communities have gravely been affected by small-scale mining activities. The Pra and Ankobra Rivers in the Western region as well as other smaller rivers and streams have also not been spared. The uncontrolled activities of illegal mining compelled the Ghana Water Company Limited (GWCL) which takes its water source from the Birim River to temporarily shut down its water treatment plant at Kyebi in the Eastern Region due to extreme pollution by the illegal miners (Modernghana news, 2011). The situation is similar in other areas which has always increased the cost of water treatment by these companies. The Atewa forest reserve which protects the headwaters of the Birim and Densu rivers is also threatened by mining activities in the region.

The indiscriminate use of mercury (Hg) to amalgamate the gold by these illegal miners is also a source of concern since the handling of this important element is not controlled or regulated. In Ghana, it is established that human activities is the basic source of environmental Hg pollution (Hilson and Pardie, 2006) and this is due to the inappropriate method of amalgamating the gold particles (Swain *et al.*, 2007). A research conducted by Oduro *et al.* (2012) found out that the main Pra river and its tributaries have  $(48.40 \pm 26.08 \text{ ng/ml})$  and  $(27.59 \pm 18.23 \text{ ng/ml})$  average dissolved Hg concentration respectively which are far above the WHO guideline value of 1.0 ng/ml due to illegal gold mining activities along the stretch of the Pra River. Since river bodies are not stagnant but flow from upstream to downstream, the pollutants travel downstream making it impossible for communities along that stretch of the river to make use of the river.



Harada *et al.* (2001) clearly stated that the effect of Hg pollution does not remain at the place where it is polluted but travels several kilometers radius from the point of discharge. It is estimated that about 650-1000 tonnes of Hg is deliberately released annually to the environment globally and artisanal small scale mining is the major culprit to such incidence (UNEP, 2008). Traces of mercury find their way into soils and water bodies which becomes a threat to the already impoverish communities which rely on these resources. Bell *et al.* (2002) found a very strong correlation between sulphate and ion traces concentrations as well as dissolve solids and electrical conductivity which is an indication of low water quality in the mining areas. According to WHO (1980) exposure to mercury can cause kidney failure and damage, nausea, pain and diarrhoea and also affect the brain and the nervous system. There is therefore the need to regulate the activities of these illegal miners to prevent further havoc to the environment and human lives. The promulgation of The Small Scale Gold Mining Law, PNDCL 218 in 1989 and the establishment of the district offices of the Minerals Commission were to regulate mining activities to comply with environmental sustainability; provide technical support to small scale miners (SSM); provide avenue for job creation especially for the rural folks and officially streamline all the minerals produced. This review paper is therefore to inform policy makers and opinion leaders about the need to take stringent measures to stop the practices of illegal mining in the country and ensure that small scale miners follow proper procedures in extracting the mineral to avoid further pollution of water bodies.

### Overview of small scale mining in Ghana

#### Pounding of gold quartz

One of the two main conventional methods of gold extraction by small scale mining is pounding of gold quartz in metal mortar with metal pestle into powder form. Gold quartz is being extracted by illegal miners from abundant pits of mining companies in the form of stones. These gold-holding ores are hacked from rock surfaces using harmer and sometimes blasted with dynamites. The broken rocks are then brought to the earth's surface for pounding. The gold quartz is then crushed into pieces in a way that prevent the debris from scattering. The broken gold quartz is then pounded in a steel mortar with steel pestle to form powdered grains which are sieved. The process is continued until all the gold quartz is grounded into powder ready for separation under water. The gold dust is then placed on a well carved car tube or wood pan and rotates under water. The spinning continues while the muddy water is poured away and more fresh water is added. The principle is that the gold particle which is heavier settles under the rubber pan which is then poured into a container for further treatment with mercury. Finally the gold particles are mixed with mercury in the rubber pan to amalgamate the gold particles. The mixture is then squeezed in a white handkerchief or light cloth to release the mercury and the gold is then subjected to fire. This

method of gold extraction is environmentally acceptable apart from the health risk associated with the inhalation of the gold dust and the danger of collapsed mine which could easily be prevented by applying appropriate safety mechanisms.

#### Washing of soil on a sluice box

This method of gold extraction is associated with various environmental challenges. Here a group of miners dig the soil where gold is identified and mix the soil with water to form slurry. A sluice system with jute sack is set up to collect the gold particles. The system is set up by raising one side of the sluice to form a slope and the sluice is lined with the jute sacks to trap the gold particles. The slurry is fed into the sluice box and washed gently along the slope. The jute sacks are then removed and washed in a big pan full of water to release the gold particles. The water in the pan is gradually poured out and the mud gently washed out leaving the gold particles in the pan. The rubber pan is then used for the finishing process and the gold particles poured into a bowl for further treatment with mercury. Finally the gold particle is processed as described earlier. This method of gold exploitation has come with various challenges due to the inappropriate methods applied and its environmental consequences.

### METHODOLOGY

This research was carried out by reviewing literature and media information on small scale mining in various mining communities. Observational trips to small scale mining communities such as Tarkwa, Aboso, Bogoso, Nsuayem in the Western region and Tinga in the Northern region among others were done. The research also involved a close observation of certain river bodies especially the Pra and Ankobra Rivers to identify the changes that have occurred over the years. There were series of interactions and interviews with some of the small scale miners in the region as well as personal experience having had the opportunity to work with such small scale miners in Tarkwa in the Western region.

#### Impact of small scale mining activities on water resources

One major impact is the pollution of water bodies. Water is life and a universal basic right. The Millennium Development Goal 7(10) on environmental sustainability requires accessibility to safe drinking water and sanitation by 2015 (UNDP, 2006). This implies that there is the need especially for developing countries to double their effort in water accessibility through integrated water resource management at all level of the economy thus any attempt to deny people of such precious resources should be tantamount to crime and infringement of human right. The pollution of water bodies by these small scale miners with mud, mercury and cyanide during gold extraction should therefore be a matter of concern to all. There have been challenges such as pollution of rivers and water bodies both surface and underground which serve as sources of drinking water and for irrigation in many



mining communities (Davis *et al.*, 1994; Paruchuri *et al.*, 2010).

Research has established that malnutrition and unsafe drinking water can escalate diseases in developing countries. In 1990 about 1.1 billion people lacked access to safe drinking water (Kavats *et al.*, 2002). With the emerging threat of climate change, water availability and accessibility is going to be a key issue in the next couple of years thus the need for government, NGOs, Environmentalist and all stakeholders to take keen interest to protect and preserve all our water bodies for the present and future generations. According to IPCC (2007) Climate change will increase water availability by 10 - 40% in high altitude leading to floods and decrease by 10 - 30% at dry tropics leading to water crisis for drinking, irrigation, and energy production. This situation may worsen the already deplorable conditions of many rural communities. Population growth and economic development over the next few decades will probably outweigh climate change in terms of per capita water availability despite the effect of climate change on the elements of the hydrologic cycle (Vorosmarty *et al.*, 2000)

Unfortunately, clean water from the Pra, Ankobra, Birim Rivers and other water bodies which communities along these stretch depended upon is polluted to the extent that it becomes very difficult for the communities to rely on them. While most countries of high Human Development Index (HDI) ranked domestic water supply as high priority, water for agriculture was ranked as high priority mainly by countries with low HDI probably because of food security and availability issues (UN Water, 2012). The activities of small scale miners especially, illegal mining affect water quality and increases the cost of water treatment for water companies that treat the water for public consumption. The pollution sometimes becomes so bad that it increases the amount of chemicals that is used in treating the water which invariably may affect the quality of water supplied to the public and sometimes the water companies have no other option than to shut down operations as happened in Kyebi. Fishes in such water bodies are sometimes killed by these poisonous chemicals and aquatic life is sometimes threatened. Chemicals left in the soil are also washed through erosion into water bodies during rain storm as revealed by Roulet *et al.* (1998) in their studies. The need for water related planning is very important especially for developing countries such as Ghana with weak adaptive capacity to climate change. Giansante *et al.* (2002) and Galaz (2005) stressed on the need for both infrastructural investment and institutional change to address drought related stresses, flood events, water quality issues and growing demands for water. Ghana cannot be an exception and the time to take action to halt further pollution by these illegal mining activities is now.

Besides water pollution, land degradation, deforestation, health and safety, and unpardonable disasters have also become another issue. With the rampant activities of illegal mining, many farms and agricultural lands are being polluted with traces of

mercury and other chemicals; uncontrolled excavation of soil causes soil erosion, loss of land for grazing and soil fertility. The vegetation is also destroyed and sometime it is very difficult to restore the land even after many years of mining activities. According to Essumang *et al.* (2007) agricultural produce such as fresh vegetables and food items are affected by the activities of illegal mining.

Another area of much concern is deforestation which has been one of the major drivers of climate change. Encroachment and destruction of forest reserves as in the case of Atiwa has brought many hardship to society. Indiscriminate felling of trees to make way for their illegal activities without replacement even years after the mining activities has resulted in serious land and forest degradation. Communities close to these mining areas suffer from malaria, vector diseases and other environmental related diseases due to stagnant waters left by these illegal miners. Traces of chemicals in water bodies in mining communities have affected the health of many people. Recently it was announce that there is a high percentage of mercury in the water supplied by the Ghana Water Company in Tarkwa which is likely to affect the health of the people as disclosed by UNEP (2008). Child labour and children's health are also at stake.

Many illegal miners have lost their lives and this continues trend is a threat to society. The death rate has been very rampant recently. Some children in mining communities sometimes lose their lives by falling into abundant pits and others have their education threatened.

## DISCUSSIONS

There is no doubt that small scale mining has some benefits which cannot be ignored. Among the benefits of the small scale mining are employment which brings income to the miners and their families. It was observed during the interviews and interactions with the miners that they make a living out of their activities. The money they get at the close of work is what they live on and for their families. During the activities of the miners, people get the opportunity to sell at the sites thus boosting local trade, creating jobs and generating income for communities closed to the operational sites. The illegal mining engages a lot of the youth thus creating employment. This situation improves quality of lives in the communities and prevents rural-urban migration. The mining business also contributes to the national economy through gold export which generates foreign exchange for the country (Wood, 1999).

According to the former Minister of Land and Forestry (Collins Dauda), about 500,000 people are directly employed in the industry with many others indirectly benefiting from the activities of the SSM. The SSM is also said to produce about 560, 715oz of gold and 354, 443 carats (cts) of diamonds forming 18% and 100% of total production in 2009 respectively. These are all positive impacts that could bring socio-economic development to rural communities, reduce poverty, rural - urban migration and guarantee balanced economic and social life.



However, their activities have had serious environmental challenges in recent years which are indeed a matter of concern to many Ghanaians. Water bodies are being polluted, forests are being destroyed, lives are also lost and the environment is being threatened. In order to address these issues of environmental degradation due to SSM or any other undertaking, there is the need for the nation to put economic value on all the natural resources. This will help the nation to rightly assess reversible or irreversible impacts as well as benefits or losses to the environment without any political influence. The assessment will determine whether the resource should be extracted or not because of the long term negative effect. Experience has shown that the various challenges facing the nation are as a result of the politicization of important issues that are of national concern which sometimes undermines the rule of law. Relevant issues that affect the citizenry such as this must be discussed objectively and the right solution sorted out irrespective of the political party in power. Many years ago Chiefs had absolute control of their territory to ensure that the basic laws of the land are obeyed. Unfortunately, it seems the traditional powers vested in Chiefs and community leaders to ensure development and sanction wrong doings in their communities are gradually waning because of politics. In an attempt to address the problem of illegal mining, the local people such as chiefs, opinion and community leaders should be fully involved in addressing the issue since they are always in their communities. District Chief Executives should cooperate with traditional leaders in their communities to address this menace.

Concessions should only be granted to the indigenous people within the communities who could be held responsible for any breach of contract. They can then work with non-residents in their communities but the right procedure for extracting the gold must be followed and it is the responsibility of the group to ensure that the right approach is used in the exploitation of the resources. These people must be registered and the rules of engagement made clear. Even though most of the small scale miners have been registered and issued with licenses to operate yet there are quite a number of them who have not been registered. To encourage the unregistered ones to register, the registration process should not be cumbersome and financially scaring. The small scale miners should also be given the needed training, legal, organizational and financial support to streamline their activities. Their activities should be regulated, monitored and controlled at all levels to ensure environmental sustainability and compliance.

The community chiefs and leaders, community police and volunteers, district officers of the Mineral Commission and the district assemblies should be responsible for the organization, regulation, evaluation, monitoring and controlling of the activities of all small scale mining in the country. The laws associated with mineral extraction must also be respected and anybody found culpable must be brought to book. There should be the political will to stop illegal mining, and unemployment

challenges in the country must not be an excuse for environmental degradation. The setting up of anti-galamsey taskforce to clamp down on illegal mining in Ghana is in the right direction but the security apparatus such as the police and the military must take over to save the nation the extra cost of maintaining this taskforce. The laws of the land must also be enforced to the letter especially where foreigners are taking the laws for granted. The fight to stop illegal mining (galamsey) should be a collaborative effort among all the authorized institutions in order to ensure that water bodies are safe for domestic, irrigation and other purposes.

## CONCLUSIONS

The problem of illegal mining has been a matter of concern for a long time but it appears the challenges have been enormous and visible in recent times. This paper has attempted to outline the challenges associated with SSM, potential impact on water for domestic and irrigation purposes; illegal mining processes and impact on environmental resources. The suggested solutions outlined in the summary are some of the possible ways to address the issue of illegal mining activities in Ghana. The question then is: should galamsey activities continue at the expense of the scarce water resources and the environment?

## REFERENCES

- Bell FG, De Bruly LA and Stacey TR. 2002. Some examples of the impacts of metalliferous mining on the environment: A South African perspective. *Bull. Engng Envir Geol.* 61: 1-20.
- Coakley GJ. 1999. The mineral industry of Ghana Minerals Yearbook, Vol. (3), United States of the Interior, Geological Survey.
- Davis DW, Hirdes N, Schaltegger U and Nunoo EA. 1994. U-Pb age constraints on deposition and provenance of Birimian and gold-bearing Tarkwaian sediments in Ghana, West Africa. *Precambrian Res.* 67: 89-107.
- Essumang DK, Dodoo DK, Obiri S and Yaney J. 2007. Arsenic, Cadmium and Mercury in Cocoyam and Water cocoyam in Tarkwa, a Mining Community. *Bull Envir Contam and Tox.* 79: 377-379.
- Galaz V. 2005. Social-ecological resilience and social conflict: Institutions and strategic adaptation in Swedish water management. *Ambio.* 34(7): 567-572.
- Giansante C, Aguilar M, Babiano L, Garrido A and Pedregal *et al.* 2002. Institutional adaptation to changing risk of water scarcity in the Lower Guadalquivir Basin. *Nat Resour J.* 42: 521-564.
- Harada M, Nakanishi J and Yasoda *et al.* 2001. Mercury pollution in the Tapajos River basin, Amazon: Mercury



level of head hair and health effects. *Environ. Int.* 27: 285-290.

Hilson G and Pardie S. 2006. Mercury: An agent of poverty in Ghana's small-scale gold- mining sector? *Resource Policy.* 31: 106-116.

IPCC. 2007. Summary for Policymakers. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* ML Parry, OF Canziani JP Palutikof PJ van der Linden and CE Hanson (Eds.). Cambridge University Press, Cambridge, UK. pp. 7- 22.

Kovats RS, Menne B, McMichael AJ, Covalan C and Bertollini R. 2000. *Climate Change and Health, impact and adaptation.* WHO/SDE/OEH/004, Geneva and Rome. WHO.

Modernghana news. 2011. Kyebi Water Plant Shut Down as a Result of Evil Effects of Galamsey. <http://www.modernghana.com/news/343119/1/kyebi-water-plant-shut-down-as-a-result-of-evil-ef.html> (accessed 11/6/13).

Oduro OW, Bayitse R, Carboo D, Kortatsi B and Hodgson I. 2012. Assessment of Dissolved Mercury in Surface Water along the Lower Basin of the River Pra in Ghana. *International Journal of Applied Science and Technology.* 2(1): 228-235.

Paruchuri Y, Siuniak A, Johnson N, Levin E and Mitchell *et al.* 2010. Occupational and environmental mercury exposure among small-scale gold miners in the Talensi-Nabdam District of Ghana's Upper East region. *Sci. Total Environ.* 408: 6079-6085.

Roulet M, Lucotte M, Saint-Aubin A, Tran S, Rheault I and Farella *et al.* 1998. The geochemistry of mercury in central Amazonian soils developed on the Alter-do-Chão formation of the lower Tapajos river valley, Para state, Brazil. *Sci. Total Environ.* 223: 1-24.

Swain EB, Jakus PM, Rice G, Lupi F, Maxson PA and Pacyna *et al.* 2007. Socio-economic consequences of mercury use and pollution. *Ambio.* 36: 45-61.

UNDP. 2006. MDG Targets and Indicators <http://www.undp.org/mdg/goallist.shtml> (accessed 18/11/12).

UNEP. 2008. Annual Report. [http://www.unep.org/PDF/Annual\\_Report\\_/2008/AnnualReport\\_2008\\_en\\_web.pdf](http://www.unep.org/PDF/Annual_Report_/2008/AnnualReport_2008_en_web.pdf) (accessed 11/6/13).

UNEP. 2012. The UN-Water Status Report on the Application of Integrated Approaches to Water Resources Management.

Vörösmarty CJ, Green P, Salisbury J and Lammers RB. 2000. Global water resources: vulnerability from climate change and population growth. *Science.* 289: 284-288.

Wood A. 1999. Natural resources, human resources and export composition: A cross country perspective. In: J. Mayer, B. Chambers and A. Farooq (Eds.). *Development Policies in Natural Resource Economies.* Cheltenham, UK: Edward Elgar.

World Health Organisation (WHO). 1980. Recommended health-based limits in occupational exposure to trace metals. Technical Report Series, No. 647. Vienna, Austria.