ALL THAT GLITTERS IS NOT GOLD- Environmental effects of Small-Scale mining in Ghana, West Africa

Gloria Appiah-Sefah, Jingyu Huang, Kyereh Boateng, Philip Nti Nkrumah

Abstract— Small-scale and artisanal mining locally known as *galamsey* has become a name on the lips of environmentalists, health practitioners, social scientists as well as politicians due to some of the negative impacts the practice have had on the society and countries as a whole. Although there are other social effects of the activities of these miners, the environmentally related ones, seem to have more precedence. The objective of the research was to use informal interviews, literature from the internet, media reports as well as field observations to bring to throw light on the effects small-scale mining activities are having on the environment of Ghana and also to propose some measures that can be put in place to address the identified issues. Interviews were organized for representatives from the various ministries concerned with the issue. It was identified that water pollution, land degradation, loss of forest cover, noise pollution as well as reduction in agricultural production were some of the effects the country is currently suffering from the activities of these *galamsey* operators. Coordination between the various ministries, ensuring implementation as well as amendment of the existing law and education of operators are some of the measures that can be taken to curb the situation.

Index Terms— galamsey, Ghana, land degradation, Small-scale mining, water pollution,

1 INTRODUCTION

The Intermediate Technology Development Group (ITDG) [1] defines small-scale miners (SSM) otherwise known as artisanal miners as groups of people who may be in small groups but due to their poor financial status, depends on mining as a livelihood. These people mostly use basic rudimentary tools such as chisels, picks, sluices as well as pans for their operations which mostly involve the exploration of mineral deposits. The United Nations (UN) defines the practice of small-scale mining as any mining operation that is of a single unit and has an annual production of about 50,000 tonnes of unprocessed materials or less, measured at the entrance of the mine [2]. These activities are mostly practiced in rural areas where most people live in poverty due to less diversity in the kind of jobs that exist. The activities of SSMs are illegal in most countries but in countries where they are legalized, special restrictions and regulations are placed on their activities. In as much as the practice provides employment and serve as source of revenue for some people within the society, negative effects on the environment, health, safety of those involved and the development of the affected countries [3] as a whole has been a major constraint to the popularity of the practice in most countries. In countries such as Liberia, Namibia and Madagascar among other 39 countries, small-scale mining activities have been identified in about 96 out of 147 protected areas [4]. Namibia, South Africa, Tanzania, Ghana, the Philippines, Sierra Leone, Latin America, Peoples Republic of China and most other less developed as well as developing have suffered from the negative effects associated with SSMs [5].

Ghana, located in West Africa has highly been affected by the activities of small-scale miners locally known as *galamsey*, over the past few decades. In view of this, the government established the Small-Scale Gold Mining Law, PNDCL 218 in 1989 to regulate the activities of these miners. The law defines small-scale mining as mining by any method that does not involve large expenditure by the individual or groups of persons involved. The broader aims of the law were to provide technical support to these miners' whiles ensuring that the gold exploited passed through the Mineral Commission to ensure that revenue accrued went to the government. Another aim was to help provide employment to those involved whiles regulating their activities to help ensure that their activities are environmentally friendly [6]. Although the sector provides employment whiles the sale of gold help increase the national income, the effects on education of the youth, endangering of lives of perpetuators as well as the embarrassment it causes the nation cannot be overlooked (Fig 1). Prominent among the effects, which is that on the environment, has taken precedence in most discussions and poses as the main worry of the

- *Gloria Appiah-Sefah is currently pursuing masters degree program in environmental engineering in Hohai University, China, PH-+8615105169251. E-mail: gee_88m@yahoo.com*
- *Co-Author Huang Jingyu is currently a lecturer in the environmental engineering department, Hohai University, China, PH-+8618652016994. E-mail: huangjingyu120120@126.com*
- *Co-Author Kyereh Boateng is currently a lecturer in the forestry department, Kwame Nkrumah University of Science and Technology, Ghana, PH-+233244636669. E-mail: kyerehb@gmail.com*
- *Philip Nti Nkrumah is currently pursuing masters degree program in environmental engineering in Hohai University, China, PH-+8615895982024. E-mail: philiponti1209@yahoo.com*

whole populace with the government inclusive [7]. There are less documented papers on the effects of small-scale mining activities on Ghana's environment as well as other natural resources. The objectives of this research were to use informal interviews, literature from the internet, media reports as well as field observations to bring to light the effects small-scale mining activities are having on the environment of Ghana and also to propose some measures that can be put in place to address the identified issues.

2 SCOPE OF THE RESEARCH

The paper outlines some of the identified as well as observed negative environmental effects of small-scale mining activities across Ghana in general. A brief literature review was done to back responses from interviewees from the various ministries concerned and field observations by the authors. Since the activities of these miners cannot be brought to an abrupt end due to some of the social benefits it offers as well as lack of adequate legislation and law enforcement, some solutions to help ensure the environmental sustainability of their operations have been outlined in this paper.

3 MATERIALS AND METHODS

3.1 Study Area

Ghana, formerly known as the Gold Coast, is located in West Africa at latitude and longitude 8°00′ and 2°00′W. It covers a land area of about 238,535km² [8]. There are currently more than twenty legal gold mining companies in operation in various parts of the country. It is believed to have as much as 70% of West African's gold deposits and it is thus not surprising that about one-sixth of the country contains extractable gold and diamond [9] (Fig 2). As such, the dependence of local people on extraction through small-scale mining has increased over the years (Fig 3). Problems such as mismanagement of mineral resources by the government resulting in poor returns to indigenous land owners, corruption during purchase of extracted minerals as well as loss of interest in investing in the mineral sector (mostly gold and diamond) by foreigners has increased the activities of these SSMs [7]. Tarkwa, Obuasi, Dunkwa, Prestea, and Dumasi are Ghana's most important gold mining areas.

Fig 1. SSM activities in some parts of the country [10]

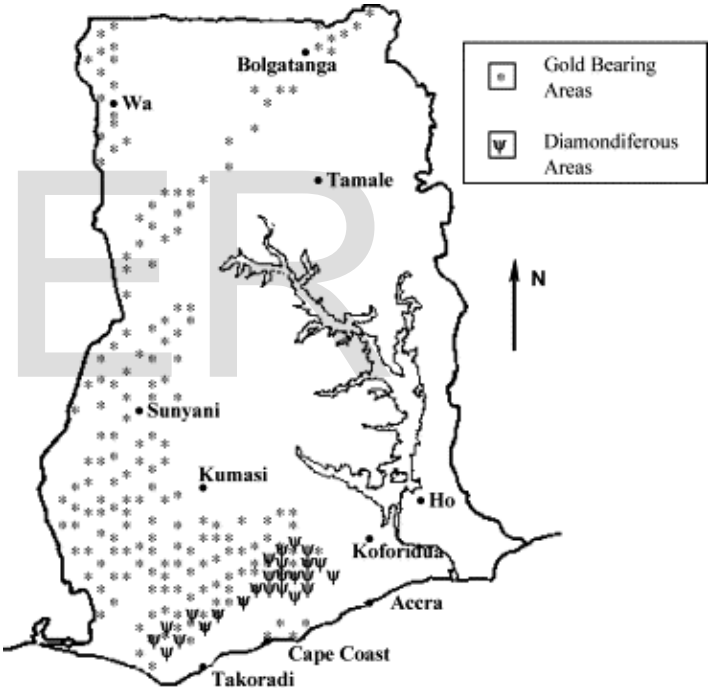

Fig 2. Gold bearing and diamondiferous areas in Ghana [9]

- *Gloria Appiah-Sefah is currently pursuing masters degree program in environmental engineering in Hohai University, China, PH-+8615105169251. E-mail: gee_88m@yahoo.com*
- *Co-Author Huang Jingyu is currently a lecturer in the environmental engineering department, Hohai University, China, PH-+8618652016994. E-mail: huangjingyu120120@126.com*
- *Co-Author Kyereh Boateng is currently a lecturer in the forestry department, Kwame Nkrumah University of Science and Technology, Ghana, PH-+233244636669. E-mail: kyerehb@gmail.com*
- *Philip Nti Nkrumah is currently pursuing masters degree program in environmental engineering in Hohai University, China, PH-+8615895982024. E-mail: philiponti1209@yahoo.com*

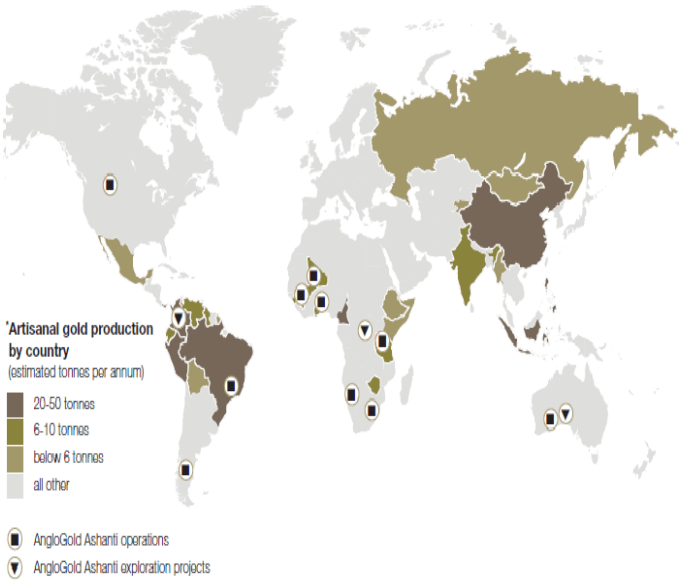

Fig 3. Artisanal gold production in the world [11]

3.2 Activities of small-scale miners

The small-scale miners (*galamsey operators*) in Ghana consist of men, women and children mostly of school- going age. Some foreigners from countries such as China are also heavily involved in these activities. The men usually do the excavation work as well as the washing and extracting of the gold. Women on the other hand are involved in carrying, sieving and washing ores, selling food around excavation sites, acting as licensed buyers whiles some also hold concessions [12]. Others also serve as bookkeepers. Young children of school- going age help with the carrying of the ore for washing. People mostly mine gold on part-time basis. That is when they need money to pay school fees, travel, settle medical expenses or during agricultural off-seasons.

The methods that are used during their operations can be grouped under shallow alluvial mining and deep alluvial mining. The former involves the digging of mineral deposits located in valleys or low-lying areas whereas the latter involves the excavation of mineral deposits located along major river banks [13]. In Ghana, major rivers such as Tano, Offin and Ankobra have been major victims of the activities of small-scale miners. Hard rock mining is another method that involves the use of explosives to break into reefs that contain minerals. Although the method is highly illegal in Ghana, some people still use it.

- *Gloria Appiah-Sefah is currently pursuing masters degree program in environmental engineering in Hohai University, China, PH-+8615105169251. E-mail: gee_88m@yahoo.com*
- *Co-Author Huang Jingyu is currently a lecturer in the environmental engineering department, Hohai University, China, PH-+8618652016994. E-mail: huangjingyu120120@126.com*
- *Co-Author Kyereh Boateng is currently a lecturer in the forestry department, Kwame Nkrumah University of Science and Technology, Ghana, PH-+233244636669. E-mail: kyerehb@gmail.com*
- *Philip Nti Nkrumah is currently pursuing masters degree program in environmental engineering in Hohai University, China, PH-+8615895982024. E-mail: philiponti1209@yahoo.com*

3.3 Sources of data

Information were obtained through informal interviews with some representatives from the Ministry of environment, science and technology, Ministry of lands and natural resources as well as the Ministry of water resources, works and housing. Data and information from the internet as well as field observations were used as secondary data sources.

4 RESULTS AND DISCUSSIONS

Environmental effects of small-scale mining

In spite of the economic boost that areas around which small-scale mining activities take place enjoy, the environmental impacts seem to mostly exceed the social benefits. The low levels of technology employed during production coupled with the lack of skilled labor as well as the low recovery of minerals have increased the environmental damages resulting from SSMs [14]. Major environmental issues as identified by respondents are discussed below:

4.1 Water pollution

Major impacts of the activities of SSMs are those on waterbodies since their activities mostly involve the use of water. Major rivers such as Ankobra, Tano and Oti and other streams have been heavily polluted by the activities of these SSMs [15]. Studies have revealed that mercury which is used during the sluicing process and the amalgamations of the mineral as well as disposed tailings mostly end up in these water bodies [13]. Most of these waterbodies which ones used to be the main source of water for the surrounding areas do not serve their purposes for domestic and industrial usage anymore. Even dug-wells can also not be used for domestic purposes anymore [15]. Furthermore, the removal of the vegetation cover increases the rate of erosion, subsequently increasing the turbidity of these waterbodies due to the washing in of eroded materials mostly sand. These have resulted in the death of several fishes and other aquatic organisms that once lived in these rivers and streams.

4.2 Land degradation

This is very common in areas where mining activities are not monitored nor controlled. Miners usually leave pits that had been dug for minerals open and unfilled after their activities and other waste that were generated in the course of their activities are mostly improperly disposed. These open pits are mostly filled with water and end up not been of any good use to the society. These pits sometimes serve as breeding grounds for mosquitoes and poses risks to people [17]. In some other cases, SSM has resulted in the replacement of indigenous species as well as the abundance of certain species where they were not found before[see 18]. Similar results have been found in the northern region of the country and if the severity associated with land degradation within the region continues, the already arid areas might turn into deserts [19].

4.3 Effects on agricultural production

Most farmlands have been cleared for artisanal mining without adequate compensation thus resulting in a reduction in crop production [20]. On the other hand, since most of these mined areas are not rehabilitated after exploration, the land is left bare and thus loses its usefulness for agricultural production [21]. The topsoil and some vegetation are lost during excavation and as such, crop production in such areas become less feasible and even in some cases, impossible. This mostly leads to a high incidence of soil erosion. Furthermore, crops, vegetables and fishes which are farmed close to mined areas have been found to contain some levels of mercury [22] which can be detrimental to human health, especially that of children and pregnant women [23].

4.4 Loss of forest cover and biodiversity

In recent years, because most of the SSMs in Ghana do not have licenses, the forest reserves have been their next target in order to hide from the law enforcement agencies. A vast area of rich forest cover (about 58%), biodiversity areas [7] and Special Biological Protection Areas have been lost due to galamsey invasions and poor operations. The Atiwa range, Sui, Kokrusua, Dampaea and Pompo forest reserves are currently under threat. Tom-Dery et al [18] observed a reduction in the number of tree as well as shrub species in mined and unmined areas within the Northern region of Ghana. Calculated density of trees on the mined and unmined sites was 2.4/100m^2 and 5.6/100m^2 respectively, showing a reduction of about 50%.

Other environmental effects include the release of dust into the atmosphere during the explosion of rocks and noise pollution. Many health risks linked to the lungs have been associated with the former whiles the latter can result in hearing impairments.

5 PROPOSED SOLUTIONS

Since the activities of SSMs in the country seem to be aggravating so fast that stopping them will be difficult, it is suggested that their activities be regularly monitored to ensure that environmental regulations are adequately followed. The various Ministries should coordinate with each other to help curb the situation from all corners. Furthermore, the people involved in the small-scale mining should be encouraged to form groups such that education on the negative impacts of their activities can be given to them and their leaders could easily be held responsible if they fail to implement what they study. Finally, the PNDC Law 218 should be amended to include the rehabilitation of mined areas after exploration (for those with licenses).

6 CONCLUSION

Small-scale mining (*galamsey*) has gradually become a household name in most rural areas in Ghana and the practice seem to be gaining approval in spite of the obvious negative environmental impacts on water, landcover, agricultural production and the atmosphere. Water, air and soil media that have suffered high mercury pollutions due to unregulated SSM activities is gradually becoming a common sight throughout the country [24]. With the trumpet of detest been sounded from all corners of the media, affected communities, environmentalists, health practitioners, large-scale miners and the country at large, it dawns on the government to put in stringent and applicable policies in place to help curb the situation whiles preventing further damages to the environment.

ACKNOWLEDGMENT

The authors are grateful for the financial support from the Natural Science Foundation of Jiangsu Province (BK2012086) and the National Program on Key Basic Research Projects of China (2012CB719804). We also thank Mr. Quaye- Ballard Jonathan, Mr Elorm Tsatsu-Green, Mr. Akomea-Agyin and Mr. Raphael Akesseh for the critical review of this work and also to the various representatives from the different ministries, for the opportunity to be interviewed.

REFERENCES

[1] Intermediate Technology Development Group (ITDG). "Small-scale mining definition". Available at http://www.natural-resources.org/minerals/smscalemining/definitions.htm. 2001

[2] Available at http://www.natural-resources.org/minerals/smscalemining/definitions.htm.

[3] B. Mamadou, "Regularizing informal mining" *A Summ. of the Proc. of the Int. roundtable on artisanal mining*. Organized by the World Bank, Washington DC. May 17-19, 1995

[4] World wildlife foundation (WWF), "Impact of artisanal and small scale mining in protected areas". Available on http://www.profor.info/knowledge/impact-artisanal-and-small-scale-mining-protected-areas. 2012

[5] T. Hentschel, F. Hrushka, and M. Priester, "Global Report on Artisanal and Small-scale Mining", *Summary Report commissioned by MMSD*, pp. 67. http://www.iied.org/mmsd/. 2002

[6] Ghana Law (GL) "Small-Scale Gold Mining Law 1989 (PNDCL 218)" Available on http://ghanalegal.com/?id=3&law=556&t=ghana-laws (2013)

[7] G. Hilson, "The environmental impact of small-scale gold mining in Ghana: identifying problems and possible solutions" *The Geograph J*, vol. 168, no 1, pp. 57-72, Mar 2002.

[8] Enyclopaedia of the nations, "Country overview: Republic of Ghana" Available on http://www.nationsencyclopedia.com/economies/Africa/Ghana.html. 2013

[9] R.K. Amankwah and C. Anim-Sackey, "Strategies for sustainable development of the small-scale gold and diamond mining industry of Ghana" Res

- *Gloria Appiah-Sefah is currently pursuing masters degree program in environmental engineering in Hohai University, China, PH-+8615105169251. E-mail: gee_88m@yahoo.com*
- *Co-Author Huang Jingyu is currently a lecturer in the environmental engineering department, Hohai University, China, PH-+8618652016994. E-mail: huangjingyu120120@126.com*
- *Co-Author Kyereh Boateng is currently a lecturer in the forestry department, Kwame Nkrumah University of Science and Technology, Ghana, PH-+233244636669. E-mail: kyerehb@gmail.com*
- *Philip Nti Nkrumah is currently pursuing masters degree program in environmental engineering in Hohai University, China, PH-+8615895982024. E-mail: philiponti1209@yahoo.com*

Pol, vol 29, no. 3-4, pp. 131-138, 2003
[10] Best nut Ghana Limited. Available on http://bestnutltd.webs.com/. 2012
[11] AngloGold Ashanti, "Artisanal and small-scale mining (ASM)" Integrated annual reports 2011. Available on http://www.aga-reports.com/11/sustainability-report/priorities-and-progress/artisanal-mining. 2011
[12] G. Hilson, "A Contextual Review of the Ghanaian Small-scale Mining Industry" *Country Study commissioned by MMSD*, pp. 29. Available on http://www.iied.org/mmsd/.2001
[13] B.N.A. Aryee, B.K. Ntibery and E. Atorkui, "Assessment of mercury pollution in rivers and streams around artisanal gold mining areas of the Birim North district of Ghana" J of Cleaner Prod, vol. 11, pp. 131-140, 2003.
[14] G. Hilson and S. Pardie, "Mercury: An agent of poverty in Ghana's small-scale gold mining sector?" Res Pol, vol. 31, no 2, pp. 106-116, 2006
[15] Y. Paruchuri, A. Siuniak, N. Johnson, E. Levin and K. Mitchell et al.:, "Occupational and environmental mercury exposure among small-scale gold miners in the Talensi- Nabdam District of Ghana's Upper East region" Sci. Total Env, vol. 408, no 24 , pp. 6079-6085, 2010
[16] S.J. Cobbina, J.Z. Dagben, S. Obiri and D. Tom-Dery, "Assessment of non-cancerous health risk from exposure to Hg, As and Cd by resident children and adults in Nangodi in the Upper East Region, Ghana" Water Qual. Expo. Health, vol. 3, pp. 225-232, 2012.
[17] G.H. Hilson, "Small-Scale miners left behind" CSQ Issue: 27.1. Available on http://www.culturalsurvival.org/publications/cultural-survival-quarterly/ghana/gold-mining-subsistence-ghanas-small-scale-miners-lef .2010
[18] D. Tom-Dery, Z.J Dagben and S.J Cobbina, "Effects of illegal small-scale mining operations on vegetation cover of arid Northern Ghana" Res J of Environ and Earth Sci, vol 4, no 6, pp. 674-679, 2012
[19] E.A. Gyasi, O. Karikari, G. Kranjac-Berisavljevic' and V. Vordzogbe, "Study of Climate Change Vulnerability and Adaptation Assessment Relative to Land Management in Ghana", Reports of the Members of the Study Team, Accra, pp. 91, 2006.
[20] T.M. Akabzaa, B.K. Banoeng-Yakubo and J.S. Seyire, "Impact of mining, Tarhwa, a mining community"Bull. Env. Conta. Tox, vol 79, no 4, pp. 377-379, 2005.
[21] M. Anane, "Gold Discovered beneath Ghana's Forest Reserve" Environment News Service Article, 4th Mar 2003.
[22] M. Babut, R. Sekyi, A. Rambaud, M. Potin-Gautier, S. Tellier, W. Bannerman and C. Beinhoff, "Improving the environmental management of small-scale gold mining in Ghana: a case study of Damasi" J of Clean Prod, vol 11, pp. 215-221, 2003.
[23] Available on http://www.who.int/water—sanitation—health/GDWQ/Summary—tables/Tab2a.htm. 1996
[24] B.A. Teschner, "Small-scale mining in Ghana: The government and the galamsey" Res. Pol , vol. 37, no 3, pp. 308-314., Sept 2012

- *Gloria Appiah-Sefah is currently pursuing masters degree program in environmental engineering in Hohai University, China, PH-+8615105169251. E-mail: gee_88m@yahoo.com*
- *Co-Author Huang Jingyu is currently a lecturer in the environmental engineering department, Hohai University, China, PH-+8618652016994. E-mail: huangjingyu120120@126.com*
- *Co-Author Kyereh Boateng is currently a lecturer in the forestry department, Kwame Nkrumah University of Science and Technology, Ghana, PH-+233244636669. E-mail: kyerehb@gmail.com*
- *Philip Nti Nkrumah is currently pursuing masters degree program in environmental engineering in Hohai University, China, PH-+8615895982024. E-mail: philiponti1209@yahoo.com*