EXPLORING THE POTENTIAL HEALTH AND SAFETY ISSUES OF
ARTISANAL AND SMALL-SCALE GOLD MINING
IN GHANA; A CASE STUDY

by

WILLIAM BUTLER MCWHORTER

SETH APPIAH-OPOKU, COMMITTEE CHAIR
JOSEPH WEBER
STEVEN JONES

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ABSTRACT

Artisanal and Small-Scale Gold Mining is a way of life for many individuals living in developing countries, especially Africa. This subsistence form of mining provides many households with an income to provide food and shelter for their families. Although done with good intentions, limited financial resources along with the lack of government capacity to properly regulate small-scale gold mining activities leads to hazardous working conditions that can be detrimental to both human health and the environment. By using a case study approach, this paper explores the current mining techniques being used in rural Ghana to identify the health and safety issues associated with small-scale gold mining and policy options to help streamline the mining process. Although the appropriate regulations exist, much of Ghana’s small-scale gold mining sector is pushed to operate informally which through financial shortcuts exposes miners and the surrounding community to health and safety risks. By identifying the issues at hand, we hope to promote more effective policies that streamline the small-scale gold mining process through active local government cooperation while creating a more sustainable environment and safe workplace for future generations.
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CHAPTER 1

INTRODUCTION

According to the World Bank, Artisanal and Small-Scale Mining occurs in roughly 80 countries worldwide, most of which are developing countries, and employs over 13 million workers worldwide suggesting that upwards of 100 million people directly depend on small-scale mining compared to only 7 million in commercial mining (The World Bank 2013). Despite these operations resulting in relatively low yields, the small-scale sector helps to provide financial security to families in some of the most poverty-stricken regions of the world. Artisanal and Small-Scale Mining is defined by its use of rudimentary techniques to extract precious metals and can be undertaken legally or illegally. Due to a lack of monetary resources, many financial shortcuts are taken which when accompanied by the limited government capacity to regulate such activities can lead to hazardous working conditions that present health and safety concerns for miners and the surrounding community. To better analyze and understand the health and safety impacts associated with small-scale gold mining, we will be using a case study of a rural mining community in Ghana, West Africa. As a developing country, Ghana relies heavily on the agricultural, industrial, and service sectors for its financial security. In 2014, the industrial sector accounted for 26% of the total GDP, and of that, mining and quarrying played a substantial role (Ghana Statistical Service 2014). Ghana, historically referred to as the Gold Coast, is known for its abundance in gold-rich sediment producing upwards of 100 metric tons per year and is second in gold exports in Africa behind South Africa (USGS 2017). Gold mining in Ghana not only has economic impacts but has a firm cultural hold on its people dating back to the Ashanti Kingdom.
which was known for its gold artifacts. Artisanal and Small-Scale Gold Mining (ASGM) has been practiced for centuries in Ghana; however, it was not officially legal until the 1989 Small-Scale Mining Laws were enacted which formalized the sector and provided avenues for small-scale miners to sell its product (1989 Small-Scale Mining Laws). Despite being legal, bureaucratic hurdles exist that lead to many operations choosing to forgo licenses and work informally and partake in *galamsey* (a local Ghanaian term meaning illegal small-scale gold mining). This accompanied with the lack of government capacity to efficiently regulate gold mining activities leads to miners and workers being unnecessarily exposed to unsafe and unhealthy working conditions. This paper explores the health and safety impacts of Small-Scale Gold Mining in Ghana in an attempt to promote more efficient policies and practices to create a more sustainable environment and workplace for future generations. This is accomplished by (1) determining current *galamsey* gold mining techniques being used in rural Ghana, (2) determining health and safety issues associated with the techniques, and (3) recommending policies to help streamline the mining process to benefit both the local government and ASGM operations.

The earliest records suggest that the peoples of Ghana mined gold for several centuries primarily through Artisanal and Small-Scale Gold Mining before the Portuguese arrived in West Africa (Ofosu-Mensah 2011). Although an official worldwide definition does not exist, ASGM is defined by its use of rudimentary techniques to extract gold with relatively low yields (World Bank 2013). Unlike large commercial operations, ASGM is primarily subsistence mining and provides for upwards of one million families worldwide. Although gold mining has existed in Ghana for centuries, activities amplified in the 1980s with the implementation of Ghana’s Structural Adjustment Program (SAP). The World Bank saw this industrial sector as a way to attract foreign investment through the privatization of the gold mining industry in an attempt to
catalyze the economy and thus help to eradicate poverty. The SAP heavily favored commercial operations and ASGM activities were pushed aside and technically illegal until the 1989 Small-Scale Mining Laws were enacted (Hilson 2005). Potential international commercial operations were given large tracts of gold-rich land despite it being home to many communities, and individuals living in these tracts were relocated from their ancestral land. Despite all of the obstacles in place, ASGM continued informally, and extracted minerals were commonly smuggled to neighboring countries through a well-established black market. This was enriching neighboring countries such as Cote d’Ivoire who were exporting gold despite lacking significant gold deposits (Teschner 2012). Once Ghana realized the loss of revenue, they enacted the 1989 Small-Scale Mining Laws which made the small-scale sector formal and created a permit system while providing avenues for the sale and purchase of artisanally mined minerals. However, the process to obtain a permit is lengthy and requires many procedural and bureaucratic hurdles and can take upwards of 6-8 months for the registration process alone. Miners reported that fees were unreasonable and paperwork was excessive (Hilson 2003). Besides the 1983 Small Scale Mining Laws, most of the legislation and government institutions governing mining is geared toward large scale commercial operations (Table 1). Therefore, many ASGM operations forgo seeking a permit and are pushed to operate informally. Due to a lack of employment opportunities and alternative work that pays little to none, participation in ASGM, legal or not, has become a means of survival for many families (Hilson 2006). These informal galamsey operations often go completely unregulated and coupled with already limited resources, the methods used are cause for serious concern in regards to the health and safety of those trapped in this economic sector. In many cases, legitimate legal small-scale operations are indistinguishable from illegal operations. Due to a lack of regulation, non-permitted operations have the same access to buyers and
equipment and therefore there are little incentives to formalize operations and most are pushed to operate without a permit. The small-scale mining sector also accounts for almost two-thirds of the entire mining labor force and comprised of around 300,000 individuals in Ghana that are being exposed to unhealthy and hazardous work environments where they have no other viable economic alternatives (Amponsah-Tawiah 2011); (Hilson 2006).

Table 1. Legislation Governing Mining in Ghana

<table>
<thead>
<tr>
<th>Legislation</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minerals Commission Law of 1986 (PNDC Law 154)</td>
<td>Created Minerals Commission and governs all things mining including ownership, land acquisition and permitting, regulation, etc…</td>
</tr>
<tr>
<td>Small-Scale Mining Law of 1989 (PNDC Law 218)</td>
<td>Legalized ASM, created a permit system, and provided avenues for ASM to sale gold.</td>
</tr>
<tr>
<td>The Environmental Protections Agency Act 1994 (Act 490)</td>
<td>Created the EPA and governs all industry regulations and minimum discharges.</td>
</tr>
</tbody>
</table>

(Source: Government of Ghana)
Table 2. Relevant Government Institutions

<table>
<thead>
<tr>
<th>Institution</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamber of Mines</td>
<td>Represents the collective interest of companies involved in mineral exploration.</td>
</tr>
<tr>
<td>Environmental Protection Agency</td>
<td>Carries out government policy, inspections, Issues environmental permits, and regulations pertaining to the environment.</td>
</tr>
<tr>
<td>Geological Survey Department</td>
<td>Carries out geological mapping and mineral exploration.</td>
</tr>
<tr>
<td>Lands Commission</td>
<td>Manages public lands and registers title to land.</td>
</tr>
<tr>
<td>Minerals Commission</td>
<td>Primary mineral regulation body. Oversees all things mining from policy implementation, monitoring mining operations, and registering new operations.</td>
</tr>
</tbody>
</table>

(Source: Government of Ghana)

Artisanal and Small-Scale Mining techniques vary depending on the scale of the operation, type of deposit being exploited, and the amount of available financial resources. Historically, most ASGM operations have relied on traditional and manual intensive methods that rely on shovels, pick axes, pans, chisels, and hammers to separate gold from rock and sediment (Aryee 2003). In recent years, however, larger artisanal operations have been able to use more advanced equipment to dig deeper and intercept gold-bearing reefs. This is a step forward, yet many operations are not prepared for the new health and safety risks that come from utilizing new and more advanced techniques.

Historically, ASGM operations have utilized shallow alluvial mining, commonly referred to as “Dig and Wash,” and is the most rudimentary technique used to extract gold from bearing deposits (Aryee 2003). When gold bearing deposits are suspected, vegetation is cleared, and soil is excavated until a gold-rich layer is discovered, usually no more than 10 feet deep. Upon reaching this layer, the sediment is removed and transported to a nearby stream where it is
sluiced to separate gold-bearing minerals and then combined with mercury and burned to create gold nuggets. This is the most common method used by ASGM operations due to its cost-effectiveness and ease of access and is mostly done illegally (Aryee 2003).

ASGM operations that have more capacity are able to employ alluvial techniques to find deeper gold deposits, often near the banks of major rivers and streams. Deep alluvial miners create and excavate pits up to a 40-foot depth where terraces and benches are constructed along its banks to prevent collapse and provide access to the bottom of the pits. Gold-rich sediment is excavated and transported to a nearby stream for sluicing and mercury amalgamation (Aryee 2003).

Recently, more advanced ASGM operations have been able to employ deep hard rock mining techniques to intercept gold bearing reefs at depths of more than 50 feet. These techniques are the most complicated and are usually only carried out by artisanal operations that have financial resources available to acquire machinery and have had experience working with large commercial mining operations. Miners construct shafts and tunnels to intercept gold-bearing rock and then follow these reefs. Heavy machinery is needed to break apart hard rock and explosives are commonly used despite being illegal even for registered mining operations. After the gold-bearing rock is excavated, it is crushed and milled before sluicing to isolate gold through mercury amalgamation (Aryee, 2003). Although these new and more advanced techniques allow for more efficient gold extraction, ASGM operations are being exposed to new health and safety issues they are not equipped to manage, placing miners and the community at risk. Therefore, we ask the question: is this advancement in the ASGM sector and what can we do to streamline the mining process so that operations have a desire to formalize and work with local government to promote healthy and safe working environment? As we move through this
paper, we will use a case study of an ASGM operation in the Brong Ahafo region of Ghana to approach these questions.
CHAPTER 2

CASE STUDY OF CURRENT ARTISANAL AND SMALL-SCALE GOLD MINING PROCESS IN GHANA

To analyze the current small-scale mining process, we used a case study of a rural informal *galamsey* ASGM operation in Kenyasi, Ghana. Kenyasi is located in the Brong Ahafo region of Ghana and is found near Sunyani (Figure 1). There are major gold deposits found all throughout Ghana. However, the majority of the deposits are concentrated in the Western, Brong Ahafo, and Ashanti Regions of the country (Figure 2). Therefore, the ASGM operation studied will give insight into the current mining processes used by small-scale operations throughout Ghana. The operation is located just outside Kenyasi and has been in existence since 2009. The *galamsey* operation provides jobs to upwards of 1,000 individuals, most of which have households. It can be broken down into two separate sections: mining for gold-bearing rocks and gold extraction. Each is its own entity as the mining operation extracts gold-bearing rock, while the second takes the gold-bearing rock and isolates the gold within. Throughout this section, we will analyze each step in the entire process from both entities and explore the organizational structure of the operations and how they interact with each other to create gold nuggets.
The mining operation in the study area is comprised of 50 to 60 different sites, each with its own workers and management. Each site operates its own underground mining shaft. These shafts can be up to 100 feet deep and are dug until gold-bearing deposits are suspected. Miners dig tunnels and follow this gold-bearing reef while excavating (Figure 3). These tunnels are reinforced with wooden beams while ventilation tubes help to mitigate low oxygen levels, high temperatures, and dust created from the use of heavy machinery. At such depths, heavy machinery such as jackhammers and explosives are needed to break apart hard gold-bearing rocks. Local expertise to operate such machinery is uncommon, and through dialogue with mining management, we discovered that many of the workers had traveled from Obuasi, Ghana, and had experience working in large commercial mining operations and had gained the skill.
necessary to dig deep and operate such machinery. Obuasi, Ghana is home to numerous large commercial mining operations and have shafts over 1000 feet deep (Ayensu 1997). This expertise is what has allowed a *galamsey* operation such as the one studied to be able to utilize more advanced methods of extracting gold. Despite explosives efficiency at breaking hard rock, it is currently illegal for any formal or informal small-scale operation to use (1989 Small-Scale Mining Laws). However, due to a lack of government capacity to properly regulate *galamsey* activities, many operations such as the one studied continue to use explosives to break up hard rock. After the suspected gold-bearing rock is mined, it is transported to the surface and organized into sacks weighing roughly 50 pounds each. These sacks are how the mining segment of this ASGM operation makes its revenue. Each sack is sold for 200 GH to the sister operation to extract the gold from the hard rock (Figure 4). It is also through these purchases that the miners receive their income. Through field research, we discovered that the miners’ wages come from commission alone. They make a certain percentage of the amount of potential gold bearing rock sold. Therefore, the miners are incentivized to produce the most amount of product possible to ensure they have enough money to provide for their families.

**Figure 3: Gold Mining Shaft**

(Source: Researcher)

**Figure 4: Potential Gold-Bearing Rock**

(Source: Researcher)
Once the potential gold bearing ore has been purchased, it is transported to nearby facilities and processed to isolate the gold. Hard rock is spread over mats in the sun to ensure they are dry and small enough for the initial machines to process. An individual will be in charge of overseeing this step while manually seeking out larger stones to crush with a mallet. If stones are too large or not entirely dry, they can cause obstructions in the machinery. Once the ore is deemed suitable, it passes through a series of mills to create a fine grain. We discovered that these mills were purchased in Kumasi and were refurbished machines used in commercial mining. The first mill is a hammer mill, commonly called a “crusher” by local workers. This mill takes the larger stones and breaks them into small grain ore, typically 2 cm in diameter (Figure 5a). This process is loud, and an abundant amount of silica dust is produced which is unhealthy for workers to breath. After this step, the small grain ore passes through another mill, commonly called a “smoother,” which further refines the ore creating fine grains (Figure 5b). This fine grain ore is then combined with water and sluiced to isolate ore containing gold. After which, it is combined with mercury to form an amalgam and eventually burned away leaving gold nuggets (Figure 6a and 6b). This gold is then sold through informal channels. However, according to Teschner (2012), political leniency and police corruption have resulted in informal ASGM operations receiving equal access to markets. The operation studied netted between 10 and 15 pounds of gold per week amounting to roughly 16,000 GH.
**Figure 7.** Overview of observed “Galamsey” gold mining process

- **Excavation**
  Gold bearing rock identified and excavated using heavy machinery

- **Grinding**
  Hard ore passes through hammer mill making small grain ore

- **Sifting**
  Small grain ore passes through smoothing mill making fine grain ore

- **Amalgamation**
  Ore containing gold combined with mercury and burned leaving gold

- **Sluicing**
  Fine grain ore sluiced to isolate ore containing gold

Source: Field Data

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**Figure 5a:** Hammer Mill; Source: Researcher

**Figure 5b:** “Smoother” Mill; Source Researcher

**Figure 6a:** Washing; Source: Researcher

**Figure 6b:** Sluicing; Source: Researcher
Although the mining organizations at the study site are individually operated, they are perpetually linked and rely on the others for economic success (Figure 7). This success also facilitates secondary economic benefits that have been seen within and around the mining community on the outskirts of Kenyasi. A large number of workers need housing, food, and transportation. Many vendors and restaurants exist at the site, and the roadside was filled with taxis taking people to and from the site. The *galamsey* mining operation has become its own financial district attracting all types of petty transaction. It has become its own functioning community and society. Due to the large nature of the current operations, a local mining council was formed that consists of a Chairman, Vice-Chairman, General Secretary, Treasurer, and even an unarmed policing task force. All of these things are signs of growth and success, however; this growth comes with serious concerns about the health and sustainability of the operation and its workers as well as the individuals of the community it has created. Since this operation is currently informal, it is unregulated and thus many health and safety issues exist that are now impacting more individuals that may not understand the consequence of these exposures. It is our goal, which through identifying the health and safety vulnerabilities at each stage of the mining process that we can begin to mitigate the impacts through education, stewardship, and local government policies.
CHAPTER 3

POTENTIAL HEALTH AND SAFETY ISSUES OF ARTISANAL AND SMALL-SCALE GOLD MINING

Throughout this section, we will be identifying and analyzing the health and safety issues at each stage of the observed mining process in Kenyasi, Ghana. As discussed in previous sections, the evolution of the ASGM process has led to more advanced and efficient techniques being utilized. However, as a consequence, it has exposed miners and the surrounding community to health and safety risks that they are not equipped to mitigate properly. By identifying these issues, we hope to facilitate awareness and promote effective policies to create a more sustainable mining process.

Table 3. Potential Health and Safety Issues at Each Stage of Observed ASGM Process

<table>
<thead>
<tr>
<th>Mining Process</th>
<th>Activities</th>
<th>Health Issues</th>
<th>Safety Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation</td>
<td>• Gold-bearing rock identified and excavated</td>
<td>• Silica Dust Exposure</td>
<td>• Tunnel Collapse</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Heavy Metal Exposure</td>
<td>• Use of Explosives</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Injury</td>
</tr>
<tr>
<td>Grinding</td>
<td>• Hard rock passes through hammer mill making small grain ore</td>
<td>• Silica Dust Exposure</td>
<td>• Injury from Operating Heavy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Heavy Metal Exposure</td>
<td>Machinery</td>
</tr>
<tr>
<td>Sifting</td>
<td>• Small grain ore passes through smoothing mill making fine grain ore</td>
<td>• Silica Dust Exposure</td>
<td>• Injury from Operating Heavy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Heavy Metal Exposure</td>
<td>Machinery</td>
</tr>
<tr>
<td>Sluicing</td>
<td>• Fine grain ore sluiced to isolate ore containing gold</td>
<td>• Silica Dust Exposure</td>
<td>• Injury</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Heavy metal Exposure</td>
<td></td>
</tr>
<tr>
<td>Amalgamation</td>
<td>• Ore containing gold combined with mercury and burned leaving gold</td>
<td>• Mercury Exposure</td>
<td>• Injury</td>
</tr>
</tbody>
</table>
Each step in the mining process exposes miners and the community to different risks. However, to simplify, we can break the mining process down into two major steps; (1) Mining/Excavation and (2) Gold Extraction. The mining segment of the process brings forth serious concerns in regards to both safety and human health. The majority of the issues stem from a lack of Personal Protective Equipment (PPE) such as breathing masks, hard hats, gloves, safety boots and protective eyewear. We observed the workers lacking PPE. No one was using a breathing mask and miners were descending into the shafts with no hard hats, or protective eyewear. The simply had a flashlight taped to the side their heads, while others were operating heavy machinery while wearing sandals. These mining shafts can be up to 100 feet deep and are often poorly ventilated. Through discussions with operation management, they revealed that they lack the financial resources to purchase proper ventilation machines which help to mitigate the dust that accumulates throughout the excavation process. This coupled with a lack of breathing masks results in serious health concerns for miners through the inhalation of silica dust and other metals as well as making it difficult to see and perform their jobs safely. In a recent study by Basu et. al 2015, they identify that exposure to silica dust is a major concern in ASGM operations in Ghana. The lack of PPE also exposes miners to injury through falling debris and the use of heavy machinery to break apart hard rock. Although uncommon, tunnel collapse is a cause for concern due to the lack of inspections and financial resources to reinforce tunnel walls properly. Although the use of explosives is illegal according to the 1989 Small-Scale Mining Laws in Ghana, the operation studied continue to use them to break apart hard rock within the tunnels. The handling and storage of explosives present safety concerns themselves. Using explosives underground can damage tunnel infrastructure to that tunnel itself as well as nearby mining tunnels. This damage can cause tunnel collapse and puts miners working in volatile and
unsafe working conditions. Another source for concern is that miners are paid based on commission. They are incentivized to produce large amounts of potential gold bearing rock as quick as possible so that they can earn more money to provide for their respective families. This incentive is likely to cause miners to cut corners and make reckless decisions to push out more product. These incautious decisions enhance the likelihood that an accident will occur when coupled with a lack of PPE and thus further elevates the risk. We were informed by operation management that no accidents have occurred at the site. However, it is possible that they were not being entirely truthful. If no accident has occurred yet, then based on the current techniques being used and a lack of basic PPE accidents are inevitable.

Although not working underground in poorly ventilated tunnels, the gold extraction step in the mining process has similar health and safety issues. Again, the majority of the issues stem from a lack of Personal Protective Equipment. While milling and crushing rock, workers are exposed to large amounts of silica dust and other metals that are inhaled due to a lack of breathing masks. According to the United Stated Department of Labor (U.S. Dept. of Labor 2002), silica dust is harmful to breathe and has been classified as a human lung carcinogen. Along with this, silica dust can cause silicosis which has no cure and causes scar tissue to build in the lungs eventually reducing the ability to take in oxygen. The inhalation of silica dust also makes the workers more susceptible to lung infections such as tuberculosis. Due to the slow chronic nature of impacts to health by silica dust, many workers do not realize the extent of the damage until it is too late. There is also a high risk of injury while operating mills and other heavy machinery including jackhammers, Jaw Crusher Mills, Hammer Mills, and grinding/smoothing machines. Much of the machinery used in the studied ASGM operation were refurbished mills that were once used in large commercial mining. In a recent study by Teschner
2012, he discovered that many depots selling machinery to ASGM operations do not require registration paperwork to make purchases, giving informal operations access to equipment that workers may or may not be trained to operate safely. During the final stage of the gold extraction process, the workers use mercury to isolate gold from fine grain ore. Due to a lack of PPE, there are no barriers between mercury and the workers causing elevated risks for mercury-related health impacts. The use of mercury in ASGM is not a new occurrence as there has been numerous scholarly article written detailing the impacts of the use of mercury in ASGM in Ghana on human health and the environment (Viega 2006, Hilson 2007, Tschakert 2007, Basu 2015). Mercury has long been used to form an amalgam and isolates gold from fine grain ore. However, it is only legal in small amounts and illegal for informal ASGM operations to use according to the 1989 Small-Scale Mining Laws. Mercury is a neurotoxin, and bio-accumulate meaning that once absorbed by an organism it accumulates due to the long biological half-life and the rate at which it is lost by catabolism and excretion (National Institute of Environmental Health Sciences 2016). Prolonged exposure to mercury leads to mercury poisoning which can cause difficulty breathing, tremors, emotional changes, neuromuscular impacts, kidney effects, and respiratory failure depending on the levels of exposure (Environmental Protection Agency 2017). At the study site, we witnessed workers handling mercury with their bare hands and no breathing masks. Therefore, the use of mercury in ASGM operations is cause for serious health concerns. Despite national policies in place limiting the use of mercury in mining operations, it is still widely used at the study site and due to a lack of proper PPE, workers and the surrounding community are being exposed to high levels of mercury to which they may not understand the long-term consequences.
To summarize, the majority of the health and safety impacts of ASGM stem from a lack of Personal Protective Equipment which as a consequence exposes workers to high levels of silica dust and mercury fumes throughout the mining process. Also, limited access to financial resources accompanied by limited regulation could potentially lead to poor decisions being made that exposes workers to health and safety risks including the use of explosives which creates a strain on tunnel systems. Currently, policies exist to limit these risks (1989 Small-Scale Mining Laws). However, the limited capacity for the national government to regulate the activities of informal ASGM operations has lead to the continued use of prohibited methods of extraction. To best approach this issue, we feel that it is best addressed at the local level and that policies should be implemented that benefit both ASGM operations and local government by providing an incentive to formalize.
CHAPTER 4
POLICY AND PROCEDURAL RECOMMENDATIONS

Although the appropriate regulations are in place through the 1989 Small-Scale Mining Laws, Ghana continues to struggle with illegal small-scale activities through unregistered operations and the use of banned extraction techniques (Hilson 2007). The Mining Commission of Ghana is in charge of overseeing and regulating large commercial mining operations and small-scale activities. With our case study as evidence, it is obvious that a lack of capacity has led the government to be unable to regulate galamsey small-scale activities effectively to aid in creating a healthy, safe, and sustainable mining process. According to Teschner (2012), revised mining laws in Ghana are no longer capturing ASGM activities within the law and are easily able to avoid regulations. Due to the inability of the government to properly oversee these activities, we recommend that a bottom-up approach through local government would be more efficient by creating a mutually beneficial relationship.

In the current system, there is little incentive to formalize since illegal small-scale operations have many of the same access to resources and opportunities that formal operations experience with the added benefit of not having to pay taxes or deal with inspections (Teschner 2012). This was confirmed through our conversations with local government officials. It was stated that if they attempted to tax the small-scale gold mining operation that it would not be received well and that the operation would refuse to oblige. This is understandable in economic terms. An operation is able to make considerably more profit through not paying taxes and through the use of illegal methods of extraction such as explosives that expedite the process.
However, as explored previously, this scenario places workers and the surrounding community under serious health and safety risks. To help mitigate these risks, local government could implement incentive programs to provide local ASGM operations with necessary Personal Protective Equipment such as breathing masks once they formalize and begin to pay taxes to local government. A policy such as this would be mutually beneficial for both local government and ASGM operations. Local government would have increased tax revenue that could help to provide essential infrastructure needs in rural communities such as maintaining roads, providing reliable electricity, and potable water while mining operations would benefit through protecting the health and safety of its workers that are an essential part of the community. Thus, this relationship could spark a positive feedback loop and facilitate exponential growth and sustainability in rural mining communities.

Unlike the government, local government in rural communities are much more aware of ongoing galamsey activities and their insight should be implemented into the current regulatory system. Exactly what this policy would consist of needs further research and exploration but, through involving local government, it could help to formalize many illegal ASGM operations and facilitate a healthier and safer work environment. Many individuals in these rural communities heavily rely on mining as a source of revenue that ensures the well-being of their household. Therefore, these policies would not seek to shut down illegal operations but rather push them to formalize through the aforementioned incentive programs. A local approach to this issue would also ensure that ASGM operations are meeting health, safety, and environmental standards through regular inspections. The proposed policy would not solve the complex issues that plague artisanal and small-scale gold mining in rural Ghana but would hopefully be a step in
the right direction and facilitate a healthier and safer work environment that’s benefits could be exponential.
ARTISANAL AND SMALL-SCALE GOLD MINING PROVIDES MANY INDIVIDUALS IN RURAL GHANA WITH THE FINANCIAL SECURITY NEEDED TO PROVIDE FOR THEIR HOUSEHOLD WHERE LITTLE ALTERNATIVE ECONOMIC OPPORTUNITIES EXIST. HOWEVER, DUE TO THE CURRENT REGULATORY SYSTEM, MANY ASGM OPERATIONS ARE PUSHED TO OPERATE INFORMALLY. THROUGH A LACK OF REGULATION AND LIMITED FINANCIAL RESOURCES (TESCHNER 2012), CURRENT ASGM TECHNIQUES EXPOSE WORKERS AND THE SURROUNDING COMMUNITY TO SERIOUS HEALTH AND SAFETY RISKS PRIMARILY DUE TO A LACK OF PERSONAL PROTECTIVE EQUIPMENT AND THE USE OF ILLEGAL EXTRACTION TECHNIQUES. FURTHER RESEARCH IS NEEDED TO QUANTIFY THE FULL EXTENT AND SEVERITY OF THESE HEALTH AND SAFETY IMPACTS. THESE ISSUES ARE CURRENTLY BEING APPROACHED THROUGH RESEARCH BY BASU ET AL., 2015. OVER THE PAST DECADE, THE ASGM SECTOR HAS EXPERIENCED GROWTH THROUGH THE ADVANCEMENT OF TECHNIQUES USED TO IDENTIFY AND EXTRACT GOLD BEARING ROCK EMPLOYING METHODS USED BY LARGE COMMERCIAL MINING OPERATIONS. THESE TECHNIQUES HAVE LEAD TO AN INCREASED OUTPUT OF GOLD. HOWEVER, THESE ADVANCED TECHNIQUES ARE EXPOSING WORKERS AND THE SURROUNDING COMMUNITY TO HEALTH AND SAFETY RISKS THAT UNDER THEIR CURRENT CAPACITY ARE NOT EQUIPPED TO PROPERLY MANAGE. THEREFORE, WE ASK THE QUESTION, IS THIS ADVANCEMENT? MANY OF THE HEALTH IMPACTS ASSOCIATED WITH THE CURRENT MINING PROCESS ARE NOT EASILY IDENTIFIABLE AND ARE CHRONIC. THEREFORE, IF THESE RISKS WERE PROPERLY MITIGATED, IT WOULD SEEK TO PROVIDE SUSTAINABILITY AND LONGEVITY FOR MINING OPERATIONS AND THE INDIVIDUALS THAT RELY HEAVILY ON ASGM FOR FINANCIAL SECURITY. WE FEEL THAT BY IMPLEMENTING AN EFFECTIVE POLICY THAT EMPOWERS LOCAL GOVERNMENT AND CREATES MUTUALLY BENEFICIAL RELATIONSHIPS THROUGH INCENTIVE PROGRAMS THAT IT COULD PROVIDE THE
push needed to formalize many *galamsey* operations and seek to create a safe and healthy work environment. Exactly what this policy would look like needs further exploration and research and would not provide a solution to the complex issues that exist with Artisanal and Small-Scale Gold Mining but could hopefully be a step in the right direction to create a healthy, safe, and sustainable mining operation and workplace.
REFERENCES


