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Mutualism, commensalism or parasitism? Perspectives on tailings trade between large-scale and artisanal and small-scale gold mining in Ghana

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ABSTRACT

Due to poor technology and lack of proper skills in mineral processing techniques, a greater percentage (about 70%) of gold is lost to the tailings stream in artisanal and small-scale gold mining (ASGM). These tailings, in the last decade, have become a major source of revenue for some large-scale mining (LSM) companies in Ghana because they have advanced technologies to optimize recovery. This paper examines the tailings trade between ASGM and LSM companies in Ghana and determines their associated relationships. It also informs policy decisions regarding gold mining in Ghana. Field visits were made to licensed ASGM sites in the Tarkwa Mining District where the trade is mostly practiced to obtain first-hand information and conduct interviews with diggers. Results indicate that both ASGM operators and LSM companies derive revenue from the tailings trade, exhibiting a relationship that could be described as mutualistic. Based on the tailings price determination, the symbiotic relationship is described as parasitic because the tailings pricing process is largely controlled by the LSM companies to the detriment of the ASGM operators. As a result of the environmental dangers posed by the tailings trade, the interdependency could equally be described as parasitic since both the ASGM operators and the LSM companies benefit to the detriment of the natural ecosystem. It was also observed that while some stakeholders attempt to criminalize the tailings trade, there is presently no law or regulation that prohibits such trade in the Ghanaian mining industry.

1. Introduction

Artisanal and small-scale gold mining (ASGM) has been practiced in Ghana for many years, giving livelihood to many rural communities. Government regulations enacted in the late 1980s have failed to keep pace with the mining activities. An occupation that conventionally involves the use of rudimentary tools such as pickaxes, chisels, hammers, shovels, and pans to dig for gold has seen the use of heavy machinery such as excavators, trucks, dredging machines, and crushers in recent times (Bansah et al., 2016; Hilson and Potter, 2005). The benefits include employment-skills development, contributions to the national economy, foreign exchange earnings, provisions of raw materials, social intervention projects, alternative livelihoods, and poverty alleviations (Hilson, 2001, 2002; Yakovleva, 2007; Aryee et al., 2003; Hilson and Potter, 2005). Presently, ASGM accounts for more than 30% of the total gold produced in Ghana. Even though the country has no reliable database for the ASGM population, the Minerals Commission of Ghana (regulatory institution responsible for mining) estimates over one million people are engaged in formal ASGM.

As a result of environmental issues such as land degradation, water pollution, mercury release, and the destruction of farmlands posed by the mining activities, many Ghanaians have called for measures to deal with the operations or to ban the mining altogether. Government and officials from the Minerals Commission have also hinted a comprehensive re-formalization/regularization of ASGM (Thebftonline, 2016; GhanaWeb, 2017). Thus, this study aims to inform policy and regulatory decisions regarding the management of tailings (by-product of sluicing) produced by artisanal and small-scale gold miners in Ghana. The study also aims to draw the attention of stakeholders and/or authorities to ensure environmental stewardship in ASGM.

In the last two decades, there have been reported cases of conflicts between artisanal and small-scale gold miners and large-scale mines (LSM) due to boundary disputes and concession ownership issues (Andrew and Hilson, 2005; Hilson, 2002; Andrew, 2003). A clash that occurred in November 2015 between Johnson Mining Company (a small-scale mine) and a large-scale multinational company in the Tarkwa Nsuaem Municipality is a typical example of confrontations that erupted between artisanal miners and LSM operators. A miner

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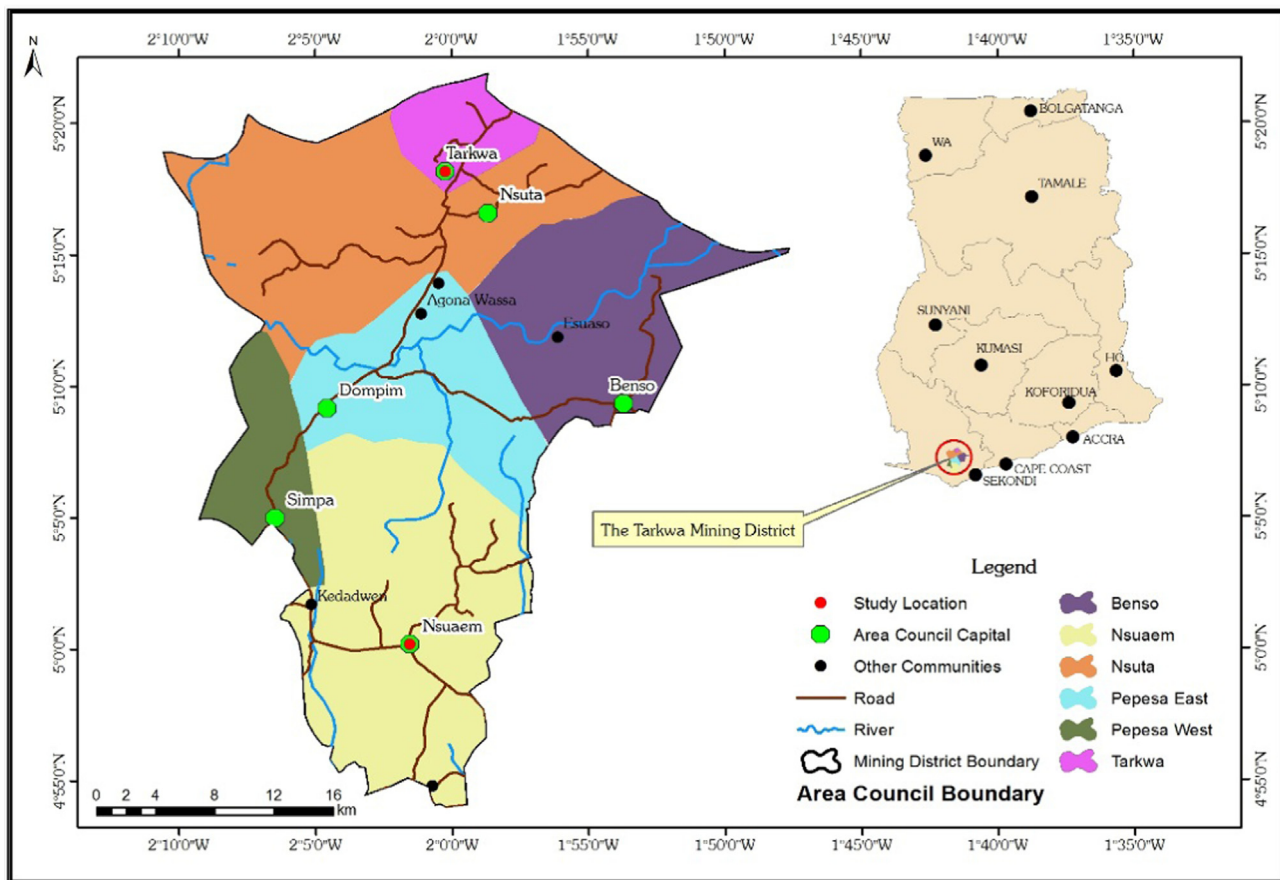


Fig. 1. Map of study area.

(coded R3) at Johnson Mining Company recounts:

We have been mining here for a long time and we did not have any problem with them until recently where they claimed we have encroached their concession... they came with security personnel... they harassed us and confiscated our equipment, so we had to stop work. Fortunately, the Minerals Commission came in to resolve the issue. (R3)

This case is similar to what was reported by [Aubynn \(2009\)](#), who states that contentions between ASGM and LSM operators broadly result from divergent views on ownership of mineral-rich lands. He discussed the case of Abooso Goldfields Limited (AGL) and the Damang ASGM community and further described how management resolved the situation by allocating a portion of the company's mining lease to the diggers under an organized system. [Hilson \(2002\)](#) also presented three case studies (Abooso Goldfields Ltd and Small-Scale Miners, Teberebie Goldfields Ltd, and AngloGold Ashanti Ltd, Obuasi) to corroborate the lack of harmonious relationship between ASGM and LSM companies.

More recently, the relationship between ASGM community and the LSM operators has improved. Media articles and discussions suggest that some LSM companies derive revenue from artisanal and small-scale miners (diggers) by purchasing tailings from them ([Graphic Online, 2013](#)). As a result of the crude and inefficient mining and processing techniques utilized by the diggers, gold recovery is generally low. This makes the tailings attractive to the large-scale mines with improved technology to enhance recovery. Gold recovery in ASGM has also been reported to be low in other countries where this type of mining occurs ([Veiga et al., 2006](#); [Hinton et al., 2003](#)). [Veiga et al. \(2006\)](#) report the use of the cyanidation process by artisanal miners in Zimbabwe, Indonesia, Philippines, and China to improve recovery. In Ghana, however, the use of cyanide by artisanal and small-scale miners is yet to be

widely implemented due to the complex and bureaucratic processes demanded by authorities. The Environmental Protection Agency (EPA) and the Minerals Commission (in Ghana) demand a permitting process that requires a technical design of the processing facility and cyanide containment and the identification of potential health, safety, and environmental impacts of the cyanide use with mitigation measures. Given that ASGM operators typically are poorly educated and lack capital ([Hilson, 2002](#); [Shen and Gunson, 2006](#)), meeting these requirements becomes an extremely difficult task, resulting in the illegal use of cyanide by some operators.

Literature on tailings has mainly focused on LSM tailings management and alternative uses ([Kiventerä et al., 2016](#); [Edraki et al., 2014](#); [Ahmari and Zhang, 2013, 2012](#)). For example, [Ahmari and Zhang \(2012\)](#) found that copper mine tailings are suitable materials for the production of eco-friendly bricks. In a related research, they indicated that the application of cement kiln dust could improve the durability and physical and mechanical properties of geopolymer bricks produced from copper mine tailings ([Ahmari and Zhang, 2013](#)). [Kiventerä et al. \(2016\)](#) observed that sulphide-containing gold tailings hold great potential as raw material in geopolymerization. In the ASGM community, the literature on tailings largely discusses tailings toxicity ([Cordy et al., 2011](#); [Velásquez-López et al., 2011](#); [de Andrade Lima et al., 2008](#)). At present, there is no literature on tailings trade in artisanal and small-scale mining. One study by [Murao et al. \(2002\)](#) only mentioned the existence of tailings trade between ASGM operators and local buyers in the Philippines. Thus, this present study is the first to document tailings trade in ASGM.

In this paper, we examine the tailings trade between artisanal and small-scale gold miners and large-scale mining companies in Ghana. We also attempt to answer the question, "Is the trade interaction mutualism, commensalism, or parasitism?" The terms mutualism,

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