

POST-MINING RECLAMATION IN ARTISANAL AND SMALL-SCALE MINING

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ABSTRACT

Artisanal and small-scale mining (ASM) is often condemned for its environmental and safety impacts. Indeed, it is uncommon to find reclaimed ASM sites in Ghana. This paper reports a successful reclamation effort by an ASM operator in Ghana. Innovative partnership that involves participation of people from host community was utilized to restore degraded ASM sites to support the livelihoods of local population and ensure environmental performance and stewardship. The construction phase of the reclamation process involved backfilling of excavated pits with waste rock (or overburden), distribution of organic-rich topsoil material across the site, and revegetation with native plant species. The successful reclamation of the ASM sites has potential to ensure post-mining landuse that contributes effectively to the productive capacity and stability of the ecosystem. ASM operators should be provided with technical and financial supports to practice reclamation and ensure sustainability in ASM in Ghana.

Keywords: artisanal mining, small-scale mining, reclamation, revegetation, land degradation, environmental stewardship

1 INTRODUCTION

Artisanal and small-scale mining (ASM) has been practiced over hundreds of years in Ghana. It has traditionally involved the extraction of gold or diamond, using simple handheld tools by unskilled individuals or groups of persons, and remains a significant contributor to socioeconomic development of Ghana. It serves a pivotal role in alleviating poverty in rural communities where the mining is practiced. Artisanal and small-scale mining is reported as a major contributor to national income and a pillar for poverty reduction in developing countries (Hentschel *et al.*, 2003; Hentschel *et al.*, 2002; World Bank, 1995). The contributions of ASM to growth of rural communities, local mineral industry and national income of Ghana have received extensive coverage in the literature (Aryee *et al.*, 2003 and Yakovleva, 2007). The ASM sector has provided employment for thousands of Ghanaians, especially indigenes of ASM communities with limited employment opportunities and has made significant contributions to foreign exchange earnings. In 2014, the sector produced 1.49 million ounces of gold representing 34.3% of Ghana's total gold output (Ntibrey, 2015).

Although the economic significance of ASM in Ghana cannot be underestimated, it has often been cited for environmental damage and health issues (Babut *et al.*, 2003; Aryee *et al.*, 2003; Hilson *et al.*, 2007). One of such environmental issues is massive land degradation. Indeed, it is not uncommon to find abandoned degraded ASM sites in Ghana. According to Nyame and Blocher (2010), arable lands used for

ASM operations are left unreclaimed, rendering the lands barren and uncultivable. In the Western and Eastern regions of Ghana for example, disturbed ASM sites are abandoned without any form of reclamation to restore the productive capacity of the land, or to better uses, to ensure sustainability. Recent mechanization of the ASM sector has widened the scale of the mining operations and increased the level of environmental degradation, resulting in large unreclaimed open areas. The absence of reclamation in ASM according to some operators is partly due to lack of funds and technical support.

To demonstrate commitment to environmental and health protection, and to ensure sustainability in ASM, Zenon Mining Company, located in Kwabeng in the Eastern Region of Ghana integrates reclamation into mine planning to make it a key ruling factor in the mining operations, waste disposal, and site closure as indicated by Johnson *et al.* (1994). The mine is owned and operated by Amina Tahiru- a strong-willed woman entrepreneur and ASM operator. For over two years, Zenon Mining Company utilized innovative partnership (that involves participation of members from host communities) and reclamation methods to progressively restore mined pits into economic resource for local population. This paper therefore aims at highlighting the successful reclamation projects conducted by the artisanal and small-scale mining operator in Ghana, and argues that the lack of training and provision of technical and financial supports to the miners by government and stakeholders, partly account for lack of post-mining reclamation in the ASM sector.

2 METHODS

The following sections describe the study area, mining methods and reclamation procedure adopted by Zenon Mining Company. Majority of the information or data have been provided through discussions and semi-structured interviews with Amina Tahiru, the CEO of Zenon Mining Company. Other ASM operators were also interviewed on their views toward post-mining reclamation in ASM. Some of the interviewees' responses have been captured verbatim for illustration.

2.1 Study area

Zenon Mining Company operates 50 acres of alluvial gold concession in the vicinity of Kwabeng which lies on latitude 6°18'48.27" N and longitude 0°18'26.12" W in the Atiwa District of the Eastern Region of Ghana (see Figure 1). The company employs over 30 permanent staff and more than 100 temporary workers. More than 50% of the employees are women who typically work as load carriers and feed auriferous gravels into washing plants. The workers are paid a commission based on revenue obtained from gold extracted. Also, the company pays medical bills and pension contributions for the permanent staff. Additionally, Zenon Mining Company provides meals once a day to its employees on site.

The mining concession is inundated with cocoa farms, requiring payment of huge compensations to farmers, prior to mining. The mine also conducts environmental impact assessment (EIA) as required by the Environmental Protection Agency (EPA) of Ghana. The EIA procedure identifies potential environmental impacts of proposed mining operations and then recommends appropriate mitigation techniques or measures. Additionally, it must be noted that Zenon Mining Company operates other mining concessions in the Central Region of Ghana, of which some of the degraded sites have undergone reclamation. However, the focus of this paper is to highlight the reclamation exercise at the Kwabeng concession.

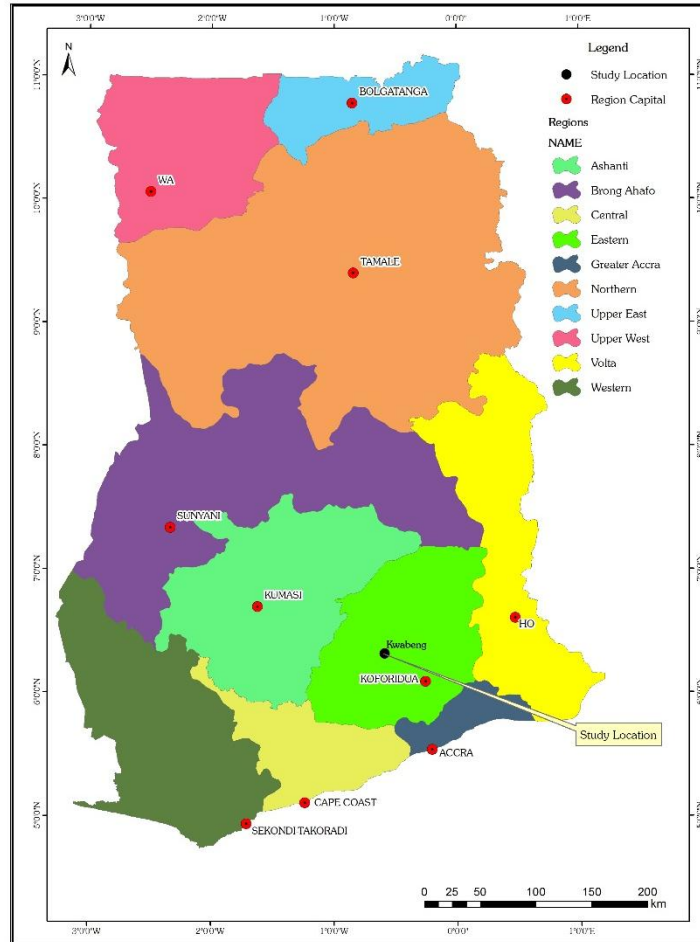


Figure 1: Location of Kwabeng where Zenon Mining Company operates

2.2 Mining Processes

The typical mining process in artisanal and small-scale mining in Ghana involves exploration, development, material handling, processing and marketing as described by Bansah *et al.* (2016). However, mineral exploration in ASM in Ghana is typically informal (Amankwah *et al.*, 2015; Bansah *et al.*, 2016). The situation has been attributed to inadequate funds to hire trained geologists or engineers to conduct exploration. Nevertheless, exploration in ASM in Ghana is conducted by indigenes that have several decades of experience in ASM activities by digging small pits and testing the samples obtained for gold. The result is either unreasonable underestimation or overestimation of grade and quantity of the deposit. Zenon Mining Company employs the services of these “self-acclaimed explorationists” to undertake exploration activities.

The mining operation involves use of excavators to dig auriferous gravels from mine pits. The company typically operates 12 pits at every single time, and depending on the depth of auriferous gravels, a pit is mined within two weeks or less. Thus, deeper pits (10-20 meters) are mined within two weeks while shallow pits (<10 meters) are mined in less than two weeks. The dug gravels are stockpiled by excavators and re-handled by women carries, who carry the load to the washing plants for processing. To save on disposal and material re-handling and reclamation costs, waste materials mined from the pits are stockpiled close to the pits. Processing involves washing gravels in alluvial washing plants and sluice boxes to concentrate gold. The extracted gold is then sold to prospective buyers. Other facilities used for mining and processing activities include shovels, pumps, shaking tables, trommel, and pans.

By law, every mineral deposit in the ground in Ghana is vested in the Republic of Ghana (Minerals and Mining Law, Act 703). Thus, a mining license is required of anyone (age 18 or above) who wants to

engage in mining in Ghana. However, landowners are entitled to “Surface Right”, which by regulations allows landholders to farm on the land, for example (Minerals and Mining Law, Act 703). It is therefore typically required of mining operators to pay compensation to farmers or owners of any project on their concessions. The reclamation plan is discussed with the landowners at this stage.

2.3 Reclamation Procedure

Reclamation is done concurrently with mining at Zenon Mining Company. The excavated pit is back-filled with overburden material stockpiled adjacent to the pit periphery, using dozers and excavators. The materials are leveled with the use of dozer and contoured appropriately to fit surrounding terrain/topography (see Figures 2, 3 and 4). Organic material (topsoil) is then added and revegetation commenced by introducing native plant species.



Figure 2: Excavated Pit being backfilled

Although chemical analysis of the reclaimed site is important, it is noted that the mine does not utilize any chemical in the extraction process in or around the pits. Hence, the overburden material or topsoil used for the reclamation is expected to be chemically stable. The reclaimed site is then returned to the landholders after the vegetation is self-sustaining and meets landowners’ requirements. Most often, the reclaimed sites are used by landowners for farming and building projects.



Figure 3: Backfilling using Excavator and Dozer at the Reclamation Site



Figure 4: Freshly Reclaimed Pit Contoured to fit Surrounding Topography

3 RESULTS AND DISCUSSION

Generally, reclamation in ASM has not received much attention, compared to reclamation in large-scale mining. The reclamation conducted by Zenon Mining Company forms part of an interesting beginning to reclamation in artisanal and small-scale mining in Ghana, and should be given the necessary publicity for awareness and to motivate other ASM operators to embark on reclamation. Figures 5 and 6 respectively show the reclaimed site at six months and two years after revegetation.

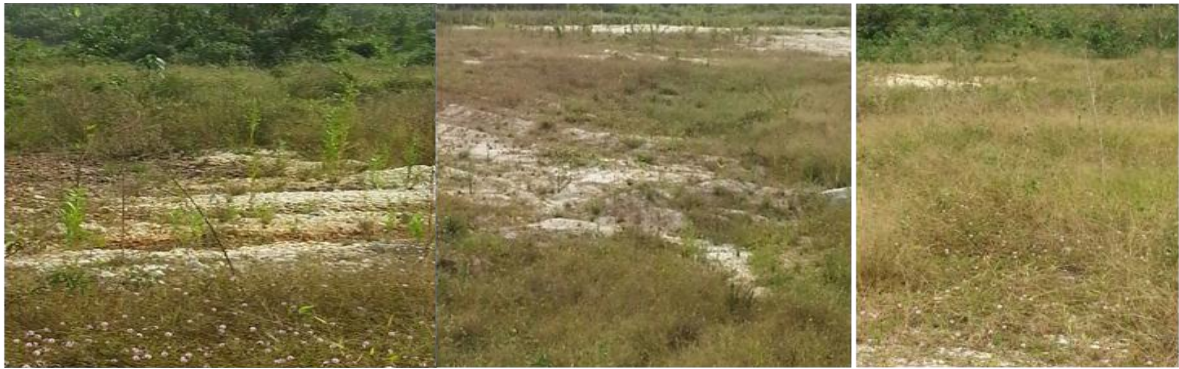


Figure 5: Vegetation Growth at Six Months after Revegetation



Figure 6: Vegetation Growth at Two Years after Revegetation

Unlike the large-scale mining companies that receive much attention from regulators (Minerals Commission and EPA) on environmental issues including reclamation of degraded lands, environmental issues, especially reclamation in small-scale mining has received little attention by regulatory institutions. The small-scale miners do not have documents from the regulators, cataloging reclamation processes. The success of the reclamation effort by Zenon Mining Company has been achieved without technical input by authorities. The CEO of Zenon Mining Company, Amina Tahiru in response to a question on the form of technical assistance her company receives from stakeholders during reclamation indicated that they receive no form of assistance:

“We do not get any technical support or financial support from any of these institutions. You are on your own”.

Amina’s response was corroborated by many small-scale mining operators within the Tarkwa mining district. For example, according to a mining engineer who works with Dakete Company Limited (a small-scale mine at Tarkwa, Ghana), the small-scale mines do not receive any support for reclamation. Financial and technical assistance they receive have been sourced from organizations such as the international civil society organization, Solidaridad.

The lack of technical and financial support for ASM has been cited by other authors around the world. Veiga and Hinton (2002) for example, in their “abandoned artisanal gold mines in the Brazilian Amazon: a legacy of mercury pollution”, indicate that “acquisition of technical support, essential to improve mineral recovery and take appropriate measures for environmental management, requires financing”. They further indicated that artisanal miners are unable to access funds from banks or lending institutions, primarily due to lack of collateral. Additionally, they argue that even though most Brazilian states in the Amazon region have environmental agencies, the agencies are inadequately funded and lack

technical expertise, hampering the implementation of educational initiatives about the impacts of ASM. These issues in the ASM sector in Brazil, reported by Veiga and Hinton (2002) are reminiscent of what pertains in the ASM sector in Ghana. Lack of adequate monitoring and technical assistance for environmental management can be attributed to inadequate staffing and lack of logistics at the Minerals Commission (Bansah *et al.*, 2016; Hilson, 2002).

To overcome the reclamation challenges, Zenon Mining Company practices concurrent reclamation and mining to allow the use of overburden from a newly excavated pit to backfill an earlier pit. This reduces reclamation cost by avoiding re-handling of materials from a distant source. The reclaimed sites are described by the authors as consistent with other reclaimed sites in large-scale gold mining in Ghana. The reclamation established appropriate and self-sustaining vegetation cover that meets the requirements of the landholders, and provides alternative livelihood supports to the community people. While subsistence farming is commonly practiced on the reclaimed sites, portions of the land are used for cultivating cash crops (e.g. cocoa) and building houses to shelter family members of landowners (Figure 7).

To enhance reclamation in ASM in Ghana, the government and stakeholders should provide training and logistics support to the ASM operators. This will ensure improved reclamation processes and sustainability in artisanal and small-scale mining in Ghana. Sousa *et al.* (2010) provide similar argument and recommendation for improved artisanal and small-scale gold mining (ASGM) in Brazil:

“There is no single solution for the environmental, health, technical and socio-economic problems associated with ASGM. However, a realistic approach should consider improving the level of education of miners, creating government programs to provide technical assistance in the field, simplifying administrative procedures and ensuring adequate measures for enforcement”.



Figure 7: Some End-uses of the Reclaimed Land: (a) Farming (b) Building

4 CONCLUSIONS

The primary objective of this study is to highlight the reclamation success achieved by an artisanal and small-scale mining operator in Ghana (Zenon Mining Company). Innovative partnership that involves community participation was used to restore degraded sites that aim at supporting the livelihoods of landholders and also ensure ecosystem stability and sustainability. The success of the reclamation was achieved with no external financial or technical support. Zenon Mining Company has demonstrated that artisanal and small-scale miners can successfully conduct reclamation of disturbed mine-lands to ensure safety and environmental protection. The reclamation by the artisanal and small-scale mining operator forms part of an interesting beginning to environmental performance and sustainability in ASM in Ghana. It must therefore be given the necessary publicity to create awareness in the ASM fraternity so that other ASM operators will be encouraged to practice reclamation. However, the miners require technical (in the

form of training and guidelines) and financial support (in the form of loans) from stakeholders and financial institutions to conduct reclamation consistent with standard reclamation practices, and ensure sustainability in artisanal and small-scale mining in Ghana.

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