



A Characterisation of Artisanal and Small Scale Mining Safety Practices at Gbane Site, Bolgatanga Area, Ghana

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Abstract

The Gbane site has witnessed a proliferation of Artisanal and Small Scale Mining (ASSM) activities for several years. ASSM is very important in Ghana since it contributes to the economic development of the country. It has reduced unemployment amongst the youth in Gbane and its environs. The SSM sector has contributed substantially to the total quantity of gold produced per year in Ghana. However, this has been achieved at the expense of the health and safety of miners as they are prone to accidents. This paper work provides an overview of the safety practices of SSM in Nalamtaaba Mining Enterprise and Artisanal mining operations in the study area, and feasible measures of managing safety and health hazards in the mines. In conducting this study, the SSM site and six unregistered mine sites were visited, interviews were conducted and questionnaires were also administered. It was realised that small scale miners focused more on the pursuit of gold with total disregard to the safety aspects. About 30% of the miners utilised Personal Protective Equipment (PPE) during operations. The results revealed that, the improper use of PPEs, proliferation of mercury application and non-adherence to work safety protocols were widespread irrespective of the legal status of the mine. Formalising or rebranding a mine in terms of name change without improving on the work ethics, training of the human resources and enforcement of the laws will not yield any meaningful results in the formalisation of artisanal and small scale mining in Talensi area.

1. Introduction

Small scale mining operations have existed at Gbane site in the Bolgatanga area for quite a long time. These activities have escalated so fast since the enactment of the Small-Scale Gold Mining Law in 1989. The high demand for gold coupled with the provision of employment to the people in the Bolgatanga area has caused these activities to intensify. [1] categorises mining in Ghana into Large Scale, Small Scale and Artisanal mining. Large scale mining involves large volumes, full mechanisation and high safety level while Small Scale Mining (SSM) involves semi-mechanisation, medium volumes and medium safety level. Artisanal mining on the other hand entails low volumes, manual operations and low safety level. However, the definition of small-scale mining in Ghana has been based on the amount of capital and human resources needed. The Minerals and Mining Act 2006 (703) of Ghana defines SSM operation as the mining of gold by any effective and efficient method that does not involve substantial expenditure by an individual or group of persons. Most people think SSM is *galamsey*, but there is a vast difference. *Galamsey* derived from the phrase “gather them and sell”, is a local Ghanaian term which means illegal small-scale gold mining in Ghana. It means *galamseyers* do not have license or permit from the Minerals Commission to mine gold in Ghana. People who do this, do it at their own risk and hence

referred to as illegal miners. SSM continually contributes substantially to the total amount of gold production in Ghana and many developing nations hence improving the livelihoods of the people involved [2].

According to [3], some unsafe mining practises in the sector poses serious dangers to human health and the environment. It is recognised that underground small scale mining in Ghana is characterised by unsafe acts and precarious working conditions including unstable stopes, improper choice of working tools, and absence of personal protective equipment. Inadequate monitoring of the operations and lack of regulatory enforcement by the Minerals Commission of Ghana are the major contributing factors to the poor environmental and safety standards. These unsupervised artisanal and small scale mining activities pose serious challenges to the security of the mining communities. However, dealing with accidents in the small-scale mining industry requires a thorough understanding of the associated risks and hazards, and the measures to minimise or eliminate their effects. This work seeks to characterise the safety practices of small-scale mining in Nalamtaaba Mining Enterprise and unregistered sites at Gbane in the Upper West Region of Ghana, and propose feasible measures of managing safety and health hazards in the mines.

Occupational health and safety issues are indispensable for the success of small scale mining. However, there are usually no systematic reports or official figures on incidents and diseases related to the operations of this mining subsector. The total disregard for safety and “get-rich-quick” mentality of the small-scale miners expose them to all sorts of workplace hazards and risks. These include; exposure to dust, mercury, noise, ground vibration, poor ventilation, and collapsing stopes among others. Uncontrolled exposure to such hazards may results to respiratory diseases, various wounds, orthopaedic ailments and optical neuritis [4].The purpose of this paper is to assess safety practices at the small-scale mining site Gbane and its environs and determine possible control measures to reduce incidence and health hazards in small scale mines.

Gbane is located in the Talensi district. The Talensi district is one of the newly created districts in the Upper East Region of northern Ghana with Tongu as its capital. Gbane is found in the eastern part of the district, about 40 km from Tongu, the District capital. Mining operations have existed so long in the upper east region as many people did illegal mining with the traditional methods. The proliferation of artisanal and small scale mining in Gbane started in the early 1990s. The Talensi district has a population of approximately 81 194 with 49.7% males and 50.3% females [5]. The population of the district is youthful (41.2%) depicting a broad base population pyramid that tapers off with a small number of elderly persons (7.0%). The total fertility rate for the district is 3.6. The crude death rate for the district is 15.0 per 1000. Accident, violence, homicide, suicide and related issues account for 13.5 percent of all the deaths while other causes constitute 86.5% of deaths in the district. Majority of migrants (68.2%) living in the district were born in the Upper West region while 29.5% were elsewhere in another region. For migrants born in another region, those born in Ashanti Region constitute 40.3% followed by Northern Region with 25.9% and Greater Accra, 11.1%. The district has a total number of 15 748 households. The average household size in the district is 5.2 persons per household. Children constitute the largest proportion of the household members accounting for 45.3%. About five in ten (52.2%) of the population aged 12 years and older are married, 35.6% have never married, 0.4 % are in consensual unions, 10.3% are widowed, 0.8% are divorced and 0.7% are separated. From 11 years and above of the population, 42.0% are literate and 58.0% are non-literate. The population of literate males is higher (89.7%) than that of females (58.4%). Only 14% indicated they could speak and write both English and Ghanaian languages. The private informal sector is the largest employer in the district, employing 96.1% of the population with the public sector, 2.4% [5]

Gbane is located in the Talensi District on latitude 10.68 N and longitude 0.67 W. Gbane is found in the eastern part of the district, about 40 km from Tongo, the District capital [6], 2015). The district covers a total land area of 912 km². It is bordered to the north by the Bolgatanga District, to the south by the West and East Mamprusi Districts, to the west by the Kassena-Nankana District and the east by the Bawku West District [7] Fig. 1 shows the location of Gbane site.

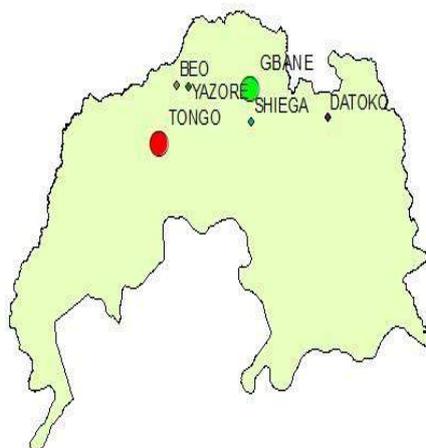


Fig. 1 Location of Gbane Site in Ghana [7]

The district is situated within the Birimian system with basement by at least six discrete volcanic belts with intervening sedimentary basins of very similar Early Proterozoic age. Within the volcanic belts there are many largely coeval, intermediate to mafic plutons. The upper part of the system is dominantly of volcanic and pyroclastic origin. The rocks consist of bedded groups of green lava. In the Birimian system, gold occurs in five parallel more than 300 km long. They are separated by basins containing pyroclastic and metasedimentary units. The gold occurrence is 2 to 30 ppm in quartz veins of laterally extensive major ore bodies. The veins consist of quartz with carbonate minerals, green sericite, carbonaceous partings and metallic sulphides and arsenides of Fe, As, Zn, Au, Sb, and Pb [8]. The Birimian system is intruded by large masses of the Bongo granitoids. It is well foliated and the potash rich rocks consist of muscovite and biotite granite and granodiorite ore porphyroclastic biotitic gneiss, aplite and pegmatite. It consists of hornblende granite or granodiorite grading locally into quartz diorite and hornblende diorite. The complex forms non-foliated discordant or semidiscordant bodies in the enclosing country rock, generally Upper Birimian meta-volcanics [9]

2. Methodology

2.1 Model Formulation

The methodology applied in this research is explained as follows:

Does the mining classification into Galamsey and Small Scale Mining have effect on the use of mercury? How has classification contributed to improvement in the use of PPEs between Galamsey and Small Scale Mining in the mining district?

Hypothesis: The F- distribution test, variance (ANOVA) statistical test was used to verify the validity of the formulated hypotheses:

H₀ (null hypothesis): There are no differences in considering the site miners work and the application work safety protocols in the Talensi district on these two issues related to Galamsey and Small Scale Mining.

H₁(alternative hypothesis): There are differences considering site miners work and the application work safety protocols in the Talensi district on these two issues related to Galamsey and Small Scale Mining

Structured and open ended questionnaires were randomly administered to hundred mine workers of the area and focal interviews were conducted with the management at Nalamtaaba Mining Enterprise during the visits. This was done to obtain the knowledge that small-scale miners have on safety practices. Respondents were welcoming and readily gave feedback to questions asked. When the questionnaires were administered, twenty workers from the site answered through face to face and the rest of them gave the feedback through the leaflets. The questions asked and response given covered the following areas.

- i. Age;
- ii. Academic qualification;
- iii. Equipment used and possible risk;
- iv. The use of mercury;
- v. Records of injuries and deaths; and

For a clearer understanding of the ASM at Gbane area and Nalamtaaba Mining Enterprise, visits were undertaken and discussions held with the concession owner or stakeholder and other miners at the site from 10th to 14th March, 2020. Questionnaires were given to the mine owner and other miners on site. Data were also acquired in the form of interviews. Data collected covered the following: age, academic qualification, equipment used, risk involved in using the equipment and personal protective equipment used.

3. Results and Discussion

The research carried out took into consideration the age of the small-scale miners. This was done to find out if everyone working under this mine are grown enough to make decisions for themselves. From the results, twenty one people representing 20% of the small scale miners questioned were below 18 years, about 53 people representing almost 50% were between 21 to 50 years and the remaining thirty one people representing approximately 30% were above 50 years. Fig. 2 is a graph which shows the age group of workers in percentage.

The work carried out looked at the academic qualification and the vocational background of the workers. This is significant as it has direct impact on their thinking ability and ways of handling things. According to the results ascertained, 25% of the fifty miners had qualification up to the Basic Education Certificate Examination (BECE) level, 15% had up to the West African Senior School Certificate Examination (WASSCE) level, 35% had no formal educational certificate, 20% had some vocational education and 5% had tertiary qualification. The results are shown in Fig. 3.

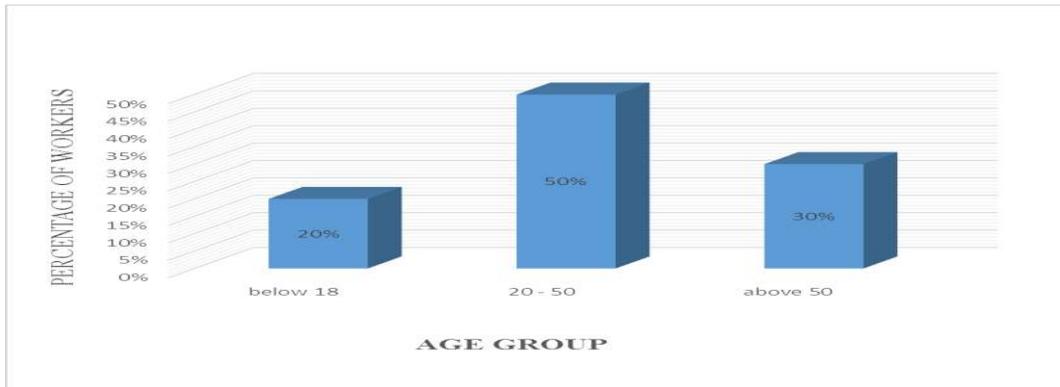


Fig. 2 Age Group of Workers in Percentage

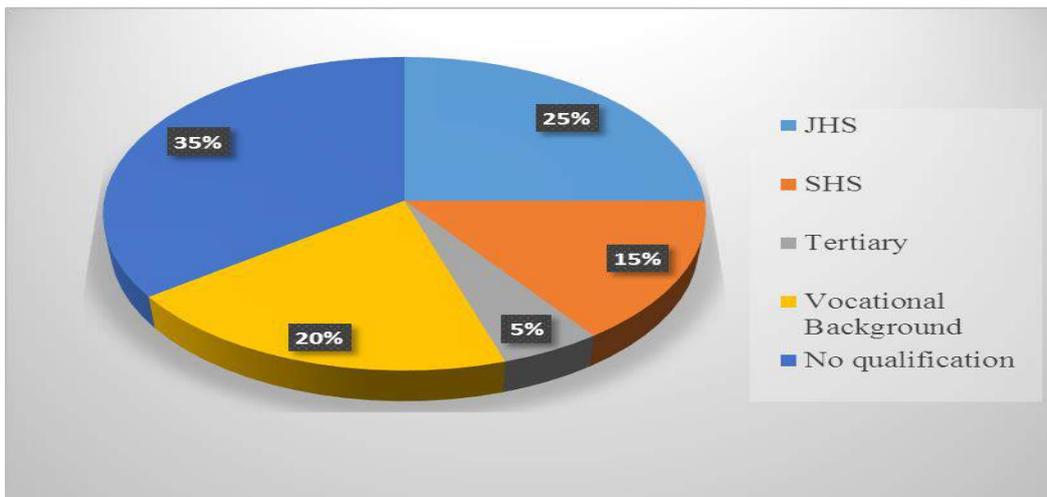


Fig. 3 the Academic Qualification and Vocational Background of Workers

The equipment or tools used by the small-scale miners in the pits were chisels, hammers, shovels, water pulleys, air compressors and jack hammers. The jack hammer was placed on the rock and drilled holes in the rock where explosives were loaded for blasting to take place. The chisel and hammer could be used to break rock formation of soft to medium formation. The compressor provides air to the workers underground and serves as flushing medium for the jack hammer. Shovels are used for fetching the ore material into sacks for transportation. Water pulley as the name suggests, pumps water from underground to surface. Equipment used at the processing section were impact crusher (*chang fang*), grinding mill, and sluice board. The crusher breaks the ore material into smaller sizes which is then transported the grinding mill for fine grinding. Fig. 4 shows some equipment used by the miners.

The gold is extracted from the ore using mercury. The mercury binds the gold particles to form an amalgam. The amalgam which is the combination of gold and mercury is then heated for the mercury to evaporate leaving the gold behind. While very conscious of mercury's harmful effects, most miners said they had no alternative.



(a) Impact Crusher



(b) Smoothing Machine

Fig. 4 Size Reduction Processes

The International Labour organisation (ILO) described Occupational Health and Safety as the sufficient protection or assurance of an employee from harm, injury and infection from work related activities. It is the health and safety status of the workforce in an organization that depicts how effective and productive its employees are. It aims at the following [10]:

- i. Improving and sustaining of the most elevated level of physical, mental and social well-being of workers in all occupations;
- ii. Causing reduction in occupational accidents evolving from or over the range of work which results in either deadly non-fatal injury;
- iii. Resistance among employees with negative effects on the working environment; and
- iv. Protection of workers in their livelihood due to poor environmental conditions.

Small scale mining injuries are categorised into minor and major. Minor injuries are the injuries that do not require any medical attention, examples are; little cuts and bruises from rocks while the major injuries refer to those that need medical attention. Examples of major injuries include collapse of a pit on a miner, a miner inhaling noxious gases underground or suffocating to death [11]. The field interviews revealed that the site could record at least two deaths a year but for the past two years now they had not recorded any fatality. The significance of the changes in the use of PPEs, mercury application and multiple injuries at both the formal and informal (galamsey) small scale mines at the Talensi District, was determined through field data collection and analysis. The data (Table 1) was obtained using questionnaire administration approach and analysed using the Analysis of Variance, ANOVA, test. The analysis was done using the data analysis tool in Microsoft Excel Office suite using a p-value of 0.05 (5%).

TABLE 1: Data on the Use of PPEs, Mercury Application, and Multiple Injuries at Work

Mine Sites	Ntalaamba Ent. N=20	Beo N=15	Tongo N=20	Yazore N=15	Gbane 10	Shiega 10	Dakoto 15	Total 105
PPE Use	10 (50%)	4(27%)	5(25%)	4(27%)	3(30%)	2(20%)	4(26%)	32(30%)
Mercury Application	20(100%)	15(100%)	20(100%)	15(100%)	10(100%)	10(100%)	15(100%)	105(100%)
Multiple Injuries at work	15(75%)	14(93%)	17(85)	13(86%)	8(80%)	7(70%)	13(86%)	87(74%)

The use of ANOVA in data analysis requires a null hypothesis and an alternative hypothesis. The null hypothesis takes the positive (true) statement and that is: the means of the various parameters are the same meaning there are no significant differences in the use of PPEs, mercury application and multiple injuries at both the formal and informal small scale mines at the Talensi district. The alternative hypothesis also takes the negative (false) statement and that is: the means of the various parameters are not the same meaning there are significant differences in the use of PPEs, mercury application and multiple injuries at both the formal and informal small scale mines at the Talensi district. The decision to accept or reject the null hypothesis depends on the p-value and the F-value. A p-value more than 0.05 and F-value equal to or almost 1 implies that, the null hypothesis should be accepted. If the p-value is less than 0.05 and the F-value is very large, then the null hypothesis should be rejected.

The results obtained after analysing the data on Table 1 is as represented on Table 2. From Table 2, it can be observed that the p-value (0.47) is more than 0.05, the F-value (0.97) is almost equal to 1 and the F-critical is greater than the calculated F-value. These imply that, the null hypothesis should be accepted. Accepting the null hypothesis means that, the means of the various parameters are the same, meaning there are no significant differences in the use of PPEs, mercury application and multiple injuries at both the formal and informal small scale mines at the Talensi district.

The results of the analysis imply that, the use of PPEs, mercury application and adherence to work safety protocols, is more of human behaviour in the sense that, formalising or rebranding a mine in terms of name change without improving on the work ethics of the human resources will not yield a meaningful result in combatting the use of mercury at mine sites, improving the use of PPEs and reducing multiple injuries at sites.

TABLE 2: Analysis and Results

Groups	Count	Sum	Average	Variance		
Column 1	3	45	15	25		
Column 2	3	33	11	37		
Column 3	3	42	14	63		
Column 4	3	32	10.67	34.33		
Column 5	3	21	7	13		
Column 6	3	19	6.33	16.33		
Column 7	3	32	10.67	34.33		
ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	186.67	6	31.11	0.98	0.48	2.85
Within Groups	446	14	31.86			
Total	632.67	20				

While very aware of the significance of PPE, most of the miners fail to wear. They have a common thought that wearing protective equipment like helmet, safety boot, nose mask, goggles and gloves makes them uncomfortable and hence retards production. Some of the personal protective equipment used by a few of them are:

- i. Rubber sandals called “Cayass” in the local language. It is light in weight and resistant to slippery;
- ii. Some of the miners wear hats to prevent their heads from getting dirty; and
- iii. Some long sleeves and jackets.

Fig. 5 shows small scale miners wearing the personal protective equipment.



Fig. 5 Small Scale Miners in their Personal Protective Clothing

The graph in Fig.6 shows the percentage of workers who work with and without PPE during operations. Out of the fifty (50) miners questioned, fifteen (15) of them used some PPE while the remaining thirty-five (35) did not. From the graph, 30% of the fifty (50) workers used PPE during operations while 70% of them didn't use PPE during operations.

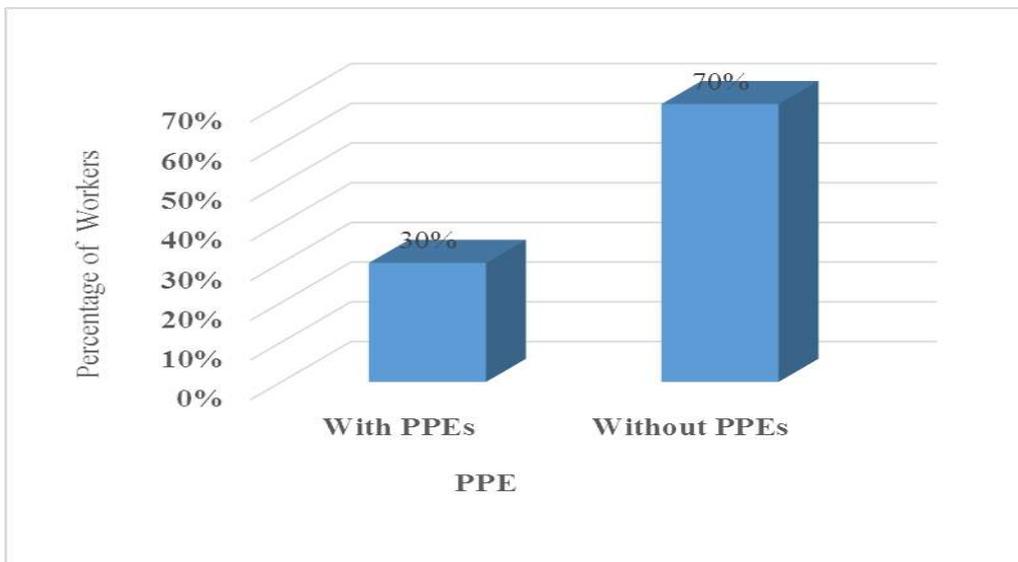


Fig. 6 Percentage of Workers with and without PPE

A hazard refers to any unsafe act or condition which may cause harm to people and damage to property. From the research, several unsafe acts and conditions which caused harm to the small scale miners are; poor pit wall monitoring, poor supporting systems, poor ventilation, and non-usage of PPE. Due to the chemical reactions and blast vibrations that occur within the formation, frequent monitoring is required to detect any movement in the pit wall. Small scale miners do not pay much attention to monitoring of pit walls for displacements. The few times that they monitor the pit walls, they use inappropriate instruments. This does not help them to detect cracks and movement until the wall collapses.

Small scale miners do not use the appropriate supporting materials to support their walls. These miners do not consider their safety when mining pillars that contain high grade ore. They mine all pillars within the stope which may cause the walls to easily collapse.

Several small scale miners get severe illness from suffocation due to poor ventilation. From interviews, small scale miners do not install fans in their tunnels for ventilation. In case of any gas leakage, there is no fresh air to dilute it.

From the research, many small scale miners do not use PPE during mining operations. Small scale miners use their bare hands to handle mercury which is very detrimental to their lives. Rock falls cause a lot of head injuries since most miners do not wear safety helmets. The small-scale miners placed more emphasis on the economic aspect rather than the safety aspect. Most of the workers did not use PPE. Most of the miners had bruises and cuts on their bodies as a result of not wearing Personal Protective Equipment.

From the author's findings, the ratio of the present occupational hazard effect to safety seems small at Gbane over the two years period from the interview report. The concession owners should be urged to provide PPE for their workers and make sure anyone who is not properly dressed in the recommended PPE does not access the mine. The District Officers of the Minerals Commission should regularly pay visits to the small scale mining sites to enforce 95 to 100% health and safety standards.

4. Conclusion

Incidents occur at the mines due to widespread non conformity to good mining, practices such as unconventional support systems, ineffective monitoring of pit walls and lack of proper mine ventilation systems. A proportion of small scale miners (30%) make use of PPE during operations. However, a significant number of small scale miners (80%) are sceptical about the use of recommended PPE.

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