Research Article
Mining and Public Health Implications: Evidence from the Newmont Ghana Gold Limited Enclaves

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Abstract: Since antiquity, mining has served as an integral component of nations' sources of revenue for many developing nations blessed with mineral resources. However, anecdotal evidence shows that the magnitude of the health impacts of mining in the Newmont Ghana Gold enclaves is beyond imagination. Yet, ardent research to measure the actual health implications is limited. This necessitated the need to examine the health implications of mining in Newmont Ghana Gold Limited enclaves in the Asutifi District, Ghana. A cross-sectional survey involving simple random and purposive sampled participants (N = 120) was conducted. Questionnaire and in-depth interview were used as research instruments. Data were analysed with a Pearson's Chi-square from the PASW for Windows application (V. 17.0). The study discovered that mining has a negative ramification on public health. The major health problems associated with mining in the Asutifi District include malaria, skin diseases, visual impairments and respiratory disorders which have a direct linkage to the morbidity pattern in the study communities. The prevalence of malaria is attributed to the neglect of uncovered mine pits which have accumulated water and serving as breeding grounds for mosquitoes. Furthermore, it has been established that diseases such as respiratory diseases and sight problems (poor vision) have been caused by suspended particulate matter emanating from the blasting of mineral bearing rocks. The health statistics on the top ten Out-Patient Diseases cases over a four year period (from 2006 to 2009) depict findings of our study. It has been recommended that Newmont Ghana Gold Limited collaborates with the various clinics to fight against certain diseases such as malaria and skin diseases and others found to be caused by the mining activities.

Keywords: Disease, enclaves, mining, Newmont Ghana gold limited, public health

INTRODUCTION

Across the globe, demand for mineral products and production costs have increased. In this vein, there is high expectation for more exploration on the global scale. It is highly expected that mineral reserve will also fall in the West. In less developed countries where there are mineral reserves, there have been reforms to stimulate foreign investment (Amponsah-Tawiah and Dartey-Baah, 2011). However, Ackley (2008) establishes in a study of evaluating environmental risks in mining at Vatukoula Gold mine in Fiji that there is often lack of legislation governing the environmental performance of mining activities in developing countries. In the light of this, he recommends a full appreciation of both the negative and positive impacts associated with mining activities.

There are numerous kinds of dangers and negative ramifications associated with mining industry despite

large quantum of investment being attracted by developing countries to their mining sector. Governments in the developing world can no longer afford to step up environmental, health and safety standards in order to reap the full benefits of the industry (Amponsah-Tawiah and Dartey-Baah, 2011). The importance of health can be conceptualized as longevity, energy and life. Thus, every nation seeks to achieve a healthy society (Adei et al., 2011). In fact, good health is a prerequisite for sustainable socioeconomic development of every nation and community seeking to maintain a balance of growth. However, Stephens and Ahern (2001) maintain that mining activities are potentially dangerous for human health and at worst cause fatalities if not properly managed. Diverse health issues are associated with the mining environment. Injury remains a major problem and can range from minor to lethal. The causes of these injuries originate from seven main sources which are

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rock fall, fires, explosions, mobile equipment, accidents, entrapments and flooding of underground mines (Donoghue, 2004).

Kitula (2006) posits that in Tanzania, mining related fatalities such as death and diseases occurred as a result of collapsing of tunnels and the presence of poisonous gases underground. To Ocansey (2013), mining activities pollute water bodies as a result of metals used by mining companies which then enter into streams and rivers. This further infiltrates into ground water. The discharge of poisonous substances such as mercury into water bodies poses serious threat to human health because water bodies become polluted and are not safe for human consumption (Hilson, 2002). Consuming this polluted water thus threatens human health. A study conducted in the Philippines by Akagi *et al*. (2000) found that major chemicals that contribute to water pollution in mining communities is mercury. Lakshmi (2009) observed that Arsenic poisoning causes skin lesions, peripheral vascular disease, risk of cancers, "Blackfoot disease"; Cyanide causes suffocation, nausea and dizziness; Mercury causes Neurotoxin, especially to fetus, infants and children. In a similar study, Bench Marks Foundation (2007) found in South Africa that many workers suffer from silicosis, a respiratory disease that is caused by inhaling silica and results in inflammation and scarring of the lung tissue or tuberculosis. In the same study, it was made known that about eight in ten of patients around Rustenburg suffer from respiratory infections and the extent of air pollution caused by the mines still has to be sufficiently examined. This is because there is lack of independent air quality monitoring capacities in the region. In Ghana, Yeboah (2011), writing on environmental and health impact of mining on surrounding communities in Obuasi, noted that air pollution emanating from the emission of dust and other chemicals into the air from mining has resulted in respiratory infections.

Ocansey (2013) and Kitula (2006) independently observe that uncovered mining pits provide an enabling environment or serve as breeding grounds for mosquitoes, thus, increasing the incidence of malaria. Donoghue (2004) has explicated that noise-induced hearing loss is a common phenomenon resulting from blasting, cutting, handling of materials, crushing, conveying and processing. Crystalline silica can bring about the problem of silicosis of HIV infections while at the same time increasing the risk (*ibid*). Amponsah-Tawiah and Dartey-Baah (2011) indicate that health and social impacts of mining activities include hearing losses and silicosis, which conditions are created by the blasting and drilling activities with their resultant noise and dust, which have become nuisance in the mining regions.

The relationship between mining and diseases aetiology has been established in a large body of literature. These diseases according to Akabzaa *et al*. (2007), include diarrhoea, skin diseases, acute eye infections and schistosomiasis. The main causes of these diseases are pollutants and accidents at the mines (Akabzaa and Darimani, 2001). Yeboah (2011) reported that the top three diseases as a result of mining in Obuasi include malaria (41.7%), respiratory diseases (27%) as well as skin diseases (17.7%). In a similar study at Ntotroso in the Asutifi District, Ghana, it was concluded that malaria which was the prevalent disease was directly associated with mining (Adei *et al*., 2011).

Newmont Ghana Gold Limited undertakes surface and underground mining. The use of heavy machines and chemicals underground cause contamination of streams and rivers which provide fresh water for surrounding communities, leading to mining related infections. Dynamite used to blast large rocks to aid excavation of the area emanates vibrations and noise which potentially interfere with human health. The release of particulate matter into the atmosphere pollutes the air and this has high tendency of leading to respiratory diseases (Yeboah, 2011). Anecdotal evidence shows that the magnitude of the health impacts of mining in the Newmont Ghana Gold enclaves is beyond imagination. Nevertheless, ardent research to measure the actual health implications is limited. Whilst Opoku-Ware (2010) focused on social and environmental impacts of mining activities on indigenous communities, Adei *et al*. (2011) concentrated on linkages between mining activities and health status of people in Ntotroso. To expand our understanding as regards health effects of mining on a wider scale is relevant. The study specifically aims at examining the health implications of mining in Newmont Ghana Gold Limited enclave in the Asutifi District, Ghana.

DATA AND METHODS

Overview of Asutifi district: Asutifi District is located between latitudes 6°40' and 7°15' North and Longitudes 2°15' and 2°45' West. It shares boundaries with Sunyani District in the North, Tano South District to the North East, Dormaa District to North West, Asunafo North and South Districts in the South West and Ahafo Ano South and North Districts (Ashanti Region) in the South East. Asutifi District has a total land surface area of 1500 km^2. The predominant occupation in Asutifi District is subsistence agriculture. Agriculture employs 66.7% of the economically active labour force. The rapid increase of mining activities in the district has led to the influx of migrants and the demand for mining related services (Asutifi District Assembly, 2010). Due to the mining activities, the mining communities have experienced a growth in business activities in mining related industries (Asutifi District Assembly, 2012) (Fig. 1).
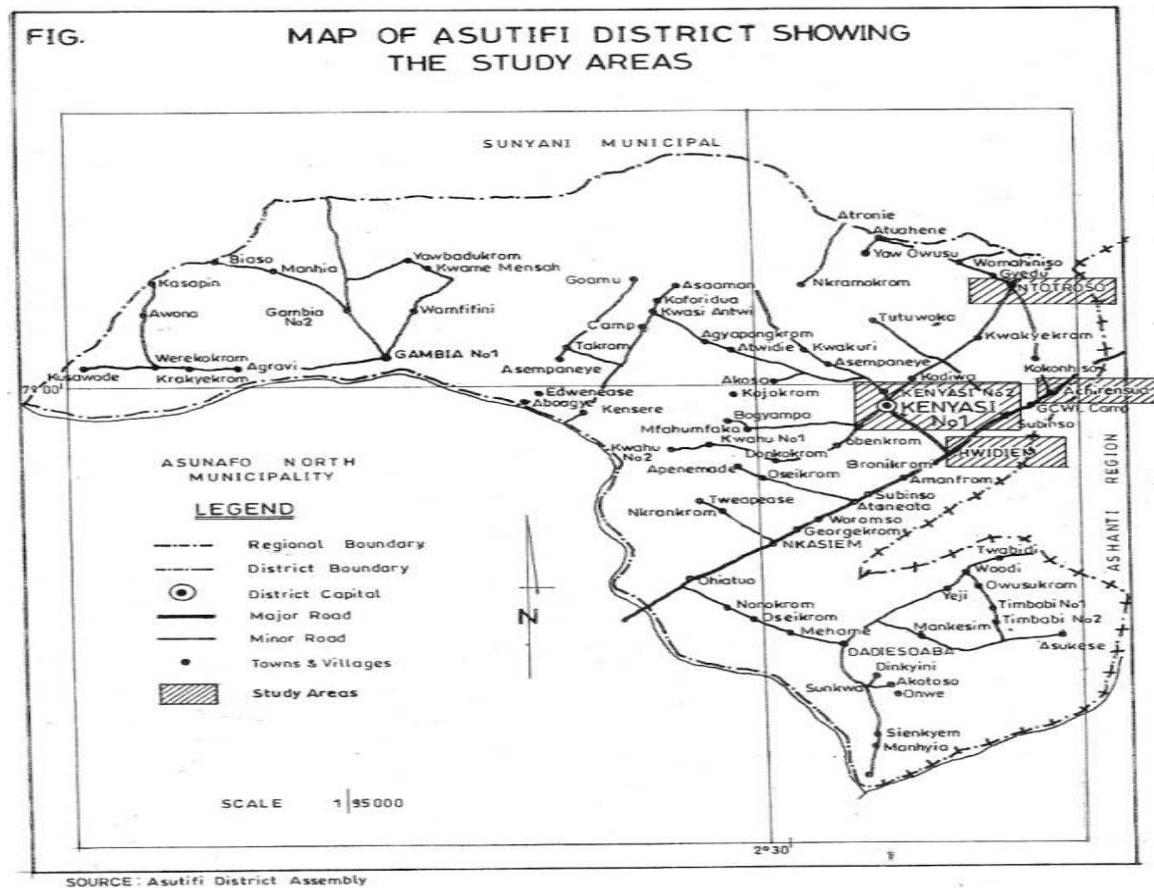
Fig. 1: Map of Asutifi District Showing the Study Areas; Mapping Unit, Department of Geography and Rural Development, Kwame Nkrumah University of Science and Technology, Kumasi

Profile of Newmont Ghana Gold Limited (NGGL): NGGL was founded in 1921 and publicly traded on the New York Stock Exchange since 1925. Newmont is one of the world's largest gold mining companies. In 2012, Newmont sold 5.0 million equity ounces of gold, while employing a global work force of approximately 16,600 employees. In addition, approximately 22,000 people were working as contractors as of 2012. The 100-%-owned Ahafo operation is located in the Brong Ahafo Region of Ghana, approximately 290 km (180 miles) North West of Accra. Newmont operates four open pits at Ahafo with reserves contained in 11 pits. Commercial production in the fourth pit, Amo, began in October 2010 (Newmont Sustainability Report, 2012). The process plant consists of a conventional mill and carbon-in-leach circuit. Ahafo produced 561,000 ounces of gold in 2012. Also, Newmont has 11.6 million ounces of gold reserves as of December 31, 2012 (Newmont Sustainability Report, 2012) (Fig. 2).

Setting, research design and variables: The study was conducted in Asutifi District in the BrongAhafo Region of Ghana. Asutifi District was selected for the study based on the pervasiveness of mining activities in the district. This study employed a cross-sectional survey involving mixed approach of both qualitative and quantitative research design. The independent variables include sex, age, religious affiliation, income, employment status, years of stayed in the community, ethnicity and marital status. Other variables include the diseases that respondents frequently contract, relationship of diseases to mining activities and causes of health effects of mining. The health of the respondents was measured based on the responses given by the respondents in each of the selected communities. These were therefore operationalized and coded so that accuracy in measurements would be ensured. Also, information on the diseases that affect the respondents in the study areas was collected from the health workers in the study areas to know whether or not some of them are related to the mining activities.

Sampling and study participants: The study participants included residents in the selected communities who had attained 18 years as of the period of the survey. This criterion was used because it is believed that at the age of 18, an individual can demonstrate in-depth knowledge regarding how mining is impacting on his/her health. The strategy for recruiting participants involved both simple random and
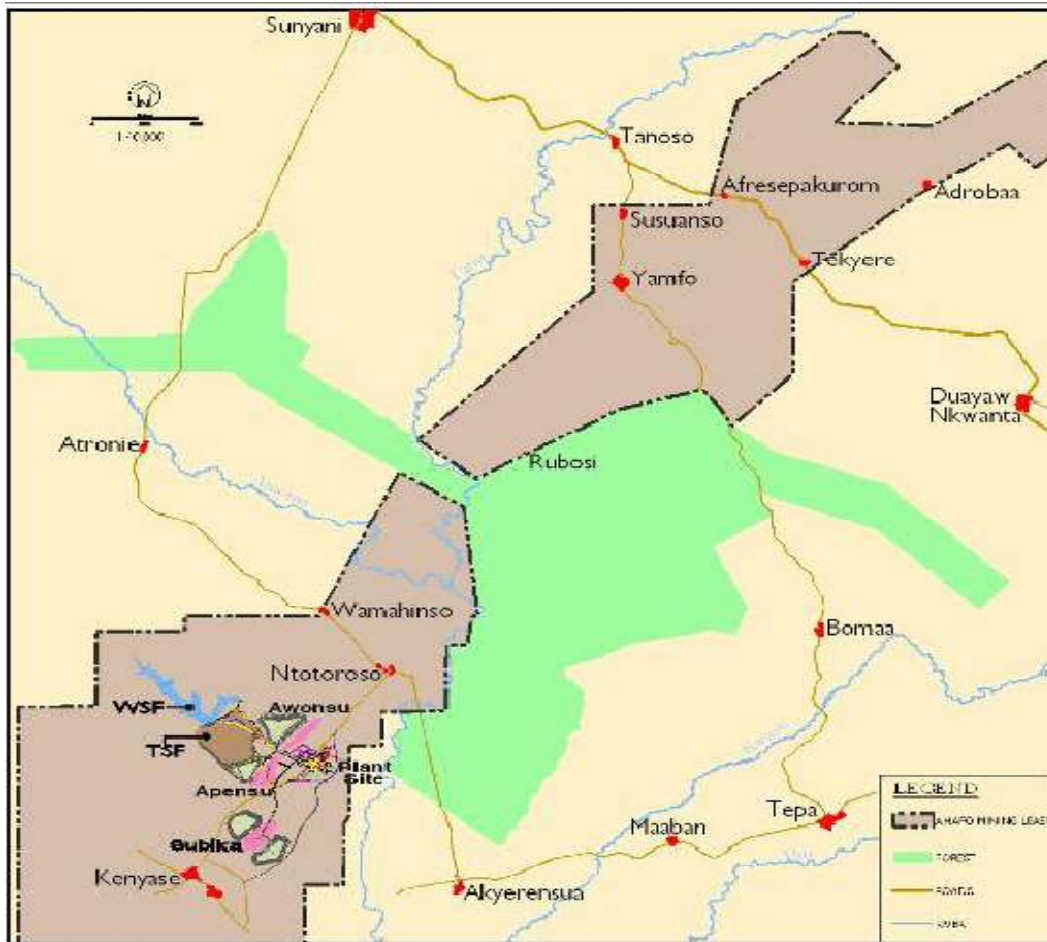
Fig. 2: Ahafo mines, showing north and south area; Newmont Ghana RAP, 2009 cited in Asante-Manteaw (2011)

purposive sampling techniques. In all, four communities viz. Acherensua, Kenyasi, Ntotroso and Hwidiem were purposively selected based on their proximity to the mining sites and for that matter, mining activities were pervasive in these communities. Altogether, a sample size of 120 was deemed adequate for this study. Simple random sampling technique was used to select the study participants from households in the selected study communities. This was done by making a blind folded person to randomly select the respondents. In situation where the selected respondent refused to participate in the study, the whole process was repeated to select another respondent. Officials from the Newmont Ghana Gold Limited, health care professionals and the Asutifi District Assembly officials were selected purposively for the study.

Research instrument and data collection procedure:
Primary data were collected through formal face-to-face interviewer-administered questionnaires. This was done so as to increase response rate and full completion of the questionnaire sets. Research assistants were recruited and trained to help in the data collection processes. Also, in-depth interview guides were developed and used to collect data from the officials of Newmont Ghana Gold Limited, Asutifi District Assembly and workers of health centers within the localities. This made it possible to compare the views of the residents to that of the officials of the institutions. The standpoints of the interviewees were recorded digitally to aid full records of the discussion. Moreover, personal observation was undertaken by the researchers to complement those gathered through questionnaires and interviews. Ethical issues were addressed before the data collection commenced. Community leaders and the individual respondents alike were briefed about the main aim of the study and were assured of full confidentiality of the information they proffered.

Data analysis: The quantitative data were entered into electronic database and analyzed statistically through the Predictive Analytics Software (PASW) for Window application programme (Version17.0) and Microsoft Excel 2010. Descriptive statistics were conducted to describe the study sample. Non-parametric Chi-square test was performed to measure extent of relationships in the study variables. The major normative issues and the concerns of the respondents were edited and presented

through direct quotation techniques in the qualitative data analysis.

RESULTS

Characteristics of the Study Participants: Table 1 presents the background characteristics by sex of the study participants. The majority (51.7%) of the respondents were males, aged 18- 29 years (47.6%), with basic education status (33.6%) worked as masons, carpenters, cooks and drivers (30.8%). Majority of the

respondents were Akan (69.2%), professed Christian beliefs (79%), earned monthly income of less than GH¢100 and were married (49.2%). Most of the respondents have lived in the community for more than 10 years (59%). A bivariate analysis was conducted to compare various sample characteristics of respondents with gender. We found a statistically significant differences between males and females as regards educational status (χ^2 [3, $N = 116$] = 11.171, $p < 0.05$) and kind of occupation study participants engaged in (χ^2 [4, $N = 120$] = 11.711, $p < 0.05$) (see Table 1).

Table 1: Background characteristics by sex of study participants

| | | Sex | | | |
| | | Male | Female | Total | |
Variable	Category	N (%)	N (%)	N (%)	*p*-value
Residence	Kenyasi	14 (22.6)	16 (27.6)	30 (25.0)	0.070
	Acherensua	21 (33.9)	9 (15.5)	30 (25.0)	
	Ntotrosu	16 (25.8)	14 (24.1)	30 (25.0)	
	Hwidiem	11 (17.7)	19 (32.8)	30 (25.0)	
	Total	62 (100.0)	58 (100.0)	120 (100.0)	
Age	18-29yrs	35 (56.5)	21 (36.2)	56 (46.7)	0.100
	30-39yrs	11 (17.7)	16 (27.6)	27 (22.5)	
	40-49yrs	8 (12.9)	11 (19.0)	19 (15.8)	
	50-59yrs	7 (11.3)	5 (8.6)	12 (10.0)	
	Above 60yrs	1 (1.6)	5 (8.6)	6 (5.0)	
	Total	62 (100.0)	58 (100.0)	120 (100.0)	
Occupation	Farming	15 (24.2)	18 (31.0)	33 (27.5)	0.020
	Trading	7 (11.3)	19 (32.8)	26 (21.7)	
	Teaching	11 (17.7)	5 (8.6)	16 (13.3)	
	Mining	5 (8.1)	3 (5.2)	8 (6.7)	
	Other specify	24 (38.7)	13 (22.4)	37 (30.8)	
	Total	62 (100.0)	58 (100.0)	120 (100.0)	
Highest level of education	Basic	13 (21.0)	26 (48.1)	39 (33.6)	0.011
	Secondary	17 (27.4)	14 (25.9)	31 (26.7)	
	Tertiary	18 (29.0)	8 (14.8)	26 (22.4)	
	None	14 (22.6)	6 (11.1)	20 (17.2)	
	Total	62 (100.0)	54 (100.0)	116 (100.0)	
Ethnicity	Akan	43 (69.4)	40 (69.0)	83 (69.2)	0.065
	Ewe	6 (9.7)	7 (12.1)	13 (10.8)	
	Ga	0 (.0)	5 (8.6)	5 (4.2)	
	Ga-Adamgbe	3 (4.8)	3 (5.2)	6 (5.0)	
	Other	10 (16.1)	3 (5.2)	13 (10.8)	
	Total	62 (100.0)	58 (100.0)	120 (100.0)	
Religion	Christianity	51 (82.3)	43 (75.4)	94 (79.0)	0.195
	Islam	8 (12.9)	8 (14.0)	16 (13.4)	
	Traditional	1 (1.6)	6 (10.5)	7 (5.9)	
	Other	2 (3.2)	0 (.0)	1 (1.6)	
	Total	62 (100.0)	57 (100.0)	119 (100.0)	
	> GH¢100	28 (46.7)	26 (45.6)	54 (46.2)	0.269
Income	GH¢100-400	20 (33.3)	24 (42.1)	44 (37.6)	
	GH¢401-1000	6 (10.0)	6 (10.5)	12 (10.3)	
	Above GH¢1000	6 (10.0)	1 (1.8)	7 (6.0)	
	Total	60 (100.0)	57 (100.0)	117 (100.0)	
	Married	25 (40.3)	34 (58.6)	59 (49.2)	0.062
Marital status	Not married	27 (43.5)	14 (24.1)	41 (34.2)	
	Divorced	2 (3.2)	5 (8.6)	7 (5.8)	
	Other	8 (12.9)	5 (8.6)	13 (10.8)	
	Total	62 (100.0)	58 (100.0)	120 (100.0)	
	>2 years	9 (14.8)	8 (14.3)	17 (14.5)	0.354
For how long have you lived in this community?	2-4 years	6 (9.8)	7 (12.5)	13 (11.1)	
	5-7 years	6 (9.8)	12 (21.4)	18 (15.4)	
	Above 7 years	40 (65.5)	29 (51.8)	69 (59)	
	Total	61 (100.0)	56 (100.0)	117 (100.0)	

*The Chi-square statistic is significant at the 0.05 level

Table 2: Common disease that afflicted community members by place of residence

		Place of Residence					
		Kenyasi N (%)	Acherensua N (%)	Ntotroso N (%)	Hwidiem N (%)	Total N (%)	p-value
Which of the following diseases do you usually suffer from or contract	Malaria	4 (13.8)	9 (30.0)	11 (37.9)	12 (41.4)	36 (30.8)	0.064
	Diarrhoea	3 (10.3)	6 (20.0)	3 (10.3)	4 (13.8)	16 (13.7)	
	Skin diseases	12 (41.4)	9 (30.0)	7 (24.1)	6 (20.7)	34 (29.1)	
	Sight problem	2 (6.9)	0 (.0)	3 (10.3)	1 (3.4)	6 (5.1)	
	Respiratory diseases	8 (27.6)	6 (20.0)	2 (6.9)	6 (20.7)	22 (18.8)	
	Body pains	0 (.0)	0 (.0)	3 (10.3)	0 (.0)	3 (2.6)	
Did you have these symptoms 5 years ago?	Yes	10 (34.5)	14 (46.7)	8 (26.7)	7 (23.3)	39 (32.8)	0.365
	No	19 (65.5)	16 (53.3)	22 (73.3)	23 (76.7)	80 (67.2)	
	Malaria	13 (44.8)	11 (36.7)	12 (41.4)	14 (50.0)	50 (43.1)	0.618
	Diarrhoea	3 (10.3)	7 (23.3)	5 (17.2)	4 (14.3)	19 (16.4)	
	Skin diseases	9 (31.0)	5 (16.7)	4 (13.8)	5 (17.9)	23 (19.8)	
What diseases do people in your family frequently contract	Sight problem	1 (3.4)	0 (.0)	2 (6.9)	1 (3.6)	4 (3.4)	
	Respiratory Infections	3 (10.3)	7 (23.3)	4 (13.8)	3 (10.7)	17 (14.7)	
Did they have these symptoms 5 years ago?	Bodily Pains	0 (.0)	0 (.0)	2 (6.9)	1 (3.6)	3 (2.6)	
	Yes	11 (37.9)	16 (53.3)	8 (27.6)	6 (21.4)	41 (35.3)	0.279
	No	18 (62.1)	14 (46.7)	21 (72.3)	22 (78.6)	75 (64.7)	
	Yes	20 (69.0)	22 (73.3)	21 (70.0)	19 (65.5)	82 (69.5)	0.933
Are these diseases related to the mining	No	9 (31.0)	8 (26.7)	9 (30.0)	10 (34.5)	36 (30.5)	

*The Chi-square statistic is significant at the 0.05 level

Table 3: Top ten out-patient diseases in Asutifi district assembly

	2006		2007		2008		2009	
No	Disease	Cases	Disease	Cases	Diseases	Cases	Diseases	Cases
1	Malaria	34,199	Malaria	50,970	Malaria	65,644	Malaria	75,358
2	URTI	6,035	URTI	10,564	URTI	13,630	URTI	25,858
3	Skin disease	3,838	Skin disease	5,961	Skin disease	8,402	Skin disease	9,438
4	Rheumatism	3,166	Diarrhoea	3,245	ARI	6,053	Diarrhoea	7,408
5	Hypertension	2,421	ARI	3,117	Rheumatism	4,874	Rheumatism	5,614
6	ARI	2,296	Rheumatism	2,964	Diarrhoea	4,872	Gynecological Disease	5,374
7	Diarrhoea	1,872	Intestinal worms	2,073	Intestinal worm	4,851	Intestinal worm	4,712
8	Intestinal worms	1,319	Eye infection	1,932	Enteric fever	5,563	Hypertension	4,437
9	Home accidents	706	Hypertension	1,525	Gynecological Diseases	2,793	Malaria in Pregnancy	3,860
10	Malaria in Pregnancy	599	Gynecological Disease	1,311	Hypertension	2,620	Enteric fever	3,356
	Total	56,451	Total	83,662	Total	119,302	Total	145,415

Major diseases in the district: Table 2 presents common disease that afflicted community members by place of residents. Majority of the respondents suffered from malaria (30.8%), skin diseases (29.1%) and respiratory diseases (18.8%). On the diseases that respondent's family contract, a comparative analysis revealed that Hwidiem community had the highest cases of malaria (41.4%) followed by Ntotroso (37.9%), Acherensua (30%) and Kenyasi (13.8%). However, skin diseases (41.4%) and respiratory diseases (27.6%) are prevalent in Kenyasi than the other three communities as of the time of field survey. Despite these variations in disease afflictions, no significant differences were observed among the four study settlements (p>0.05). Majority of the respondents (67.2%) reported that they did not have these diseases in five years ago as of the time of the field survey. With regard to the diseases that respondent's family contract, it was revealed that most of them suffer from Malaria (43.1%), diarrhoea (16.4%), skin diseases (19.8%).

Most of the respondents (69.5%) related these diseases to the mining activities. One respondent at Ntotroso noted that:

"Gentleman, see me and observe me critically, you can now see what is happening to me, all my body is made up of skin rashes just because of mining activities, in the past 5 years I was not suffering from this disease but as soon as the mining company came to this area this disease attacked me and other people around here, so you see how harmful mining can cost our precious health. You tell me if this disease is not related to the mining activities?"

This suggests the extent to which mining is impacting adversely on the health of the people. Malaria, URTI and skin diseases were the most common health problems among the respondents (see Table 2). This was confirmed by the top ten Out-Patient

Diseases in the records of the Asutifi District Health Directorate over a four year period; that is from 2006 to 2009. It could be deduced that malaria remained the highest disease in the district throughout the years followed by Upper Respiratory Tract Infection (URTI) (see Table 3).

Diseases aetiology and diffusion: Based on the disease profile reported by the respondents, major diseases that posed public health challenges in the study area were directly or indirectly associated with the operation of mining activities. These health problems in ascendency included malaria, skin diseases, respiratory diseases, sight problems and intestinal worms. Malaria was attributed to the proliferated uncovered mine pits that have accumulated water and serving as breeding grounds for mosquitoes. In an interview with a male physician at the Kenyasi Clinic, he stated that:

"The increasing malaria cases recorded in this community is due to the proliferation of stagnant waters induced by uncovered mining pits"

Diseases such as skin rashes were directly related to residents' exposure to mining activities, especially by the use of contaminated water for bathing and inhalation of polluted air caused by the blasting effect of rocks. Furthermore, skin diseases were confirmed by the health officials as the direct outcome of the mining activities. According to a male health worker at the St. Elizabeth Hospital:

"Diseases such as intestinal worms and skin diseases are mainly caused by pollution of water by Newmont"

Arguably, skin diseases were the resultant effect of polluted water used mainly for bathing. One respondent at Acherensua made the following statement with regard to the causes of the prevalent skin diseases in the area:

"The chemicals used in the processing of the minerals mostly find their ways into the various water bodies which are also the sources of the drinking water for the people. Dependence on it eventually results in infection of water-borne diseases"

One resident at Kenyasi made this declaration:

"Chemicals like cyanide and mercury are introduced into water bodies which affects our health when drunk. Oh, Williams, these days, because of this problem we fear to drink from the various water bodies which are believed to have been polluted. Again, rain water is also our main source of drinking water however because of the operation of Newmont they have warned us not to drink rain water again"

Table 4: Newmont contribution to health needs of residents

Residence	Yes	No	Total
Kenyasi	5 (16.7%)	25 (83.3%)	30
Acherensua	10 (33.3%)	20 (66.7%)	30
Ntotroso	9 (30%)	21 (70%)	30
Hwidiem	5 (16.7%)	25 (83.3%)	30
Total	29 (24.2%)	91 (75.8%)	120

Field Survey, 2014

The officials of Newmont Ghana Gold Limited supported the views of the respondents. They attributed the health consequences of mining to the pollution of water bodies, blasting and noise from their heavy equipment's as well as the chemicals used by the company. The official at Newmont reiterated that:

"Mining affects the air through pollution which in effect affects the people. Also cyanide leakages affect water bodies that serve as drinking water to some community people"

A health worker at the Acherensua Clinic added that the increasing worm infestation in the community is also induced by the presence of coliform in drinking water sources, most of which are due to faecal matter contamination from the mining areas.

Diseases such as respiratory disorders and sight problems (poor vision) were caused by suspended particulate matter emanating from the blasting of mineral bearing rocks. Acute Respiratory Infection (ARI) was identified by the health officials as resulting from air pollution. Diseases such as waist and bodily pains were tied to the tedious nature of the mining occupation, especially among the mining workers.

Intervention measures to health problems in the mining area: Based on the health conditions and diseases prevalent in the study communities, our study sought to find out intervention measures by Newmont Ghana Gold Limited. This was to enable us to effectively assess the preparedness of the mining company to address the health problems associated with the mining activity as part of their mandatory corporate social responsibility. In this regard, 24.2% of respondents said that the mining company was helping the community to address their health concerns whereas 75.8% of the respondents said that the mining company has not addressed their health challenges (see Table 4).

Most respondents posited that their estimated monthly income could not even cater for their health insurance premium let alone buying of prescribed drugs and paying for treatment not covered by the National Health Insurance Scheme.

However, as part of control measures to limit the extent of water pollution, the company has built a dam to accumulate the polluted water from the mines downstream. Other measures put in place by Newmont Ghana Gold limited include reduction of air pollution, resettlement of the affected people, providing health equipment such as drugs and rehabilitation of health facilities.

DISCUSSION

The study examined health effects of mining in Newmont Ghana Gold Limited Enclaves, taking evidence from Asutifi District in the BrongAhafo Region, Ghana. Current evidence suggests that mining has negative impact on the health of mankind. Stephens and Ahern (2001) maintain that mining is potentially dangerous for human health and at worst causes fatalities if not properly managed. Kitula (2006) posited that in Tanzania, mining related fatalities such as death and diseases occurred as a result of collapsing of tunnels and the presence of poisonous gases underground. A substantial proportion of the respondents (69.5%) attributed various diseases such as malaria, skin diseases, respiratory diseases and sight problems in the areas to the mining activities. This finding has validated other research findings (Stephens and Ahern, 2001; Kitula, 2006).

Our study found that diseases such as malaria (30.8%), skin diseases (29.1%) and respiratory diseases (18.8%) were prevalent in the Newmont Enclaves. This finding supports various studies that reported prevalent diseases in mining communities in Ghana and elsewhere (Akabzaa *et al.*, 2007; Yeboah, 2011; Adei *et al.*, 2011). Statistically, the prevalence rate of malaria and skin diseases were much lower in the study areas than what was reported by Yeboah (2011) in Obuasi. Likewise, skindiseases were also higher in the current study than what was reported earlier by Yeboah (2011). The differences in the results might be due the sample size, research design, sampling technique and the study settings. However, our finding contradicts with some previous studies (Lakshmi, 2009; Amponsah-Tawiah and Dartey-Baah, 2011). Diseases such as peripheral vascular disease, cancers, suffocation, nausea and dizziness, hearing losses and silicosis were not found in the study areas. This contradiction lies in the years of operation of the mining company. This is because Newmont has not operated in the study areas for long period of time. Thus as time goes on, these diseases are likely to manifest in the areas. The mineral commission and those responsible for mining operation in Ghana thus need to put up measures in place so as to prevent these diseases likely to emerge and compound the existing health challenges in the areas in the long run. The onus therefore lies on these institutions to furnish the communities members with the right source of information such that they can desist from drinking polluted water in the areas and also stay away from the operation of the Company.

Our study shows that the increasing malaria cases were as a result of the proliferated uncovered mine pits that have accumulated water and serving as breeding grounds for mosquitoes. This result is akin to the findings of other studies (Kitula, 2006; Ocansey, 2013). They reported that uncovered mining pits provide an enabling environment or serve as breeding grounds for mosquitoes thus, increasing the incidence of malaria. Thus, most of the residents in the areas continue to be exposed to malaria in as much as the Newmont continues to operate in the areas.

Water is a basic commodity in life without which man cannot survive. However, mining undermines this basic principle. Our finding shows that diseases such as skin rashes were directly related to residents' exposure to mining activities, especially, by the use of contaminated water for bathing and inhalation of polluted air caused by the blasting effect of rocks. Previous studies have reported that mining activities pollute water bodies through the use of metals and chemicals such as mercury and cyanide (Hilson, 2002; Ocansey, 2013). The discharge of poisonous substances such mercury into water bodies poses serious threat to human health because water bodies become polluted and are not safe for human consumption (Hilson, 2002). This finding is in consonance with other studies (Hilson, 2002; Ocansey, 2013). As individuals and families continue to be exposed to polluted water, health conditions will forever remain a challenge with consequence effect on food security. This is because most of the polluted water bodies are relied upon by the communities as alternative water sources.

Our study found out that NGGL has instituted measures such as limiting the extent of water pollution, reducing the incidence of water pollution, rehabilitating some of the clinics in the study communities and resettlement of some of the affected people to reduce their exposure to environmental health hazards. The study revealed that the Company is minimizing the dust emission on the roads by constantly watering the untarred roads. However, dust emissions from the blasting mechanism remains uncontrolled; hence, increasing air pollution and other environmental health hazards. Furthermore, Newmont has put up control measures to limit the extent of water pollution. The Company has built a dam to accumulate polluted water from the mines downstream. Despite these intervention measures, diseases such as malaria and respiratory diseases still constitute a threat to public health. It could be deduced that most of these measures put forward by the NGGL are not sustainable.

Our study was confronted by a number of limitations. In the first place, the cross sectional survey employed might lead to recall bias. Furthermore, most of the respondents were not willing to provide data needed for the study because they claimed that the process was time wasting and energy sapping but will hardly improve their social wellbeing. However, mechanisms were put in place to minimize their effects

on the study and thus made minimal impact on the result of the study.

CONCLUSION

The current study provides evidence to suggest that mining activities have resulted in the health problems in the Newmont Ghana Gold Limited Enclaves in the Asutifi District. The major health problems was attributed to malaria, skin diseases, visual impairments and respiratory disorders which has a direct linkage to the morbidity pattern in the study communities. The prevalence of malaria was attributed to the neglect of uncovered mine pits which have accumulated water and serving as breeding grounds for mosquitoes. Furthermore, it has been established that diseases such as respiratory diseases and sight problems (poor vision) have been caused by suspended particulate matter emanating from the blasting of mineral bearing rocks. The health statistics on the top ten causes of OPD over a four year period (from 2006 to 2009) reflect findings of our study. It has been recommended that NGGL must collaborate with the various clinics to fight against certain diseases such as malaria and skin diseases and others found to be caused by the mining activities.

RECOMMENDATIONS

Based on the findings of the study and health challenges associated with mining activities, the following recommendations to address the health effects of mining are made:

- Newmont Gold Ghana Limited should organize regular health program in the surrounding communities of Kenyasi. The health program should be incorporated with frequent health screening as well as educating the people on how to live in good health. There should be a mechanism in place so that it will be sustainable.
- In as much as Newmont is commended for enrolling all their workers and families (such as their wives and children) onto the National Health Insurance Scheme (NHIS) to access medical care, it is recommended that they support the poor people in the area to enroll in the NHIS so that they could also access better health care.
- Newmont, in collaboration with the Asutifi District Health Directorate, should provide health equipment and drugs for the clinics in the area. Also, the company must collaborate with the various clinics to fight against certain diseases such as malaria and skin diseases and others found to be caused by the mining activities.
- The agencies responsible for monitoring, regulation and evaluation of activities of the mining company should ensure that water bodies are not polluted by Newmont. They should make sure that Newmont provides alternative sources of potable drinking water such as bore holes and pipe borne to the affected communities.
- Residents in the communities should insist on using mosquitoes nets in their rooms especially for expectant and nursing mothers and children to avoid malaria infections through biting by mosquitoes. In line with this, reliable and pragmatic measures should be deployed by Newmont to protect all pits that serve as breeding grounds for mosquitoes. Again, the health official of NGGL and opinion leaders in the various communities should come together to negotiate for free insecticide mosquito nets for the residents in the communities.

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