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An Assessment of the Institutional Capacity for the Management of Quarry Industries in Ghana: The Case of Buoho Stone Quarries

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Abstract

Globally, the stone quarrying industry is considered as one of the most vibrant industries that provide a huge source of revenue for every country. Technological advancement all over the world has led to an immense improvement in the way quarrying activities are carried out. Moreover, several other emerging trends such as increase in customer expectation, increase in demand for production and the need to reduce cost of production has led to the delivery of poor services by quarrying industries which in turn has resulted in a huge negative impact on the environment. It is clear that technological advancement will continue to play a significant role in quarrying activities, it is therefore necessary to minimize the harmful effects quarrying activities pose to the environment. It is in light of this that both primary and secondary data were collected with structured interviews undertaken with all relevant institutional stakeholders in the Afigya Kwabre District Assembly. However, the study revealed that quarrying as an activity has several negative environmental effects, in spite of the numerous economic and social gains the activity comes along with. The study therefore recommends that quarrying companies spray water on their conveyor belts to reduce the amount of dust produced from their operations. The study further recommends that a buffer zone is created and strictly adhered to by the Town and Country Planning Department of the Afigya Kwabre district to help in the restoration of such sites.

Key words: Stone, Quarry, Environment, Restoration .

1. Introduction

The importance of the stone quarry industry to the infrastructure development in particular and overall development of every country cannot be over emphasized. With the exponential growth in the construction industry since the last decade, the need for quarry products and materials is on the increase. Though statistics are not readily available, indications are that there has been a corresponding increase in quarry sites and companies to cater for the increasing demand for quarry materials for the construction industry. The benefits accruing to the nation as a whole and individuals in particular from this increase in quarry companies are enormous. Both the highly skilled technicians to man the machinery used and the various unskilled labour needed along the production and supply chain is huge. In essence, the industry creates employment for the middle level technical workforce and the lower level unskilled labour. This is unique to the extractive industry especially the quarry sector. Also, some appreciable amount of revenue accrues to government in the form of direct and indirect taxes. Also, some social intervention programmes are sometimes undertaken by these companies. However, notwithstanding the enormous benefits of quarrying, it also comes along with other trailing environmental effects.

The Plate below show a section of the town and the Quarry (Granite hills) at Buoho.

Plate 1- Showing a section of the BuohoTown

Source: Field Survey, 2015

Environmental and even some social complaints about quarrying activities were voiced out as far back as the 1890s. The main concerns about the environmental effects of quarrying have been visual intrusion, damage to landscapes, traffic, smoke, noise, dust, damage to caves, loss of land, and deterioration in water quality (British Geological Survey, 2013). For instance, the removal of top and sub-soil to access the required resource underneath the earth leads to loss of organic rich soil and the forms of life it contains. Again, the loss of wildlife - land without top and sub-soil is less capable of sustaining life and barren land is created after quarry operations have ceased if the land is not restored with soil. It leads to dust emissions, fumes and nuisance as shown below.

Plate 2- Showing loss of vegetation and top soil at Buoho

Source: Field Survey, 2015

Dust deposition on surrounding properties and land or nuisance dust may be described as the coarse fraction of airborne particulates, typically greater than about 20 μm. In terms of the ecology, physical effects of stomata damage and blockage, resulting in drought stress. Then there are the chemical effects of dust either directly on the plant surface or on the soil (change in soil chemistry). Other impacts in the area of health include an increase

in particulate concentration, thus open cast coal mining is associated with a small increase in the mean concentration of airborne particles measured as PM10 but this is not thought to have any effect on health. It is also not thought that health has been affected around working quarries. Noise/vibration which are the results of quarry activities include:

- Audible noise - Discussed under the use of mobile plant equipment and a processing plant
- Ground vibration
- Overpressure (pressure waves that travel through air from a blast)
- Flyrock (fragments of rock propelled into the air by explosions)
- Possible structural or cosmetic damage, but more often fear of damage and/or nuisance.

Equally of great importance is air pollution, which seems to be an issue of great concern to the environment. Aggregates produced from the blasting of the rocks travel into the atmosphere, causing air pollution which is health hazard to the people living in and around the quarry site. The health outcomes of inhaling high amount of dust include respiratory tract infections and other dust related diseases. The notable diseases among a few are bronchitis and cold which are mostly caused by inhalation of dust into the lungs.

The Government of Ghana, in its quest to increase investment in the mining industry which includes quarrying, seeks to ensure that quarrying activities are carried out responsibly. The Ghana Mining Law 2015, section 8 therefore takes into account the protection of the environment and local communities after mining operations. This comes to confirm section 72 (prevention of pollution of Environment) of the Minerals And Mining Act - 1986 (PNDCL 153)

This is to ensure that the country secures the full economic and social benefits that mining development promises, in an environmentally and socially responsible manner.

The irreversibility of the damage that quarrying activities in particular and the extractive industry in general cause to the environment cannot be over-emphasized. There is therefore the need to critically identify and understand the various activities with the view to reduce the impact of adverse human activities on the environment, which includes quarrying activities. The environmental effects of quarrying are chronic and felt even after closure and reclamation. In Ghana, some governmental agencies have been tasked to manage the negative effects of quarrying activities. These include the Traditional Authority and Town and Country Planning Department, Environmental Health Unit, District Health Directorate of the District Assembly. Impact of the work of these institutions is not being felt by the inhabitants of communities around quarry sites. What are their various roles in dealing with the negative impacts of the industry? What is their modus operandi and what are the implementation challenges? Specifically, the purpose of this study is to assess the role of local institutions in mitigating the negative environmental and social effects of quarrying.

2. **Review Of Background Literature**

2.1. Effects of Quarrying

Priyadarshi (2009) identifies two positive effects of quarrying. After the quarry is abandoned, the basin formed serves as good reservoir for surface water that is trapped during the rainy season. Villagers and miners use this water for domestic purposes and sometimes for other purposes, especially in the dry season when most sources of water are dry or are not good enough for domestic use.

Also, information on the geology is another positive environmental effect of quarrying. At a quarry where stone is cut from the ground, geologists are able to study layers exposed by the mining. If miners work in conjunction with scientists and communities, the geological effects of quarrying can be useful. When restoring these sights, the geological information procured is kept in mind so it may benefit generations in the future (Erikson, 2006).

Quarrying, according to Adams (2001), is one of the occupations that have serious degrading effects on land. The primary source of noise from extraction of aggregate and dimension stone is from earth-moving equipment, processing equipment, and blasting (USGS, 2002). From the construction of roads, buildings and facilities at the site to the blasting and crushing activities at the site, the noise produced from quarries could be disturbing (Mae, 2010). One of the most frequent complaints the public makes to the crushed stone industry situated near population centers is about blasting noise from quarries (National Academy of Sciences, 1980).

Air Pollution is another key negative impact. Dust from rock processing and unpaved (dusty) roads settle on crops and other plants as a result of sedimentation. High concentration of dust on plants results in poor plant performance and yield (Nartey, 2012). Workers in quarries as well as residents living around quarries are also likely to inhale dust particles into the lungs which normally results in silicosis, tuberculosis and bronchitis, which leads to pulmonary fibrosis and premature death (Madhavan and Raj, 2005).

Pollution of surface and ground water also results from the activities of quarry industry. Engineering activities associated with quarrying can directly change the course of surface water. In fact, sinkholes created by quarrying can intercept surface water flow (USGS, 2002). The quantity, and physical and chemical quality of surface waters and groundwater may be affected by quarrying activities; flows can be increased or decreased and may be contaminated by runoff or dust from the quarry (Irish Department of Environment, Heritage and Local Government. 2004). Quarrying is likely to result in increased runoff, reduced water quality, rerouting of recharge water through the aquifer, and localized reduction in ground-water storage (USGS, 2002).

Natural habitats can be damaged or lost entirely as a result of quarrying, and features such as hedgerows, stone walls and trees can be removed (Irish Department of Environment, Heritage and Local Government. 2004). The main negative ecological and biological effect of rock quarrying is loss of habitat and the species that inhabited it. Habitats are altered or destroyed by excess dust, water runoff, soil erosion and noise caused by quarries (Erikson, 2006). Madhavan and Raj (2005), also submitted that although some wildlife may become accustomed to blasting noises, others will move from the area, potentially reducing the population of those species.

The plates below show the negative effects of quarrying on the environment.

Plate 3- Showing the effect of dust from mining activities on crops Source: Nartey, 2012

Plate 4- Showing a River Polluted by Quarry Run-off Source: Nartey, 2012

Plate 5- Showing Loss of Biodiversity Source: Biriwa, 2006

2.2. Effective Institutional Control

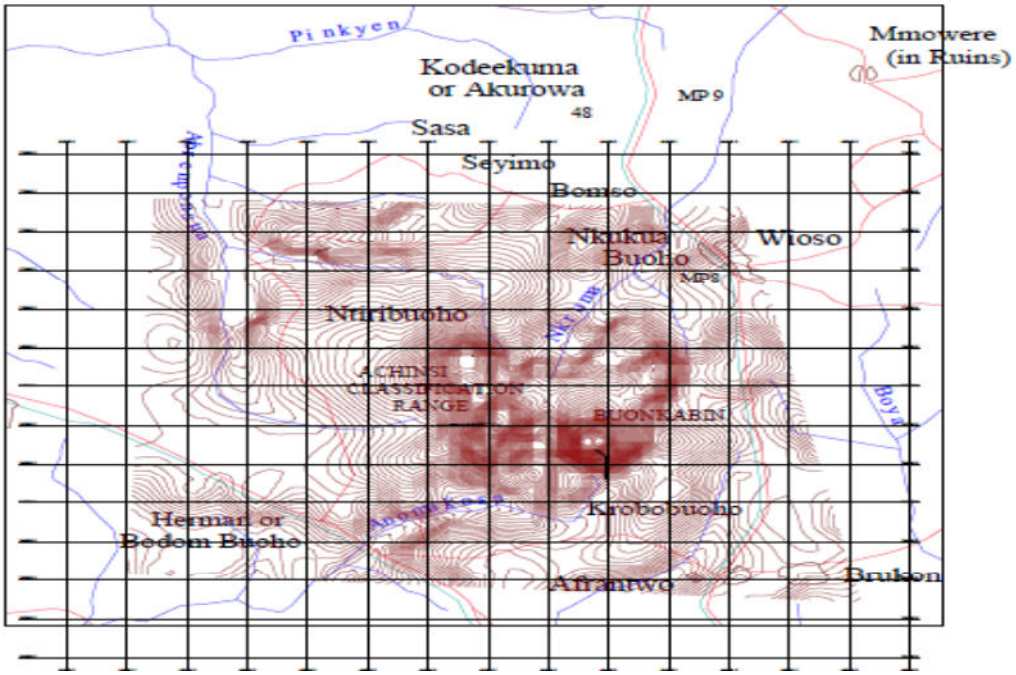
Institutional control should be effective in order to manage quarry site successfully. Through a Secretarial proclamation, a plan was established for development of a comprehensive public involvement and education program. This program would act as an institutional control to communicate the historical legacy of the site and would make information available about contamination present at the site to guide people in making decisions

about appropriate site activities. Deyo and Pauling (2006). This helped in the management of The Weldon Spring Site is located within the St. Louis, Missouri, USA.

3. Methodology and Scope

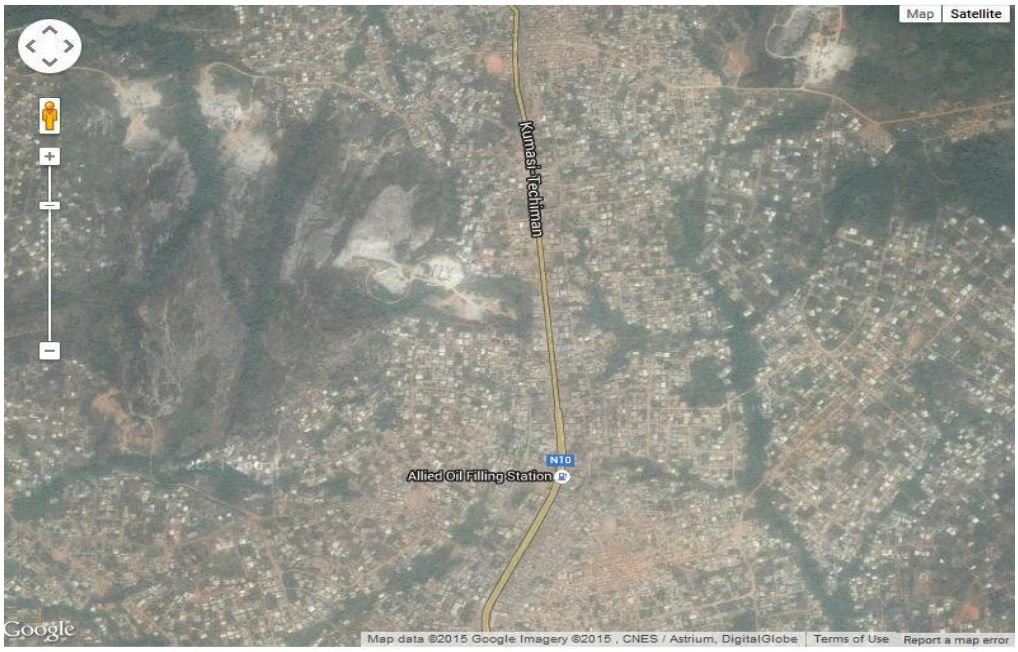
The contextual scope of the study seeks to examine the existing institutional capacity available to implement the mitigative measures to solve the social and environmental effects of quarrying on the selected community. The geographical scope of the study is Nkukua Buoho, in the Afigya Kwabre district of the Ashanti region of Ghana. The area of operation falls within the coordinates 660000 and 665000 E and 765000 and 770000 N. The outcrop rises sharply from relatively low lying area. About six rivers take their source from the outcrop. These water bodies are important source of water for the various communities. Settlement communities can be found near the water bodies; for example Nkukua Buoho depends on the Nkruma stream, Krobo buoho and Heman depend on Anomakosa stream and its tributaries (Map 1).

A case study approach was employed for the study. This approach was necessary in order to tackle the problem within a real life context. The purposive sampling technique was employed in selecting the institutions that are mandated by law to manage the quarry activities. The local institutions interviewed were the Traditional Authority, the Environmental Health Unit of the Afigya Kwabre District, the Town and Country Planning and the Afigya Kwabre District Health Directorate. These institutions were selected because they are directly involved in environmental issues in the district.



Map 1: Showing the Study Area.

Source: Field Study, 2014



Map 2: Showing the Study Area.

Source: Google imagery, 2015

4. Discussion And Analysis

4.1. Identification of the Effects of Quarrying at Buoho on the Environment by Households, Quarrying Company, Quarry Workers and Local Institutions

Residents in Buoho gain easy access to building materials such as stones, gravel and sand. It is easier to gain access to building materials such as stone chippings, gravel sand and quarry dust for building purposes in this area. This in turn saves time and money for residents and developers.

Quarrying companies employ some residents of Buoho thereby reducing the unemployment rate in the community. Some residents also act as middle men in sale of quarry products to nearby communities for profit. This activity therefore creates employment and income for such people.

Quarrying companies pay taxes to the government and royalties to the custodians of Buoho lands, thereby generating revenue for community development. Government uses taxes paid by quarrying companies to undertake developmental projects such as schools, hospitals and other social services for the community. Royalties paid for quarry lands are also channeled into developmental projects that benefit the community as a whole.

Quarrying serves as a means of tourist attraction. Tourists from other parts of the country as well as outside the country pay visits to quarry sites to explore how stones are extracted from the quarry. This in turn generates income or revenue for the company (the companies do not derive revenue directly from the tourists) and the community as a whole since most of these tourists end up investing in the local economy.

Quarrying companies such as KAS Products (a major quarry firm in the study area), as a result of their operations, undertake developmental projects as a way of giving back to the community and showing their solidarity towards the community. Quarrying companies also provide financial and material resources to support other development projects in the community.

Table 1: Projects undertaken by KAS Products for Various Communities

Project	Community
Construction of Buoho Palace	Buoho
Construction of Afrancho Health Centre Maternity Ward	Afrancho
Construction of 6 unit classroom block	Krobo

Source: Field Study, 2014

However, respondents identified some negative effects of quarrying at Buoho on the environment. From the chart in figure 1, 42% of respondents indicated air pollution as the major effect of quarrying on the environment. About 28% of respondents indicated noise pollution as another negative effect of quarrying on the environment, 24% of respondents indicated vibration as a negative effect of quarrying on the environment. Also, about 6% indicated water pollution and insecurity as negative effects of quarrying on the environment.

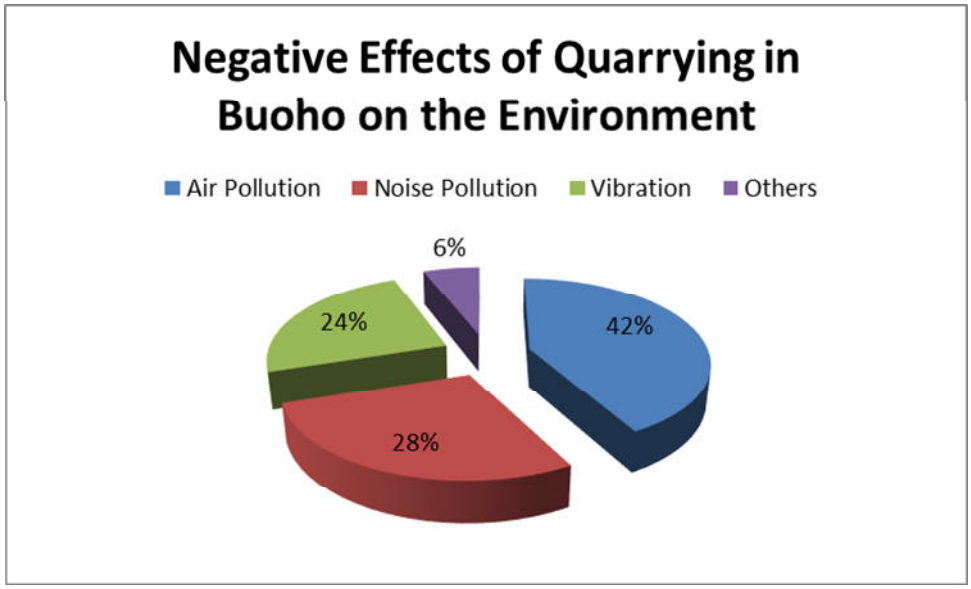


Figure 1: Negative Effects of Quarrying at Buoho on the Environment

Source: Field Study, 2014

4.2. **Extent of Negative Effects of Quarrying at Buoho on the Environment**

4.2.1. Air Pollution

Respondents attributed air pollution to be the major negative effect of quarrying on the environment. Quarrying activities at Buoho produce high amount of dust through screening and crushing of rock particles. The dust produced travel into the atmosphere, causing pollution to the environment. According to the respondents, inhaling dust particles cause a lot diseases and infections.

Table 2: Air Pollution Related Diseases Affecting Households

Type of Disease	Frequency	Percentage
Headache	18	34
Catarrh	14	26
Coughing	10	19
Chest Pains	5	9
Skin Diseases	4	8
Eye Infections	2	4
Total	53	100

Source: Field Study, 2014

From the table 2, 53 out of a total of 98 respondents suffer air pollution related diseases which reflects the extent of negative effect of air pollution as a result of quarrying at Buoho on the environment. This implies that expenditure on hospital and medication will be increased in the near future if measures are not put in place to reduce the effects of air pollution on the environment. These results could also increase mortality rate of the community in the future. Moreover, fumes i.e carbon emmissions from equipment and vehicles used in quarrying activities at Buoho are also known to contribute to the air pollution. Most importantly, households complained that dust produced from quarrying activities result in dusty surroundings. The dusty surroundings lead to frequent cleaning, changing of window insecticide nets and repainting of houses.

4.2.2. Noise Pollution

Noise pollution is another negative effect of quarrying at Buoho on the environment as mentioned by households. The unpleasant sound produced by quarrying activities creates an unfriendly environment for most residents. Households complained that, quarrying activities are undertaken from the early morning till late in the night. Quarrying operations such as crushing, blasting and excavation produce very high level noise that disturb the whole environment throughout the day and night. The deafening noise produced by quarrying activities result in sleeplessness for most residents; affecting the sick, students, the aged and workers who require enough sleep to refresh their minds for their various activities. Equipment and vehicles used to convey goods from the quarry are also said to contribute to noise pollution in the community.

4.2.3. Vibration

Vibration was mentioned as another crucial negative effect of quarrying at Buoho on the environment. Quarrying activities here is said to cause high level vibration. Respondents complained that blasting activities produce high level vibration which results in an uncontrollable fear and panic to residents anytime the activity is undertaken. Respondents complained that vibration produced from blasting activities result in rapid differential settlement leading to cracks in their buildings, which is a hazard to inhabitants. This makes it necessary to properly reinforce all to eliminate the hazard.

Plate 6: Cracked Walls due to vibration

Plate 7: Damaged roof from flying rocks

Plate 6 shows a cracked wall caused as a result of excessive vibration produced from quarrying activities at Buoho; and plate 7 shows damage in the roofing sheet of a building resulting from flying stones as a result of quarry operations at Buoho.

4.2.4. Insecurity

Insecurity was another issue of concern raised by some respondents as a negative effect of quarrying at Buoho and its environs. Respondents complained that, blasting activities of quarrying operations explode stones particles into the atmosphere. These particles penetrate through the aluminum roofing sheets of buildings or end up hitting people walking around, posing a great threat to the security of residents. Some respondents recollected a few of such terrible situations that led to the death of victims.

4.2.5. Water Pollution

The survey further revealed that water pollution is another effect of quarrying at Buoho on the environment. Harmful chemicals (examples?)used for quarrying operations run off and pollute underground water which serves as a source of drinking water to some residents.

5. Role of Local Institutions in Mitigating the Negative Effects of Quarrying

5.1. Buoho Traditional Authority

The Buoho Traditional Authority is a nine member group with five of them educated to the Master's degree level. The Buoho Traditional Authority are the custodians and owners of the land and hence are legally entitled to ground rents which is payable annually. Also, there are some other payments and benefits that accrue to the Traditional Authority based on whatever MOU that is signed at the commencement of the factory. It is the role of the TA to ensure that some benefits such as employment opportunities, provision of social facilities, scholarship schemes, etc. are provided to the community by the Company.

The negotiation abilities of the TA to a very large extent determines the social amenities that are stated in the MOU and the extent to which the Company abides by it. However, for the quarry in Buoho, no MOU was signed, though the ground rents are paid periodically and hence, there seem to be a coordinal relationship between the company and the TA. This cannot be blamed on the current TA as the company began operations before the installment of this current TA. The TA tries to meet with the quarry companies to evaluate the effects of their operations on the environment every six months. However, no such meeting had been held for the past three years.

The knowledge base of the members of the TA about the negative impacts of quarry activities was very impressive. To them, the main issue was the dust and hence, ensured that the quarry companies water the dust

after their operation. They also acknowledge that, it was important to collaborate with all state agencies such as the District Assembly and EPA to prevent people from building around quarry sites. This the TA is pursuing very well.

5.2. Town and Country Planning Department of Afigya Kwabre District Assembly

The functions of the Town and Country Planning Department in the district include:

- To develop schemes for all communities under their watch
- To ensure that the physical development of the communities are done according to the laid down scheme.
- Educate people on the need to develop according to the laid down scheme.
- Determines land use in the district.
- Undertakes regular inspection on the activities of developers.

Based on the functions of the TCPD as stated above, it is clear that the siting of the quarry companies and its compatibility with the environment and the development scheme of the communities are duties of TCPD. From the discussions with the personnel available, there were no schemes for the community when quarry activities started. Hence, the development of the area was centered around the quarries.

The role of the TCPD in mitigating the negative effects of the quarry activities on the environment includes:

- Develop a buffer zone of about 300 meters beyond which no development should be done
- Educate developers to know the buffer zone.
- Undertake regular inspection of the buffer zone to monitor activities of developers.
- Ensure that quarrying companies to give out notice before blasting.
- Ensure the maintenance of the buffer zone by not approving any sale of such lands by the TA.
- Sanction people who disregard the laid down rules and regulations on the development of the 300m buffer zones.

To be able to effectively and efficiently undertake these roles, the TCPD needs to collaborate with the companies, the TA and the people as a whole. This collaboration is very weak among them and the TA as well as the quarry companies. The Department had met only once in the last two years with the quarry companies to discuss ways of reducing the negative effects of their activities on the environment. Notices to be served before blasting are mostly not adhered to. The other main challenge of the TCPD is the personnel to implement the mandate. There is currently only one professional in the department and no vehicle to undertake site inspections. Most times, the department has to resort to commercial vehicles such as taxis to go to site visits and inspections. In cases where people complain of cracks in their building due to the blast, such complainants have to provide means of transport for the officer to undertake an inspection of the crack. Though it is the responsibility of the department to ensure that no housing developments are done beyond the buffer, the vehicle and technology to track such developments is a challenge.

5.3. Environmental Health Unit

Generally, the functions of the unit are to:

- Ensure that quarry companies do not cause any injury around their premise or around the community as a result of blasting activities.

- Ensure that the quarry companies galert people before blasting activities are done.
- Make sure that, quarry workers wear protective clothing.
- Ensures that quarry companies control waste generated.

Again for this unit under the District Assembly, the major challenge is the logistics especially vehicles to undertake the inspections and educational campaigns as stated in their functions. The Unit is currently manned by only one officer. However, the ideal situation would be to have three staff under the Unit. This makes it virtually impossible for any serious education and inspections to be done. Also, the unit has no vehicle and resorts to taxis and vehicles from other divisions.

5.4. Afigya Kwabre District Health Directorate

Out of the top ten diseases in the district, malaria, acute respiratory tract infections and skin diseases, which are the top three diseases in the district are linked to quarrying activities as a result of negative effects of quarrying activities in the district. Also, out of these diseases, it was established by the directorate that there was a link between quarrying activities and the causes of mortality in the district as malaria, acute respiratory diseases and skin diseases are mostly attracted as a result of quarrying operations. It is again established by the directorate that, there are 4570 cases of malaria, 526 cases of skin diseases and 45 cases of Acute Respiratory Tract Infections reported in each month (on the average) of the year as a result of effects of quarrying activities.

The role the District Health Directorate plays in reducing the diseases attracted as a result of quarrying is basically health education at all health centers in the district on the need to pay regular visits to the hospital for checkup. The health education is not geared towards a particular disease but all other diseases that could cause infirmity in humans. The District Health Directorate also seizes opportunities at occasions such as grand durbars and other social gatherings to educate people on the need to visit the hospital regularly for consultation.

Table 3: Human Resource Needs Assessment

Medical Personnel	**Current Number**	**Short Fall**
Doctors	5	15
Nurses	180	20
Pharmacists	2	10
Medical Assistants	11	18
Laboratory Technicians	16	14
Other Staff	7	23

Source: Field Study, 2014

Table 3 shows a shortfall in medical personnel in the district. This implies that there will be pressure on the already existing medical personnel and hence, it will lead to poor service delivery. More to it, the district unfortunately has only one ambulance at the Ankaase Methodist Hospital. This implies that the district is not capable of responding to emergency cases such as a stone hitting the head of a resident near a quarry site.

6. Summary Of Key Findings

The negative effects of quarrying activities in Buoho include air and noise pollution, insecurity, vibration and water pollution. These notwithstanding, there are some positives that come with the activity, including employment opportunities to the local people, payment of ground rents to the TA to be used for community development, etc. However, it was clear from the study, that the negative impacts about the activity was overwhelming.

The management of these negative impacts is the responsibility of a number of state institutions including the TCPD, Environmental Health Unit and the District Health Directorate all of the District Assembly as well as the Traditional Authority, Minerals CommissionCommissionw and the Regional EPA. These state institutions have been legally empowered with the mandate to regulate the activities and subsequent impacts of quarry operations. From the discussions with the officers in the various units, there is a clear indication that they are doing their outmost best given the prevailing circumstances. The abilities and knowledge of these officials cannot be underestimated. However, they are faced with a number of challenges that derail their efforts in managing the negative impacts of the quarrying operation especially within the Buoho community.

The key challenge is the availability of vehicles and logistics. For all these units, their role in the management of the quarry companies involve constant on-site monitoring and inspections. This means that ideally there should be a vehicle for each unit. For instance, the TCPD have developed a scheme for the area which shows the buffer zone. However, there have been instances where the TA have sold portions of these buffer zones for private development. Lands are given unlawfully to quarry companies and residents close to quarry sites by traditional authorities. In the circumstance, it is only through constant inspection and monitoring that the TCPD can identify such land parcels. But once there are no vehicles for such constant inspections and monitoring, then these unauthorized development become the order of the day. Interestingly, it is these same buildings that suffer cracks due to the blasting from the quarry.

Also, the inadequate personnel syndrome is a major challenge. The quantum of work needed to be done as against the number of personnel available makes the management of the activities virtually impossible. For example, the District Health Directorate lacks the required human resource and logistics to address emergency health cases relating to effects of quarrying. Quarrying related diseases are among the most reported cases at health centers in the district. There are 4,570 cases of malaria caused by quarry waste and stagnant water created in quarry pits that breeds mosquitoes in the community. There are also 526 cases on skin diseases as a result of air pollution and there are 45 cases of pneumonia caused by inhalation of high amounts dust (GHS,2013). There is poor collaboration between local institutions in mitigating the negative effects of quarrying on the environment.

7. **Recommendations**

The following are recommendations made based on findings to help reduce the negative effects of quarrying on the environment.

- The buffer zone of 300m away from the quarry site by the Afigya Kwabre Town and Country Planning Department must be increased to 500meters to increase safety and must be strictly adhered to. This will prevent buildings close to the quarry site. This will in turn minimize the insecurity caused by explosion and flying stones from quarries.

- Enough warning signals and alarm bells are required prior to blasting.

- Water spraying of the conveyor belts must be done to reduce the amount of dust produced by quarrying activities.

- Local institutions in the district must collaborate effectively with each other in ensuring that, the negative effects of quarrying on the environment is minimized. The effective collaboration of local institutions ensures that institutions serve as checks and balances on each other in ensuring that each institution executethats its roles and responsibilities effectively.

- The Town and Country Planning as well as the Environmental Health Unit must intensify their periodic inspections at quarry sites to ensure quarrying companies do not harm the environment with their activities. This could be achieved by recruiting volunteers from the communities.

- The traditional authority in Buoho must be educated on the risks of selling out land close to quarry sites to people in the community.

- Various biological, bio-engineering and engineering measures such as:

- diversion of run-off,
- construction of retaining walls,
- carpeting with Geo-Textiles and mulching
- as well as re-vegetation

  are proposed for the restoration of the quarry sites.

8. Conclusion

Quarrying as an environmental activity has shown to have several positive social and economic benefits to the society. For instance, quarrying provides income, revenue and employment. Quarrying also provide raw materials to facilitate building and construction activities. However, it is worthy to mention that, the activity in spite of its numerous social and economic benefits comes along with other negative effects on the environment. In order to ensure sustainable development, there is need to recognize activities such as quarrying by policy makers and local institutions. There is need to also ensure that quarrying operations are conducted in a way that its long term benefits to the society are regarded whilst minimizing its potential negative effects on the environment and human society. Removal of rocks from the quarry sites for different construction works will result in the formation of depression and craters. These will be filled up by the dumping materials consisting of boulders, rock, gravel and soil from nearby sites. To achieve this, appropriate measures should be adopted at various sites in the project area so that restoration work will be scientifically executed.

References

Adams, W. M. (2001). Green Development Environment in the Third World. London: Routledge Group.

Biriwa, E (2006), Small -scale stone quarrying: Its contribution to people's livelihoods. A Case study of Kasenge Parish, Nama Sub-Country, Mukono District (Uganda). M. Phil thesis in development studies submitted to the Department of Geography, Norwegian University of Science and Technology. (2004), Quarries and Ancillary Activities, Guidelines for Planning Authorities.

Ghana Health Services (GHS) 2013, Annual progress Report, Afigya Kwabre West District Health Directorate

Google Imagery – 2015, http://googlemaps/kumasimaps. 20/05/2015

Madhavan., P. and Raj. S, (2005). Budhpura 'Ground Zero' Sandstone quarrying in India. Mine Labour Protection Campaign.

Minerals And Mining Act - 1986 (PNDCL 153), http://laws.ghanalegal.com/acts/id/535. 13/04/2015

National Academy of Sciences, 1980, Surface mining of non-coal minerals - Appendix I- Sand and gravel mining, and quarrying and blasting for crushed stone and other construction minerals: National Academy of Sciences, Washington, D.C.,p 91.

Priyadarshi, N. (2009), Social and Gender Issues in the Stone Quarries around Ranchi city, Jharkhand, India.

Rwanda Stones & Construction (Rsc) Ltd Co. (2011), Environmental Impact Assessment (EIA) Report For A Stone Crushing Factory.

The Ghana Mining Law 2015, http://www.iclg.co.uk/practice-areas/mining-law/mining-law-2015/ghana. Accessed on 13/04/2015

Union of Concerned Scientists (1992), World Scientists' Warning to Humanity. Available online at; www.ucsusa.org /about /1992-world- scientists.html. (30th September, 2013)

United States Geological Survey, (2002), Impacts of quarrying Stone in Karst. Publication available online at: http://geology.cr.usgs.gov/pub/ofrs/OFR-01-0484/accessed on17/02/14.

Y.E. Deyo and T. Pauling, (2006), Community Involvement as an Effective Institutional Control at the Weldon Spring Site, a U.S. Department of Energy Office of Legacy Management Site, WM'06 Conference, February,26-March 2, 2006, Tucson, AZ