

Stone Quarrying and Livelihood Transformation in Peri-Urban Kumasi

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Abstract

Stone quarrying is one of the key extractive economic activities in the Ashanti Region, supplying the bulk of stone of varying aggregates to the construction industry within the region and beyond. Yet the resource-rich communities have seen little socio-economic improvements. The paper draws on experiences from Nkukua Buoho and Ntiri Buoho in the Afigya Kwabre District of Ghana. It examines the peoples' livelihood transformation where quarrying, both small and large-scale is a dominant economic activity. With a sample size of 110 respondents, data was collected by means of questionnaires and in-depth interviews. The paper observed that while quarrying is a major economic activity, its effects in socio-economic and environmental terms are unsatisfactory. It is the view of this paper that effective collaboration involving all the stakeholders would make the industry socio-economically beneficial to the communities and environmentally sustainable.

Keywords: Stone Quarrying, Livelihood transformation, Sustainability, Peri-urban, Buoho

1. Introduction

Agriculture and mineral extraction are seen as playing a critical role in rural livelihood improvement thereby helping to alleviate rural poverty. Even though agriculture remains the key strategy for rural poverty reduction, access to agricultural land remains a major challenge to the majority of the rural poor. It is estimated that about 45 per cent of the world's population are landless (Fellmann et al., 2005). This has compelled over 500 million people in developing countries to engage in occupations such as small-scale surface mining and quarrying for survival (Wang et al, 2010).

In Africa, East Asia, Southeast Asia and Latin America, accessibility to natural resources plays a critical role in the livelihood conditions of people. Since the formal sectors in developing countries have very little potential in terms of job creation (Ibrahim, 2007) the informal sector has become an attractive alternative for achieving livelihood needs. However, population growth and its concomitant high demand for natural resources have put severe stress on the available resources with dire consequences on their sustainability. Over exploitation of the natural environment has depleted most resources and rendered most productive land beyond repairs (IEG, 2008). This development is likely to compound the health and unemployment problems of the poor majority seeking alternative means of livelihoods in rural areas. This condition is expected to worsen by 2035 if drastic environmental policy regulations are not implemented to restore the loss (IEG, 2008).

The World Bank (2001) identifies over 40 per cent of the world's population as poor and that about 75 per cent of rural residents in developing countries experience absolute poverty. These people are regarded as the landless, powerless, marginalised, vulnerable and disadvantaged. Since the poor rural dwellers have limited access to the socio-economic benefits that are easily accessed by urban dwellers they usually seek livelihood opportunities in the primary and informal sectors of the economy especially in subsistence agriculture, small scale mining and quarrying (Birabwa, 2006).

In Malaysia, it is estimated that the informal sector employs the services of over 70 per cent of the population with the quarry industry alone employing about 30 per cent. Quarry operations have been identified as a key

contributor to the Malaysian economy providing job opportunities for individuals especially adults and children. According to Ibrahim (2007), the quarry industry has expanded significantly in thirteen different states with Perak and Sabah states operating fifty five (55) and sixty two (62) quarrying sites respectively. Regardless of the environmental and health impacts associated with the quarry industry majority of the Malaysian poor still depend on quarry operation as the only alternative form of livelihood activity. A survey conducted by Brajesh (2006) in India revealed that, rural households depend largely on non-farm activities in order to make a living. Available statistics by Fellmann et al. (2005) indicate that about 20 per cent of residents occupying the Ukrainian massif also depend largely on quarrying for income to sustain family life.

In Africa, the picture is not different. Many people in rural Africa see non-farm activities as pre-occupation. Several factors account for this. In most cases it has been noted that dependence on agricultural output could no longer provide year round security in terms of finance due to continuous decline in farm yields. This is not surprising since most of the rural farmers are subject to varying degrees of uncertainty due to climate variability and post-production loss. It is for this reason that diversification of rural income has become common among those who wish to live, at least, an average life. Since non-agricultural activities in many instances yield as much returns as subsistence farming the only option for those without access to productive farmlands is to subject the natural environment to other activities such as sandblasting, stone extraction and small scale mining (Wells, 2000).

In the Mukono district of Uganda, Birabwa (2006) observed that poor individuals and households seek livelihood alternatives from small-scale stone extraction especially those close to the hills of Kasenge. Though the negative repercussions of the quarry occupation far outweigh the positive impacts, residents find the occupation as the only livelihood alternative. The occupation attracts the adult population with mouths to feed but with limited access to cultivable land (Birabwa, 2006). In Kenya, both rural and urban dwellers depend on day-to-day gathering and breaking of stones for sale. Wells (2000) identifies small-scale stone extraction in rural Kenya as a major source of livelihood in spite of the dangers it poses to the environment and the other livelihood activities such as farming.

In Ghana, majority (55.5%) of the working population is employed in agricultural activities (Ghana Statistical Service, 2008). However there are numerous occupations under the informal sector, which contribute to livelihoods of majority of rural Ghanaians. About 80 percent of the economically active population in Ghana work in the informal sector (Ghana Statistical Service, 2008). Even though agriculture remains the backbone of Ghanaian economy it is saddled with myriad of challenges. Diversification into non-agricultural activity is thus seen as very important to ensuring sustainable livelihoods among rural dwellers (Brajesh, 2006). Diversification provides countless opportunities for the poor seeking livelihoods in rural and peri-urban areas. In most rural and peri-urban Ghana, people engage in non-farm activities to supplement family income. Even though the informal sector can affect positively rural livelihoods, access to micro-finance to develop the sector so as to provide more jobs to the rural and peri-urban poor is a challenge.

Quarrying has environmental and health effects. It is estimated that some 4 million people die each year from acute respiratory problems in developing countries, for the most part being aggravated by environmental pollution emanating from quarrying, sandblasting and emission of dangerous chemicals (Langer, 2001). A report by the World Bank working group on environmental sustainability reveals that occupations such as lumbering, mining, quarrying, and sandblasting degrade the environmental and worsen the plight of the poor (IEG, 2008). In the Northern Region of Ghana and East Gonja District in particular commercial extraction of sand and gravel has led to land degradation and desertification through destruction of economically important trees mostly indigenous in nature (Musah, 2009). In spite of this, quarrying continues to be a major occupation for most poor people living in rural areas across the globe and especially in Asia, Latin America and Africa. It offers the opportunity for diversification of the economies of rural and peri-urban areas. Aside employment and income that it generates, the quarrying industry is a major source of raw materials for building and other constructional works.

At Buoho, stone quarrying provides varying economic benefits to the local economy. Although only a few stone quarrying companies operate there, majority of the local people depend on it albeit small-scale as a livelihood strategy. This is however achieved at the expense of the environment. Research that examines the effects of this extractive activity on the livelihood of the people of Buoho in particular and the environment in general is lacking. It is this gap that this research seeks to fill. The goal is to ensure that optimum benefits are derived from such operations while ensuring environmental sustainability.

1.1 Sustainable Livelihoods Framework and Quarrying

Pioneered by DFID, the Sustainable Livelihoods Approach (SLA) centres on both people and their livelihood; prioritizing both the tangible and intangible assets they utilise to achieve their desires. The approach also considers the vulnerable environment the poor operate in and their ability to withstand shocks and stresses, amidst external forces such as policies that affect accessibility of the assets upon which people depend. A livelihood according to Chambers and Conway (1992) comprises of capabilities, assets and activities required for a means of living: A livelihood is considered sustainable when it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and contributes net benefits to other livelihoods at the local and global levels and in the long and short term. Helmore and Singh (2001) identify a sustainable livelihood as one that maintains ecological integrity of the environment.

The approach is founded on a belief that people require a range of assets to achieve positive livelihood outcomes. No single category of assets on its own is sufficient to yield the varied livelihood outcomes that people seek but are utilized synergistically to pursue the different livelihood people aspire. The relevance of the Sustainable Livelihoods Approach lies in the fact that it is people-centered. It seeks to gain an accurate and realistic understanding of people's strengths (assets or capital endowments) and how they endeavor to convert these into positive livelihood outcomes. The approach does not perceive the poor to be in 'lack of' but it recognizes the inherent potential in individuals, households and communities, which is used to build positive livelihood outcomes (Helmore and Singh, 2001).

This approach is relevant to stone quarrying in understanding how individuals meet their needs using minimal financial input, simple technology and indigenous resources amidst a competitive formal market and restrictive government policy.

Stone workers use the different assets (human, capital, financial, physical, natural and social capital) they have in order to achieve the different livelihood outcomes. In an effort to ensure sustainable development, laws and policies are often in place to limit over exploitation of these resources. In most cases however these have not worked satisfactorily.

The Sustainable Livelihoods Framework (SLF) forms the core of the Sustainable Livelihoods Approach and serves as an instrument for the investigation of poor people's livelihoods. The framework is divided into five key components, which include the Vulnerability Context, Livelihood Assets, Transforming Structures and Processes (Policy, Institutions and Processes), Livelihood Strategies and Livelihood Outcomes. The vulnerability context in the framework is viewed as the external environment in which people exist (DFID, 1999). In relation to quarrying, the *Vulnerability context* encompasses *shocks* such as accidents, diseases and death occasioned by the activity. It also includes price fluctuations, loss of stone products and loss of money during business transactions. *Seasonality* and *trends* in the framework can also be related to *stress*, which are predictable events that affect livelihood outcomes attained from a livelihood strategy. Seasonality in relation to stone quarrying can be related to the weather changes that affect productivity at the quarry especially during the rainy season. Seasonality can also be related to the price fluctuations that are mainly determined by the demand for stone products. All these may have a temporal or permanent effect on the income flow of an average or poor income household.

The vulnerability context also acknowledges how people cope with stresses and shocks associated with their livelihood activity. As coping strategies the stone workers would diversify their livelihood portfolios or lean on other family members to survive. Common in informal activities such as stone quarrying is the reliance on social networks such as family, friends for material and immaterial support. *Assets* according to framework are presented in the asset pentagon, which shows the different assets people use to realise livelihood outcomes. Ellis (2000) defines assets as natural capital (such as land, water, forests), human capital (including skills, knowledge, physical capability and ability of labour), physical capital (infrastructure such as roads), and social capital (safety networks, social claims, social relations). Thus within a certain context, the use of these assets and appropriate strategies would yield livelihood outcomes. This framework largely guides the organization of this current work.

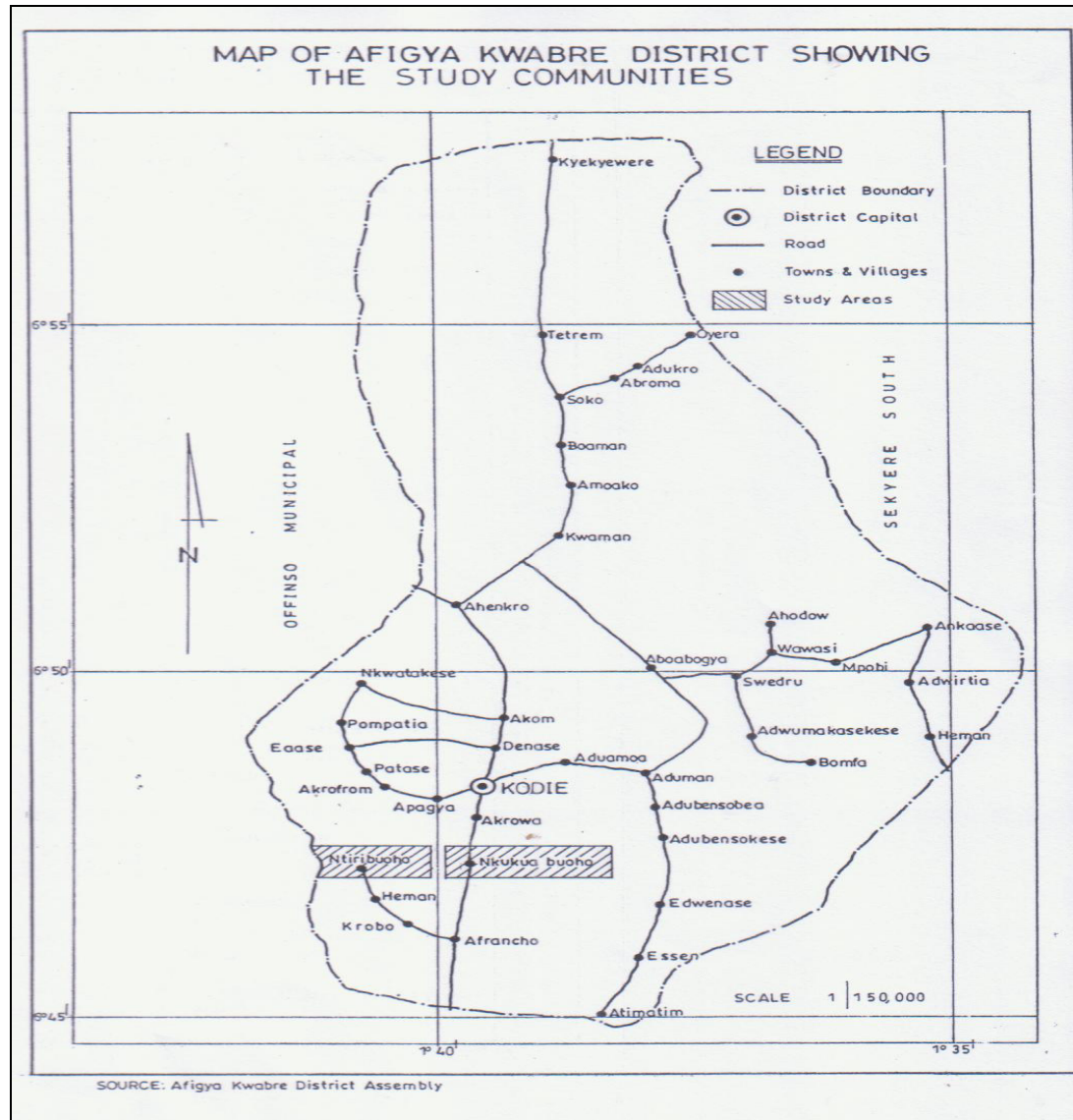
1.2 Study Background and Methods of Research

Buoho is positioned within latitudes $6^{\circ}45'$ and $6^{\circ}50'$ N and longitudes $1^{\circ}38'$ and $1^{\circ}42'$ W and as part of the Afigya Kwabre District covers a total surface area of 342.3 km^2 being 1.44 per cent of the Ashanti regional land

surface area. The district shares boundary with the Kumasi Metropolitan Assembly to the south, Sekyere South to the north, Offinso Municipal Assembly to the west and Kwabre district to the east. The location of Buoho is shown in Figure 1.

The average elevation of Buoho ranges between 600 and 900 metres above sea level. Buoho has a unique location, being a transition point between the Ashanti regional capital and the northern part of Ghana.

Fig. 1



Source: Afigya Kwabre District Assembly

Buoho falls within the sub-equatorial climate with an average minimum temperature experience of about 22⁰ C and a maximum temperature of 30.6⁰ C. It experiences a relative humidity of between 90 and 98 per cent at 0900 GMT, especially during the rainy season and 75 per cent at 1500 GMT during the dry season. The vegetation type is moist semi deciduous forest (Afigya Kwabre District Profile (undated).

Buoho lies within a dissected plateau, which forms part of the Mampong-Gambaga scarp with an undulating topography. Geologically, the Afigya Kwabre District is made up of two distinct rock formations namely the Voltaian and the Dahomeyan rocks. The Dahomeyan formation consists of igneous and metamorphic rocks with gneiss and granite being dominant in areas like Nkukua Buoho, Agyarko Buoho, Heman Buoho and Adomako Buoho. This has accorded localities in Buoho the accolade of being home to most quarrying industries. The

dominant soil in the study area is forest ochrosol however, the Boameng Simple Association and the Kumasi-Offin Compound Association are the most dominant soil association in the area. These soils support the cultivation of food crops such as yam, cassava and plantain (Afigya Kwabre District Profile (undated)).

The total population of Buoho as at 2008 was 7,157 and formed approximately 6.2 per cent of the district's total population. It was projected to reach 8,302 by 2013 based on a growth rate of 3.2 per cent per annum (Afigya Kwabre District Profile (undated)). Both natural increase and migration underlie the population growth. The area has attracted a lot of people due to its proximity to the regional capital-Kumasi and also its endowment in mineral resources like the rock aggregate being exploited by the quarry industries and the local residents. The major economic activities in the area can be grouped into three categories namely, industries, agriculture, and commerce.

Currently, three main commercial quarry companies are found in the area extracting the mineral aggregate for sale to construction firms. Although commercial extraction by private firms (such as KAS Company limited, CYMAIN Ghana limited and TAYSEC construction firm) is the norm, individuals are given the space to operate on small-scale. Stone quarrying provides countless opportunities for the people of Buoho in terms of jobs and income generation.

This paper made use of both primary and secondary data sources. The primary data was collected from the people who are directly or indirectly affected by the quarry activities. The secondary data was obtained from published and unpublished documents. A mixed method approach was used, employing both quantitative and qualitative techniques. Specific data gathering tools included an in-depth interview guide and a survey questionnaire. The purposive sampling technique was used to select one (1) key informant each from the District Assembly and Environmental Protection Agency (EPA) and two persons from the large-scale quarrying companies. Using the simple random sampling technique, a total of 106 household respondents including small-scale quarry workers were interviewed from two purposively selected communities of Nkukua Buoho (56) and Ntiri Buoho (50). In all, a total of 110 respondents were sampled. Using the Statistical Product for Service Solution (SPSS) version 12 the quantitative data was analysed and the results presented employing descriptive statistics. The qualitative data was tape-recorded, transcribed, edited and portions teased out to support the quantitative data findings.

2. Results and Discussions

2.1 Livelihood Strategies

Livelihood is the command an individual, family or other social group has over an income or bundles of resources that can be used or exchanged to satisfy their needs. This may involve information, cultural knowledge, social networks, legal rights as well as tools, land or other physical resources (Blaikie et al., 1994; Valdivia et al., 1996). The idea of livelihood strategies concentrates on the process by which families construct portfolios of activities, and social relations in order to improve their well being, or cope with crises (Valdivia and Gilles, 2001). Livelihood strategies are the range and combination of activities and choices that people make in order to achieve their livelihood goals. Livelihood strategy is thus linked with diversification of income and assets (Datta and Hossain, 2003).

The research explored the various livelihood strategies adopted by people in Buoho to meet their livelihood needs. In spite of the generally low economic status of the residents and the unfavourable environmental conditions they find themselves in, majority of respondents have well established livelihood strategies that help them to survive. These are characterised by highly diversified options for income generation as shown in Table 1 below.

Table 1: Households' Livelihood Strategy Options

Response	Nkukua Buoho		Ntiri Buoho		Total	
	Frequency	Per cent (%)	Frequency	Per cent (%)	Frequency	Per cent (%)
Quarrying and other livelihood strategies	41	38.7	30	28.3	71	67
Only quarrying	1	1	-	-	1	1
Other livelihood strategies without quarrying	14	13	20	19	34	32
Total	56	52.7	50	47.3	106	100

Source: Fieldwork, 2013

From Table 1, about 68 per cent of household heads indicated their engagement in quarrying as a livelihood strategy. Of these, 67 per cent combine quarrying with other livelihood portfolios suggesting that only 1 per cent took quarrying as a full-time business. About 32 per cent did not engage in quarrying or related activities. The most cited alternative source of livelihood in the communities aside quarrying was farming, followed by petty trading, masonry, with few others seeking livelihood in the service sector as teachers, nurses and secretaries. This is in accord with the findings of Yankson (2003) that agriculture aside, most rural people engage in occupations such as quarrying and small-scale surface mining for livelihoods in mineral rich communities.

The reason for this multiple economic portfolios is not difficult to find. Farming in the area is mainly for subsistence but the difficult environment makes it increasingly unreliable. Quarrying is a difficult operation and besides, returns from it are slow and inadequate. These, coupled with the limited formal sector employment and the need to ensure a sustained positive livelihood outcome underlie the multiple portfolio strategy. For the extreme poor however, these strategies merely permit survival and do not enable them to accumulate sufficient assets to overcome their poverty and advance their lot (Ellis, 1998; 1999). The reality is that majority of these respondents operate on a small-scale basis. With limited personal savings and difficulty in accessing credit, quarrying business for the majority of people in the community is limited to the small-scale level.

This is what a middle-aged small-scale quarry operator at Ntiri Buoho said in an in-depth interview:

This stone quarrying business requires money. We have to pay for the rocks from its source and transport them here to be broken into various grades or sizes. Besides we have to pay ground rent to owners of the land for keeping the stones by the roadside. The real difficulty we face is how to raise enough capital to expand our business

In the quest to improve rural livelihood, Brajesh (2006) suggests the need to provide adequate resources in the form of micro credit to facilitate production capacities of the poor whose main economic activities fall within the informal sector. Yankson (2003) stressed the need to strengthen the informal sector of the economy to widen the choices and assets of the poor seeking livelihood opportunities in the informal sector. This will enable the rural poor to diversify their income by exploring other opportunities without jeopardising the environment.

2.2 Quarrying and Livelihood Outcomes

2.2.1 Quarrying and household employment

Quarrying provides direct and indirect employment to residents of Buoho. Direct employment comes in the form of those who are employed in the quarry companies as drivers, engineers, administrative staff and those involved in rock blasting operations. It also includes self-employed individuals who operate small-scale quarrying. They buy rocks of various aggregates for resale purposes. There are also those who sell water and foodstuff near these quarrying sites to the workers. The services of some taxi drivers are often sought to convey rocks in small volumes by buyers. The quarrying industry thus provides indirect employment to this category of people.

In the household survey, 68 per cent of the respondents were directly engaged in the quarrying industry. Of this number, only 5 per cent worked with the big quarry companies (Table 1). The indication is that majority of the respondents operate on a small-scale basis as indicated in Plate 1.

Plate 1: The nature of the small-scale quarry industry in Nkukua Buoho.



Source: Fieldwork, 2013

As shown in plate 1, men are engaged in brisk stone business. These stones are mainly obtained from small-scale stone quarrying operations and sometimes from the large-scale companies. To both direct and indirect employment, quarrying contributes substantially. The high level of poverty and hardship, limited suitable agricultural land and poor environmental condition offer little alternative resources for subsistence in the study area. These, coupled with the limited formal sector job avenues in the area, has compelled majority of the indigenes to engage in quarrying. This confirms Birabwa (2006) whose study in the Mukono district of Uganda showed that high unemployment rate pushed majority of the youth into small scale quarrying for sustainable livelihood.

Stone quarrying as a business enterprise is a more vibrant economic activity at Nkukua Buoho than Ntiri Buoho. Proximity of residents of the former to the commercial quarry industries was identified as contributing to this. The cost involved in doing business with the large-scale quarry concerns is minimal for residents of Nkukua Buoho than those of Ntiri Buoho. Besides, both the small-scale and the commercial quarry firms are located along the main road in Nkukua Buoho offering ready market for the quarry products in Nkukua Buoho than Ntiri Buoho. Impressive as the statistics above may appear in terms of employment, majority of the respondents (82 per cent) do not see the quarry business as a permanent one. There are indications that people will quit the job if they secure a new job that is economically rewarding and less arduous in terms of task.

2.2.2 Quarrying, household income and wellbeing

Regarding the average monthly contribution of quarrying to household incomes, about 68 per cent and 56 per cent of respondents in Nkukua Buoho and Ntiri Buoho respectively earn between GH¢ 50 to 299 monthly as of 2013. This is shown in Table 2 below.

Table 2: Average monthly income earned from quarrying

Income	Nkukua Buoho		Ntiri Buoho	
	Frequency	Percent (%)	Frequency	Percent (%)
Below GH¢ 50	1	1.8	0	0.0
GH¢ 50-99	3	5.4	1	2.0
GH¢ 100-199	20	35.7	19	38.0
GH¢ 200-300	14	25.0	8	16.0
Above GH¢ 300	4	7.1	2	4.0
Nil	14	25.0	20	40.0
Total	56	100.0	50	100.0

Source: Fieldwork, 2013

From Table 2, only about 6 per cent of the total respondents earned above GH¢ 300.00. Majority of these were small-scale quarry operators who have other jobs aside quarrying. Those who earned nothing represent those not into quarrying as a business. As indicated earlier they depend on other livelihood strategies including farming, petty trading, teaching among others as well as support from family members both home and abroad.

While on the one hand incomes are earned working in quarrying industry, the inflow of migrant workers, and the conversion of common and other land to quarrying has increased the pressure on natural resources such as forest products which traditionally have played an important part in the local livelihood systems. This observation has been amply demonstrated in the works of de Hann (2002), Lahiri-Dutt, (2006), and Weyzig and Knottnerus (2006).

When respondents were asked to make their own assessment of household's share of income emanating from quarrying activities the following were observed. Of the 72 respondents who earned some income from quarrying operations, about 19 per cent, 45 per cent and 19 per cent indicated very good, good and average respectively. The distribution of these responses is shown in Table 3.

Table 3: Level of Satisfaction of the Contribution of quarrying to Households' income

Response	Nkukua Buoho		Ntiri Buoho	
	Frequency	Per cent (%)	Frequency	Per cent (%)
Very satisfied	9	12.5	5	6.9
Satisfied	19	26.4	13	18.1
Partially satisfied	8	11.1	6	8.3
Not satisfied	4	5.6	3	4.2
Indifferent	2	2.8	3	4.2
Total	42	58.3	30	41.7

Source: Fieldwork, 2013

From Table 3 only about 9 per cent and 7 per cent indicated poor and very poor respectively. The general feeling among the respondents is that the income from their operations does not meet their expectations but important supplementary income.

2.2.3 Quarrying and Agriculture

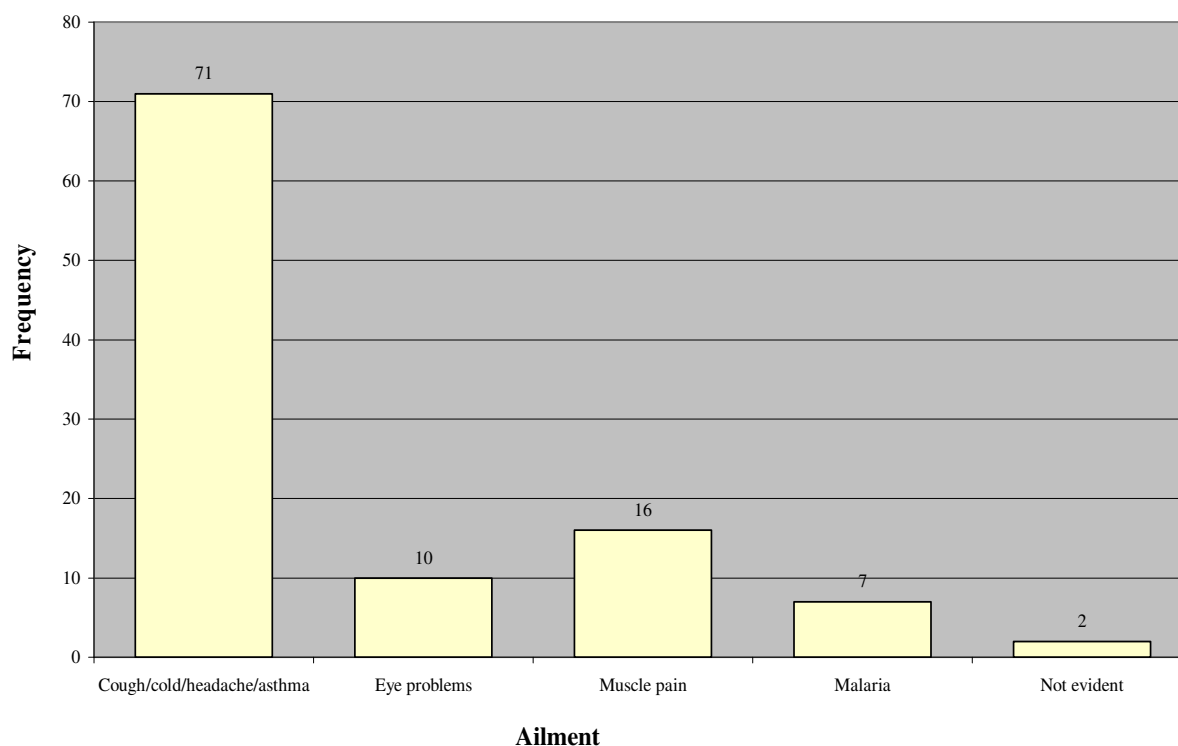
The study shows that agriculture is still an important livelihood activity in the study area. It is a critical component of the multiple economic activities adopted by the majority of the quarry workers. There is however the concern that the establishment of big quarries and the operations of numerous small-scale quarries pose serious threat to farming. The rich topsoil, which supports small-scale subsistence arable farming, is cleared to make way for quarrying. The rocky nature of the area in itself is a disincentive to farming as it makes large-scale mechanised farming a non-productive venture. There is a large parcel of unproductive land, especially within the buffer zone of the CYMAIN Quarries except close to the valleys where residents have cultivated food crops and vegetables such as plantain, cassava, pepper, tomatoes and garden eggs. The nature of geology close to KAS Quarries hardly permits any farming activities due to the abundance of boulders and extrusive igneous rocks covering a wide area. Interactions with the quarrying companies revealed that large acres of available lands

have been given out as concessions spanning several years to these quarry companies. ADU 2 Company Limited for example has acquired a total land area of 72.62 acres to produce about 300,000 tons of quarry products per annum. KAS quarry concession covers an area of 25.5 acres characterised by outcrops of granite, which is being mined to produce the rock aggregates. Brosa Mineral Resource Limited on the other hand has a concession of 18.70 acres, which is part of a mountain chain stretching for over 3km. This coupled with peri-urbanism poses a serious challenge to food security. As Hammond (2011) noted, in the peri-urban interface, a dwindling agricultural sector in which farmlands are under severe threat of displacement by residential development is always taking place. In the view of Afrane and Amoako (2011), high land prices in the core and along arterial roads of Kumasi has forced developers to seek lower prices in the peripheral areas. The effect is that rural land use gives way for urban land use forms in the form of residential development. These factors acting in tandem could jeopardise the food security situation in the study area.

2.2.4 Quarrying and health outcome

Quarrying activities in Buoho have negative effects on the health of the people living in and around the area, the workers at the quarry companies as well as the small-scale stone quarry operators. Quarrying degrades the environment with dire consequences on human health. About 78 per cent of the respondents had a history of an ailment, which according to them is related to quarry activities. Of those who had suffered some ill health related to quarrying the main health problems complained about include respiratory diseases, eye problems, muscle pains and malaria, with upper respiratory diseases dominating (see Figure 2).

Fig. 2: Main quarrying-related health problems



Source: Fieldwork, 2013

These diseases, according to the respondents were due to the high levels of dust concentration in the atmosphere (Plate 2) and the presence of ponds after rains that bred mosquitoes (Plate 4).

Plate 2: Dust emission from stone crushing



Source: Fieldwork, 2013

During blasting and stone crushing process, a large amount of dust is blown into the atmosphere to the discomfort of residents. In addition, movement of heavy-duty trucks adds to the dust problem as they convey boulders and finished products to and fro the quarry sites. Where the roads are not tarred, the problem of dust emissions is compounded. The worst affected people are the small-scale quarry operators and occupants of residential units sited close to the quarries. This observation supports the view of Bergman and Renwick (1999), who have proven that most of the suspended particles generated from quarrying activities contain over 70 per cent silica which is responsible for 80 per cent lung related diseases and 45 per cent visual complications. With very little or no protective gears, these workers are mostly exposed to occupation-related hazards such as injuries from flying rocks. The use of simple tools means that small-scale quarry operators have to rely on brute strength to extract, lift and transport heavy rock materials. This is probably the cause of the body or muscle pains that respondents complained about.

Apart from these ailments, respondents also expressed worry about actual and potential accidents from vibration of buildings, heavy-duty trucks, and flying rocks. According to one of them they are always in constant fear, as they cannot predict when such mishaps will occur. This is what a male head of household said in an in-depth interview:

We always feel insecure and under perpetual fear from occasional accidents. These occur when fast-moving trucks hit residents or operators sustain injury from flying rocks during blasting. Aside cracks in walls we do occasionally lose other household valuables including dressing mirrors, television set, other glassware and fragile items when they tilt, slide and fall over as a result of vibrations emanating from rock blasting.

The findings support observations by Yankson (2003) in Wenchi in the Brong-Ahafo region where quarrying not only contributed to rural livelihood but also had negative repercussions on the health of the quarry workers and severe damage to the natural environment.

2.3 Quarrying and the Environment

From the environmental point of view, Helmore and Singh (2001) identify sustainable livelihood as one that maintains the ecological integrity of the environment. Judging by the operations of the quarrying companies, environmental sustainability is put to serious question. According to the chief programme officer in-charge of quarries at the Environmental Protection Agency in Kumasi, KAS Product Limited and CYMAIN Quarry Company Limited operating in Nkukua Buoho have secured permit to operate under the Legislative Instrument (LI) 1657 and 1999 following the Environmental Protection Act 490 of 1994. This obviously means that they undertook Environmental Impact Assessment prior to the commencement of their operations. However, most small-scale quarry operators have not secured permit from the EPA. In the main, it is the activities of these people, which are responsible for the apparent widespread environmental degradation. The land is stripped of its vegetative cover making it more vulnerable to agents of denudation (see Plate 3 below).

Plate 3: Degraded state of the environment caused by quarrying in Nkukua Buoho



Source: Fieldwork, 2013

The respondents also complained of loud, deafening, incessant noise from blasting and breaking of rock boulders that can have serious health implications. Such noise from especially the large-scale quarrying concerns (for example KAS Quarry Company limited) is problematic. Pockets of small and large gaping holes associated with quarrying activities not only destroy the aesthetic beauty of the landscape but also become suitable breeding grounds for mosquitoes when rainwater collects in them (Plate 4).

Plate 4: Stagnant pool of water in a quarry pit



Source: Fieldwork, 2013

This is what a 41-year old roadside food vendor and a resident of Ntiri Buoho in her frustration had to say:

I am disappointed that people simply do not care about other people's wellbeing. The desire for money seems to override the need for environmental protection. The wanton degradation of the environment is problematic. We have petitioned the quarry operators/firms to minimise the air pollution and the destruction caused to our environment but they could not be bothered. If I have the means I will relocate away from this community.

The management of KAS product and CYMAIN quarries were of the view that those residing close to the quarry firms knew of the dangers they could be exposed to but would not relocate because of some perceived benefits. From the perspective of household respondents however, voluntary relocation because of imminent dangers is not an immediate option. Some held the view that they have every right to settle on their land and if activities of stone quarrying firms pose a threat to the environment, life and property then they must be made to stop their operations. The current findings reflect the environmental impact assessment report by Langer (2001) that quarrying operations contribute to environmental degradation (loss of biodiversity and environmental pollution). The current state of affairs is that quarrying operations in the study area has failed the test of environmental sustainability.

Like in many natural resource rich communities in Ghana, resource exploitation has little impact on the local communities studied. Access routes to the quarry sites are not in the best of shape. They are untarred, dusty and riddled with potholes and developing into gullies. One clear case is the road connecting the main town of Nkukua Buoho to CYMAIN quarries (Plate 5).

Plate 5: Bumpy and dusty road with deep surface holes



Source: Fieldwork, 2013

Nevertheless, quarrying is a source of raw material (chippings and other stone aggregates) for building and road construction projects.

With the spatial expansion of the Buoho township however, some residential units have virtually merged with the quarries and as such suffer from adverse consequences of vibrations occasioned by rock blasts using power drills and explosives. For instance KAS Product Company Limited has now virtually merged with the community as several residential quarters have sprung up around the company.

This has caused some damage in the form of cracks to buildings less than a kilometre from quarrying operations. There is scanty evidence of cracks in walls of houses close to KAS Quarry Company located within 50 to 80 meters away from the quarry site. While the evidence available casts some doubts on the causal linkage between cracks in walls and rock blasting operations of CYMAIN Quarry Company because of their distant locations, some aggrieved residents were quick to blame the situation on the quarry activities. The cracks on buildings and walls caused by such vibrations according to the respondents have also increased the cost of maintaining houses in term of repairs of cracks and also repainting of houses and walls. This is what a middle aged man had to say in an in-depth interview:

Our buildings have suffered serious cracks from rock blasting. The numerous cracks you see lend abundant credence to our plight. During rock blasting we feel the house 'shaking'.

It was also observed that some people who are building residential/housing units close to quarry sites have abandoned their projects for the reason that excessive vibration caused by the blasting could cause their buildings to collapse. This may explain why there are a number of uncompleted houses dotted around the quarries which further reduces the aesthetic beauty of the environment.

3. Conclusion and Recommendations

Quarrying provides some levels of employment and generates some income to the people of Buoho. Majority of the people however are engaged in the small-scale operations. With inadequate financial capital and simple hand-made tools small-scale quarrying does not generate returns to commensurate the efforts and time expended. Consequently income from the sector is abysmally low. According to Lanjuow and Abusaleh (2004), exploitation of natural resource is vital to rural livelihood improvement. The picture in Buoho is different. With limited job opportunities and poverty grim, the people of Bouho have to eke out a living from different livelihood portfolios including stone quarrying and farming. The quarrying operation in its current form is environmentally unsustainable. Land degradation is widespread posing serious threat to food security. Atmospheric dust concentration coupled with the physical nature of the quarrying process creates negative health consequences. The paper recommends the following:

In ensuring equity in the distribution of benefits derived from quarrying activities, there is the need for an effective collaboration involving all the stakeholders. The District Assembly, the traditional rulers (as custodians of stool lands), and the managers of both the large- and scale-scale quarry concerns should have a role to play to ensure that quarrying becomes mutually beneficial not only to the players in the industry but the generality of the

community. Effective collaboration among stakeholders should lead to conscious efforts at capacity building and financial support for small-scale enterprises and individuals seeking to diversify their livelihood incomes in order to cope with poverty in the community.

The land policy of Ghana provides a comprehensive policy framework for ensuring polluter pays principle and restoring any loss caused to the natural environment provided it is detrimental to the socio-economic development of the area. In order to control and reduce the extent of environmental damage caused by the quarry industry, the Environmental Protection Agency must enforce its environmental regulations. It must see to it that all those involved in quarrying operations have, as a matter of priority, the protection of the integrity of the environment. The information unit of the District Assembly in collaboration with the management of the quarry firms and health institutions must organise periodic community sensitisation on the negative effects of stone quarrying operations on the people of Buoho.

Small-scale quarry operations could come together under one umbrella. This move would make banks and other financial institutions more willing to give them loans as credible and credit worthy entity. This will create better opportunities for diversification of livelihood incomes and assets that will promote positive livelihood outcomes.

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