ENVIRONMENTAL AND HEALTH IMPACT OF QUARRYING AMONG RESIDENTS OF AKURE, ONDO STATE, NIGERIA.

ABSTRACT

The role of quarrying activities in the economics of the world cannot be underestimated and it has tremendously contributed to the present transformation and urbanization but not without repercussions. A field study was conducted to investigate the effect of granite quarrying operations on residents around quarry sites in Akure, Ondo State, Nigeria. Three quarry sites were selected for this study. The objective of the study was to investigate the environmental and health risks associated with quarrying activities in the study areas with the view of recommending ways of reducing these effects to the barest minimum possible. A well-structured closed questionnaire was used to collect information about demographic, environmental and health implications, and status of residents around the quarry sites. Majority of the respondents interviewed experienced various health issues ranging from headache, catarrh, cough, ear ringing, eye ache, body ache and skin itch. Environmental effects such as water, soil, air and noise pollution were also reported by the residents. This study has demonstrated vividly that quarrying operations have significant effects on the environment and health of residents around quarry sites.

INTRODUCTION

In recent times, environmental health issues have gained prominence across the globe and several international protocols have been established by the global community to ameliorate emerging issues (Lameed and Ayodele, 2010).

Rock-quarrying and stone crushing is a global phenomenon, and has been the cause of concern globally with the advanced countries not left out. Quarrying activity is a necessity

that provides much of the materials used in traditional hard flooring, such as granite, limestone, marble, sandstone, slate and even clay to make ceramic tiles. However, like many other man-made activities, quarrying activities cause significant impact on the environment (Okafor, 2006).

Environmental impacts of mining can occur at local, regional, and global scales through direct and indirect mining. Impacts can result in erosion, sinkholes, loss of biodiversity, or the contamination of soil, groundwater, and surface water by the chemicals emitted from mining processes. These processes also have an impact on the atmosphere from the emissions of carbon which have effect on the quality of human health (Sonter, 2018).

In blasting of rocks into smaller pebbles in quarry site, explosives are used. These explosives are employed in rock blasting to extract material for processing whiich cause noise and air pollution. A working quarry needs methods of transportation and this means that large amount of machinery and heavy traffic will be brought into the area causing an increase in local noise pollution and erosion. These vehicles and machineries release carbon II oxide (CO) due to incomplete combustion of fuel, also nitrogen oxide (NO) which are hazardous to human health (Iqbal and Shafig, 2001).

Suspended particulate matter like dust, smoke and fumes have effects on breathing and respiratory systems, aggravation of existing respiratory and cardiovascular diseases, alteration of body's defense systems against foreign materials, damage to lung tissues, cause carcers, and premature mortality (still-births) especially in elderly people and children (Iqbal and Shafig, 2001).

Undoubtedly, the most contentious environmental and health impact experienced by residents living adjacent or in the vicinity of quarries and surface mines is those produced by blasting. This has been confirmed not only anecdotally but also by surveys carried out by mineral planning authorities (William and Hugh, 2006).

Fly rock is a serious concern due to the implications of rock matter being projected from the quarry site and causing bodily harm to residents around the quarry. Also, the use of powered machinery to transport the materials as well as possibly processing plants to crush

and grade the minerals to required sizes all contribute even more noise to the environment (Lameed and Ayodele, 2010).

Thus, the changes in the physical, chemical or biological characteristics of our physical environment (air, water and land) brought about by quarrying are undesirable and causes harm to humans, other living organisms and cultural assets (Sinha *et al*., 2000).

MATERIALS AND METHODS

Study Area and Experimental sites

Quarry sites within Akure were chosen as the experimental sites for this study. Akure was chosen as the study area because of the quarry activities in the city.

Akure is the capital and largest city of Ondo State in South-Western Nigeria. It has an area of 991km² with population of 774,000. It is located on latilude 7º15¹0¹¹N on the equator and longitude 5º11¹42¹¹E on the Greenwich meridian. It has two seasons, which are the rainy and dry seasons.

Three quarries were selected for this study, they are: Dortmond quarry on lat. 7º20¹32.3¹¹N, long. 5º14¹59.4¹¹E, Ebenezer quarry on lat. 7º16¹44.0¹¹N long.5º14¹47.9¹¹E and Samchase quarry on lat. 7º20¹47.0¹¹N long. 5º14¹59.3¹¹E (Figure 1).

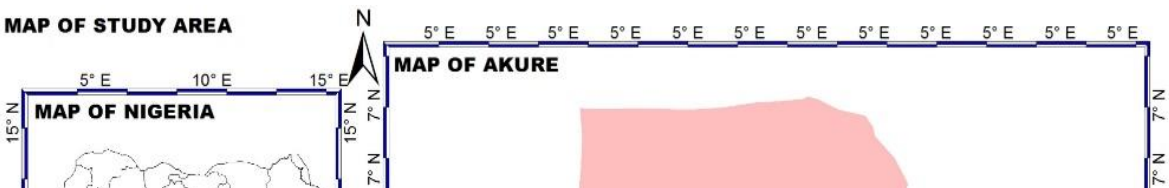

Figure 1: Map of Sampling Locations in Akure

Questionnaires

A well-structured questionnaire was administered to residents who live around the quarries to obtain information on their demography (age, gender, tribe, level of education), common ailments and other effects caused by quarrying operations on participants. Each participant's information was obtained through oral interview and the importance of the research was explained to the participants. Interpretation to local language was done for participants that did not understand English Language

RESULTS

Majority of the 100 residents interviewed were male (62 %) while the female were 38 %. The ages of respondents that participated in the study ranges from 20 to above 50 years (Table 1). However the highest age group observed in the study area is 20 – 30 years (38 %) while the lowest age group is 50 years and above. The marital status of respondents as presented in Table 1 showed that 72 % of them were married, 20 % of them unmarried while 4 % were divorced or widowed. Almost all the residents 92 % claimed that the quarry activities had significant effect on them and the environment (Table 2). Most of the respondents had been living around the quarry for 11 to 15 years and admitted that they know the health implication of living close to a quarry (Figure 2).

Health status of interviewed residents showed that majority (Table 3a) suffer from catarrh, cough and headache at least once in a week (40.0, 36.0 and 42.0 % respectively) which were significantly different ($P < 0.05$) among the respondents.

It was also observed in Table 3b that majority of the respondents (32 and 22 %) experienced eye ache and ear ache/ ringing weekly. It was noted that 86 %, 72 % and 50 % of respondents experienced eye ache, ear ache and skin itch at different times of the year respectively (Table 3b). However, no resident suffered from lung disease or impaired vision but 20 % suffered from visual disturbance, while 18 % suffered from impaired hearing (Table 3c).

Most residents (82 %) that lived around the quarries experience sleep disorder while 18 % claimed they don't have any problem as regards sleeping (Table 3c).

Table 1: Demographic Information of Residents Around Quarry Sites (n=100)

Variables		Frequency	Percentage (%)
Gender	Male	62	62.0
	Female	38	38.0
Age (yrs)	20 – 30	38	38.0
	31 – 40	34	34.0
	41 – 50	20	20.0
	Above 50	8	8.0
Marital Status	Married	72	72.0
	Single	20	20.0
	Divorced	4	4.0
	Widowed	4	4.0
Education	Primary	22	22.0
	Secondary	34	34.0
	Tertiary	14	14.0
	None	30	30.0
Tribe	Yoruba	36	36.0
	Hausa	56	56.0
	Others	8	8.0

Table 2: Awareness Information of Residents Around Quarry Sites (n=100)

Variables	Response	Frequency	Percentage (%)
How long have you been living here?	1-5 years	20	20.0
	6-10years	18	18.0
	11-15 years	34	34.0
	16-20 years	10	10.0
	Above 20 years	18	18.0
Do the quarrying activities have any effect on you or your environment?	Yes	92	92.0
	No	8	8.0

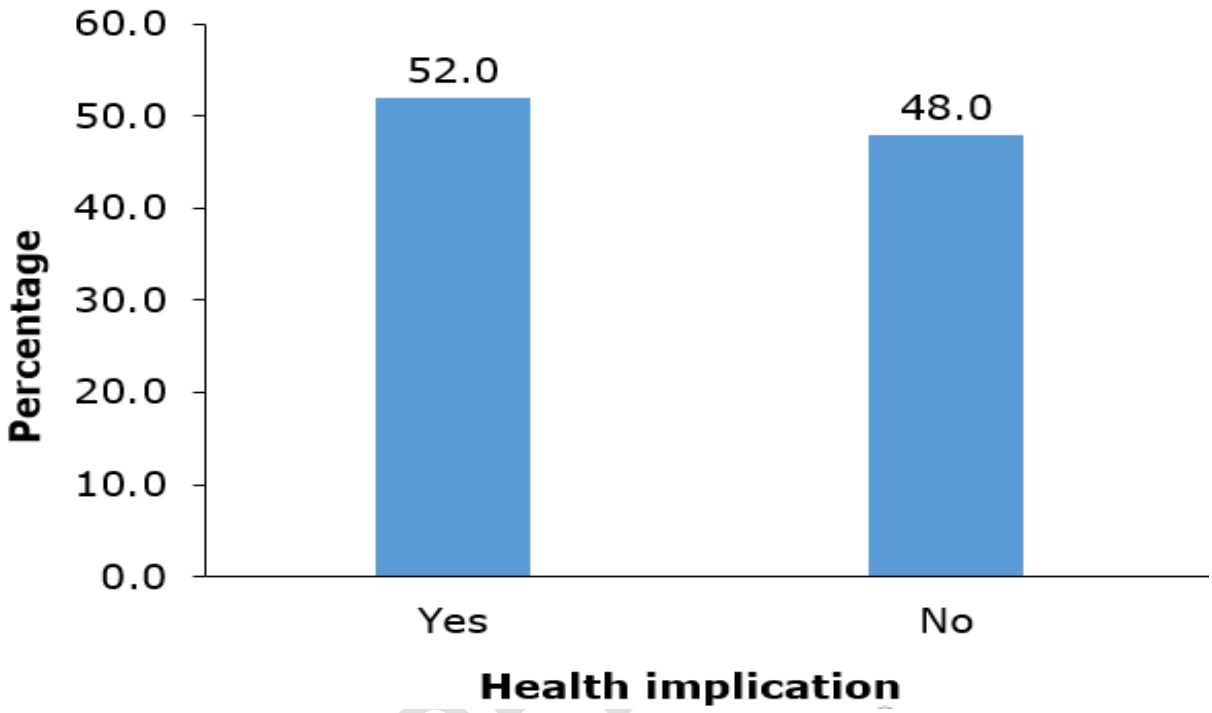

Figure 2: Knowledge of Residents about Health Implication of Living Around a Quarry

Table 3a: Health Status of Interviewed Residents (n=100)

Variables	Response	Frequency	Percentage (%)	Chi-square	P value
Cough	Daily	14	14.0	62.72	p<0.05
	Weekly	40	40.0		
	Every two weeks	28	28.0		
	Monthly	8	8.0		
	Quarterly	2	2.0		
	Never	8	8.0		
Catarrh	Daily	14	14.0	76.96	p<0.05
	Weekly	36	36.0		
	Every two weeks	30	30.0		
	Monthly	10	10.0		
	Quarterly	4	4.0		
	Yearly	2	2.0		
	Never	4	4.0		
Headache	Daily	28	28.0	71.72	p<0.05
	Weekly	42	42.0		
	Every two weeks	14	14.0		
	Monthly	6	6.0		
	Quarterly	6	6.0		
	Never	4	4.0		

Table 3b: Health Status of Interviewed Residents at the Study Sites (n=100)

Ailments	Response	Freque ncy value	Percentage (%)	Chi-square	P
Eye ache	Daily	12 P<0.05	12.0	38.28	
	Weekly	32	32.0		
	Every two weeks	12	12.0		
	Monthly	14	14.0		
	Quarterly	14	14.0		
	Yearly	2	2.0		
	Never	14	14.0		
Ear ache/ringing	Daily	18 P<0.05	18.0	37.76	
	Weekly	22	22.0		
	Every two weeks	10	10.0		
	Monthly	16	16.0		
	Quarterly	4	4.0		
	Yearly	2	2.0		
	Never	28	28.0		
Skin Itch	Daily	18 P<0.05	18.0	118.40	
	Weekly	14	14.0		
	Every two weeks	8	8.0		
	Monthly	4	4.0		
	Quarterly	4	4.0		

Yearly	2	2.0
Never	50	50.0

Table 3c: Health Status of Interviewed Residents at the Study Sites (n=100)

Ailments	Response	Frequency	Percentage (%)	Chi-square	P value
Visual disturbance	Daily	12	12.0	40.00	P<0.05
	Weekly	20	20.0		
	Every two weeks	8	8.0		
	Monthly	10	10.0		
	Quarterly	10	10.0		
	Yearly	6	6.0		
	Never	34	34.0		
Lung disease	Yes	0	0.0	NC	NC
	No	100	100.0		
Impaired hearing	Yes	18	18.0	40.96	P<0.05
	No	82	82.0		
Skin problem	Yes	26	26.0	23.04	P<0.05
	No	74	74.0		
Impaired vision	No	100	100.0	NC	NC
	Yes	0	0.0		
Sleeping Disorder	Always	30	30.0	17.84	P<0.05
	Sometimes	52	52.0		
	Never	18	18.0		

Table 4 shows the effects of living close to a quarry as experienced by respondents. Intermittent presence of dust in the atmosphere was reported by 78 % of residents, 20 % claimed the air is always dusty while 12% claimed this rarely happens.

Almost all the respondents (98 %) admitted that the highest concentration of particulate matter is during the dry season while all of them claimed there was no attempt by the quarries to minimize these effects.

Figure 3 showed the environmental hazards as experienced by those living close to the quarry. Air pollution, noise pollution and flyrocks (90, 96 and 88 %) were major problems experienced by residents while few residents complained about land degradation (14 %) and damage to crops (36 %). When asked about possible solution(s) to these problems, 52 % of residents wanted provision of a health care facility, 50 % wanted compensation while 26 % each wanted provision of alternative water supply and shut down of the quarry (Figure 4).

Flyrocks were seen scattered all over farmlands close to the quarry sites as shown in Plate 1.

Table 4: Effects of living close to a Quarry Sites.

Effects	Response	Frequency	Percentage (%)
Presence of dust in the air	Rarely	12	12.0
	Intermittently	68	68.0
	Permanently	20	20.0
What season do you have the highest concentration of particulate matter in the air?	Dry season	98	98.0
	All year round	2	2.0
When do you feel the vibration effect most?	Drilling	2	2.0
	Blasting	94	94.0
	Crushing	4	4.0
Is there any attempt by Company to reduce Impact?	Yes	0	0.0
	No	100	100.0

Plate 1: Samples of flyrocks from Dortmond and Samchase Quarries on nearby farms (Arrows)

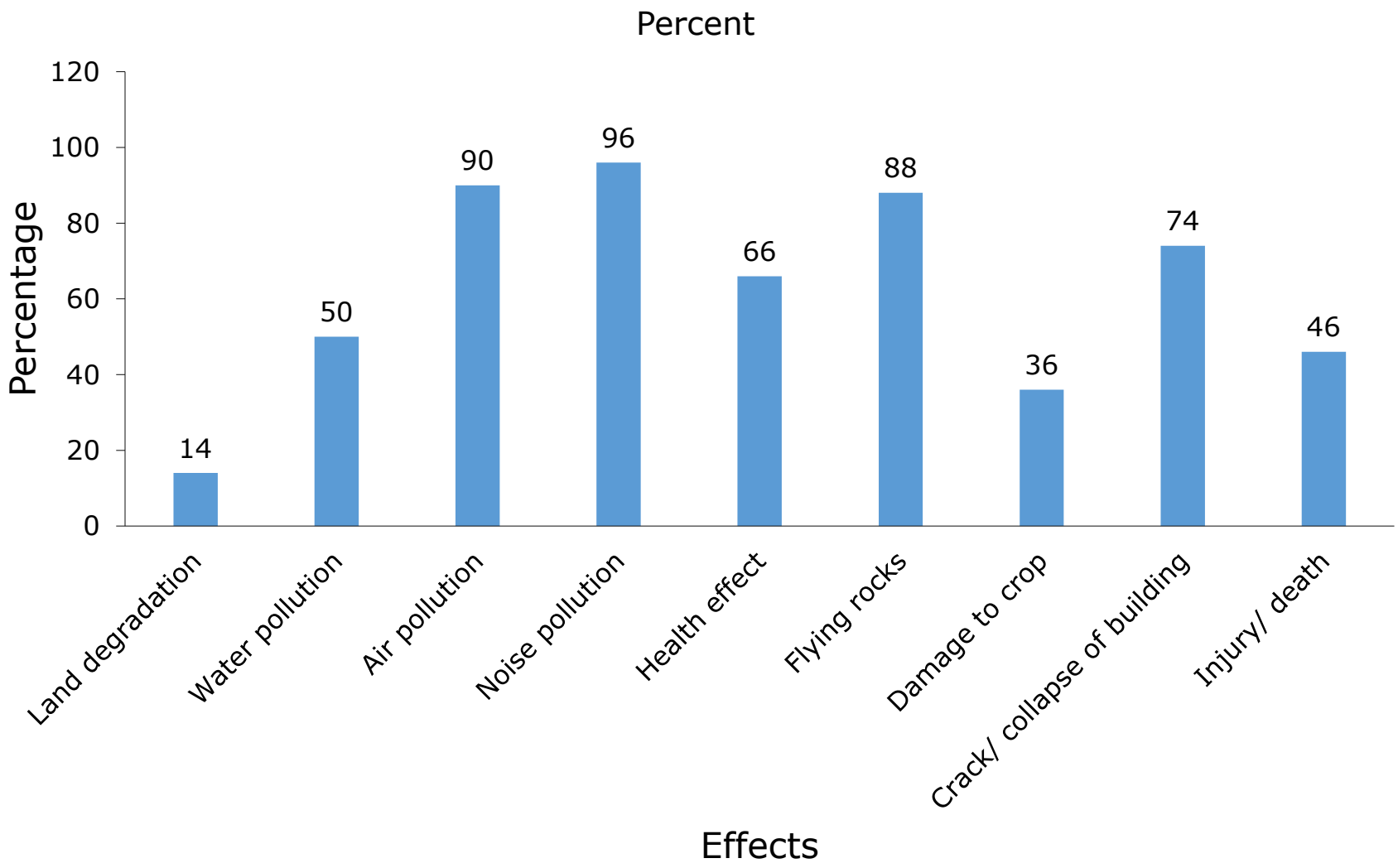

Figure 3: Effects of living close to quarry sites

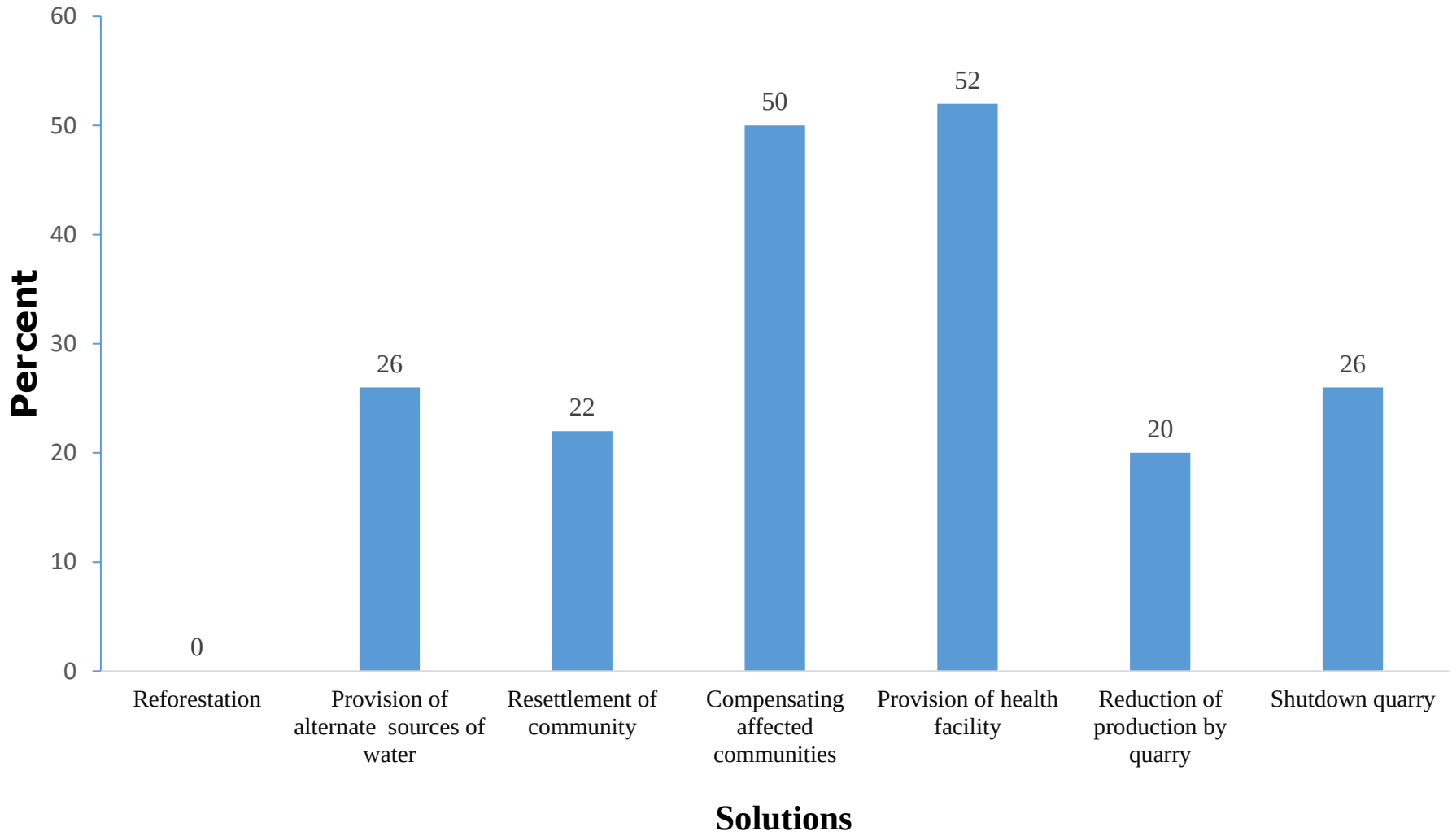

Figure 4: Suggestions by the Residents to Quarry Owners and Government

DICUSSION

The socio-demographic characteristics of residents around the quarry sites showed that majority (72 %) are within the ages of 20 to 40 years and had been living there for over 10 years (62 %) with low level of education (only 14 % had up to tertiary education). Although, most of the residents interviewed claimed that quarry activities have effects on them and their environment (92 %) but they refused to relocate, this could be because their source of livelihood is dependent on the location and there are no better alternatives available. The poor socio-economic status of residents living in close proximity to quarry site may portend a negative implication for proper awareness for pollution arising from quarrying and the required capability to demand for compensation and or relocation of their settlements farther away from quarry sites (Oguntoke *et. al.*2009).

Health problems suffered by residents at least once in two weeks include cough (82 %), catarrh (80 %), headache (84 %), eye ache (56 %) and sleeping disorders (82 %). These ailments may be as a direct consequence of dust and fumes generated during crushing and blasting, noise and air pollution brought about by quarry operations. It could be inferred from the results that most residents suffered from upper respiratory diseases (cough and catarrh) this may be caused by inhalation of dust carried by wind to the surrounding communities. Workers as well as residents in quarry areas are most likely to inhale dust particles into the lungs which causes silicosis, tuberculosis, bronchitis and even cancers (Madhavan and Raj 2005; Decondi-Nelson *et. al.*, 2015). Nartey *et. al.* (2012) observed that there was a rise in cough, pneumonia, common cold, eye problems, headaches and ear infections in residents staying close to quarry sites in the lower Manya Krobo district of the eastern region of Ghana. Noise, air and water pollution are some of the major challenges faced by residents around quarries. These pollutions are direct results of the effects caused by the operations of these quarries. Similar effects on residents of Ajebo Obafemi-Owode local government Abeokuta Ogun State was reported by Mbuyi (2017), the author identified water, air and noise pollutions as major problems facing residents around quarry sites.

Cracks to buildings reported by residents around quarry sites could be linked to vibration effects caused during blasting of rocks. This aligns with the findings of Kamaldeen and Ajibade (2011) when they researched on the environmental impact of quarrying on Otere village, Odeda, South-

west Nigeria and discovered that most houses had cracks and some had even collapsed due to quarry activities. Vibration and noise are associated with many types of equipment used for quarry operations but blasting is considered the major source of vibration which has affected the stability of infrastructures, buildings and homes of those living close to quarries (Akabzaa and Darmani 2001).

Injuries and deaths caused by fly rock were among the effects reported by residents. This is as a result of blasting of rocks with explosives which cause rock particles being projected to nearby places thereby causing harm and even death of residents or workers. Mine Safety and Health Administration (MSHA) had reported several accidents occurring due to fly rocks from mine and quarry sites. On July 5, 2000 at the Kent stone company Cadwell county, Kentucky a blaster standing on the top of a 200 feet high wall about 555 feet from the blast site was fatally injured by fly rock after sustaining a major head injury (MSHA 2000a). Also on October 12 2000, a visitor sustained severe injuries while a miner was killed by fly rock in a surface silica flux mine at Lucina mining inc., Lunar county, New Mexico. (MSHA 2000b).

Most residents suggested provision of healthcare facilities as a form of compensation to affected communities. This shows there is a pressing need for treatment of various health challenges brought about by quarry activities on the residents. Various health problems had been linked to quarrying activities by several authors (Enger and Smith 2002, Deborah 2006, Oguntoke *et. al.*2009).

CONCLUSION

Although quarrying and stone cutting activities are economically important worldwide, however its enormous deleterious effects on man and health cannot be overlooked. This research has revealed that quarrying is a major source of air, water, land and noise pollution and have significant effects on residents around the quarry sites by exposing them to varying degrees of health challenges and hazards without adequate compensation and health insurance.

RECOMMENDATIONSS

- The use of blasting mats during blasting to contain blast, prevent flyrocks and suppress dust should be mandated for all quarries in study areas.
- The use of modern technologies and equipment that produce negligible noise, precipitate and filter particulate matters should be employed by quarry owners to minimize the impact on the environment
- Approval should not be given for residential buildings where there are rocks or quarries
- Lastly, government should mandate quarry owners to compensate affected communities and also implement health insurance scheme for people living

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