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Assessment of the Socio-Economic and Health Impact of Quarrying on the Inhabitants of Kenta Logemo Village in Odeda Local Government Area, Ogun State, Nigeria

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Abstract

Quarry is a small scale industry generating materials used for construction, thus contributing to the Gross Domestic Product (GDP) of the country. This study was carried out to evaluate the socio-economic and health impact of quarry on the inhabitants of Kenta Logemo Village in Odeda Local Government Area, Ogun State. The sampling was carried out in three different distances (100, 200, 300 m) around the quarry site and 1000 m (control). The air quality monitored are (gaseous component) CO_2 NO_2, CO, volcanic organic compound (VOC) and particulate matters (PM) and noise level. Thirty copies of questionnaire were administered to the workers and inhabitants. The result showed that the gaseous pollutants were more pronounced at 100 m and there were no significant differences ($p > 0.05$) among the distances and they were below Federal Ministry of Environment (FmEnv) limit. The PM_{10} at 200 m (137.1 ug/m^3) was highest among three types of particulate matters and distances monitored. There were no significant differences ($p > 0.05$) across distances from the quarry. Noise level ranges from 59.3 to 86.3 dB(A) and higher than the control (50. 8 dB(A) but below FmEnv limit (90 dB(A). The analysis of the questionnaire revealed that the vegetation (40.0 %) and animal (46.7 %) were into extinction and threatened and dust (30.0 %) covered food or cash crops. Water bodies were affected by taste, colour and turbidity (63.3 %). Among the diseases suffered were catarrh (53.3 %) and eye irritation (46.7 %). In conclusion, the surrounding of the quarry is not polluted with CO_2 NO_2, CO, VOC, PM and noise but there is significant effect of the activity of quarry on the health and socio-economic of the inhabitants hence, improved the economic status.

Keywords: assessment, health, inhabitants, quarry, socio-economic, Kenta Logemo

1. Introduction

Rock quarrying and stone crushing is a worldwide phenomenon, and has been the cause of concern everywhere in the world. Quarrying as a small scale industry provides materials used in building and construction such as granite, sand dust and sandstone. However, like any other anthropogenic activity, this causes significant impact on the environment (Okafor, 2006). Guach (2001) reported that quarrying industry often goes with blasting of rocks with explosives in order to extract granite, sand dust etc. that always gives rise to noise and air pollution, habitat and biodiversity destruction.

The importance of this industry cannot be overemphasised as it contributes to the GDP of every nation of the world. In Palestine according to Sayara (2016), there were approximately 300 quarries and 1000 factories and workshops that yielded over 100 million tons of raw stone. Also, the quarries and factories produce approximately 25 million square meters of stone per annum. This implies that Palestine produces approximately 4 % of the world's production of stone and marble Sayara (2016). Actually, this industry contributes approximately 4.5% to gross national product (GNP) and 5.5 % to gross domestic product (GDP) in Palestine (Sayara, 2016). Oyinloye and Ajayi (2015) reported that there were noise and air pollution around quarry site at Oba-Ile in Ondo state in their study. In a survey conducted by Melodi (2017) 91% of the respondents (staff and residents around quarry) agreed that environmental problems such as land degradation and pollution (including air, water and noise) were linked

with quarry activities in their respective communities.

Most of these quarry sites release obnoxious gases during their operations hence resulting in the complaints of the nearby inhabitants (United State Environmental Protection Agency [USEPA], 2008), such as CO_2, CO, NO_2, SO_2 CH_4 and particulate matter (Adam, 2007). However, Combustion of fossil fuel for energy production also produces CO and CO_2 in quarry operations (EcoSmart, 2011). Human beings exposure to dust could cause pneumonia, catarrh chest pain, cough and eye problem (Mwaiselage, Moen, & Bråtveit, 2006). Quarry dust has also been found to cause a killer disease called 'silicosis', especially among quarry workers through the inhalation of minute dust particles (0.1 to 150 μm) high in silica (Madhaven & Sanjay, 2005). Occurrence of other respiratory and skin problems among manual stone-quarrying workers has been reported by Ugbogu, Ohakwe, and Foltescu (2009). The process of making hole in rock, limestone or overburden with the aid of a drilling machine (drilling process) may be treated as a point source of pollutant emission (Hsin-Yi, 2012). It can lead to chronic health effects, for instance decreased lung capacity and lung cancer resulting from long-term exposure to toxic air pollutants (Sunyer, 2001). Concerning the environmental impact, quarries and stone cutting industries cause ecological disturbance, pollution of air and landscape degradation (Aigbedion & Iyayi, 2007).

Concentration of carbon monoxide (CO) was highest in the drilling point followed by the crushing section, loading section and workshop place in the quarry site studied. Generator house had the least concentration of CO (Bada, Olatunde, & Akande, 2013). Oguntoke, Aboaba, and Gbadebo (2009) reported that the highest means of Suspended Particulate Matter (SPM) levels among the selected quarries vary between 26.03±1.36 and 11.03±1.52 mg/m^3. SPM levels declined significantly ($p>0.05$) with distance from the drilling and crushing locations at each of the quarry sites. At 25 m away from the quarry sites, mean SPM levels reduced drastically to 4.85±0.20 and 3.67±0.40 mg/m^3.

The inhabitants of Logemo village for some years back had been experiencing a terrible environmental pollution and discomforts from quarry operations which ranges from air pollution and a lots of respiratory diseases. Hence, this study; assessment of air quality and noise level of the environment; with emphasis on the socio-economic and health impact of the quarry activities on inhabitants of Kenta Logemo village in Odeda L.G.A in Ogun State.

2. Materials and Methods

2.1 Description of Site

Western Quarry Limited is one of the biggest crushing and grinding industry in Kenta Logemo village on longitude 4.151737˚ and latitude 6.816046˚in Odeda Local Government, Abeokuta; Ogun State. It was founded in 2010; since the establishment; Western Quarry has been rendering efficient and all round service for its client. This site was chosen based on its great and evergreen technology. The assessment was carried out on November 15th 2013.

2.2 Air Sampling

2.2.1 Gaseous Component

Parameter monitored include Nitrogen (IV) oxide (NO_2), Sulphur (IV) oxide (SO_2), Carbon (II) oxide (CO), Volatile organic compound (VOC) at 100, 200, 300 and the 1000 m (control) away from the quarry site. The instrument used was Aero Qual Series 200 meter. Each gas monitored has a sensor head that is attached to the meter. Air was sucked for three (3) minutes and the level of the gas pollutant was displayed on the meter; for various gas parameters determined. However, with the exception VOC sensor that was left for 5 minutes on the meter because of volatility of the Volatile organic compound.

2.2.2 Suspended particulate matter (SPM): This was measured using aerosol mass monitor model 831 at 100, 200, 300 m and control. Each particulate matter size monitored has a sensor head that is attached to the meter. The meter was held for ten (10) minutes at each point of the study area. After ten minutes the reading was recorded.

2.3 Noise Level

Noise level was measured using Testo noise meter. This was carried out by holding the meter display unit in the air at 100, 200, 300 m and control; until it made a pop sound; after which the measured values display. All the readings (air component, suspended particulate matter and noise level) were taken during the production period.

2.4 Questionnaire

Residents were asked questions on social demographic characteristics, residency period and perception about quarrying activities and their health experiences in the sampled community. During this survey; thirty- five copies of questionnaire were administered to thirty- five respondents; whose businesses were sited or living within the quarry site but thirty copies of questionnaire were retrieved and five non respondents were recorded; so we based our analysis on the 30 copies of questionnaire retrieved and inferences were made based on the collected data.

3. Results

Table 1. Gaseous Component Around the Quarry

Parameter	FMEnvLimit	100	200	300 m	control
NO_2	0.04-0.06 ug/m^3	0.007	0.005	0.005	0.03
SO_2	0.01 ug/m^3	0.00	0.00	0.00	0.04
CO	10 ug/m^3	0.00	0.00	0.00	0.01
VOC	180 ug/m^3	45.0	22.0	22.0	50.7

Parameter	Mean	Standard Deviation	100		200		300 m		Control	
			t-test	P-value	t-test	P-value	t-test	P-value	t-test	P-value
NO_2	0.012	0.012	-0.674	0.570	-0.958	0.439	-0.958	0.439	2.590	0.122
SO_2	0.010	0.020	-0.866	0.478	-0.866	0.478	-0.866	0.478	2.598	0.122
CO	0.003	0.005	-0.866	0.478	-0.866	0.478	-0.866	0.478	2.598	0.122
VOC	34.925	15.105	1.155	0.367	-1.482	0.277	-1.482	0.277	1.809	0.212

Table 2. Suspended Particulate Matter Around the Quarry

Parameter	FMEnvLimit	100	200	300 m	control
$PM_{2.5}$		1.8	6.1	2.0	1.5
PM_5	250 ug/m^3	34.8	80.7	33.2	20.7
PM_{10}		91.9	137.1	76.0	40.6

Parameter	Mean	Standard Deviation	100 meters		200 meters		300 meters		Control	
			t-test	P-value	t-test	P-value	t-test	P-value	t-test	P-value
$PM_{2.5}$	2.85	2.18	-0.84	0.49	2.59	0.12	-0.68	0.57	-1.07	0.40
PM_5	42.35	26.33	-0.50	0.67	2.52	0.13	-0.60	0.61	-1.42	0.29
PM_{10}	86.40	40.03	0.24	0.83	2.19	0.16	-0.45	0.70	-1.98	0.19

Table 3. Noise Level Around the Quarry

Parameter	FMEnvLimit	100	200	300 m	Control
Noise Level	90 dB(A)	86.5	83.5	59.3	50.8

Parameter	Mean	Standard Deviation	100 meters		200 meters		300 meters		Control	
			t-test	P-value	t-test	P-value	t-test	P-value	t-test	P-value
Noise Level	70.03	17.68	1.61	0.25	1.32	0.32	-1.05	0.40	-1.88	0.20

Table 4. Socio-Demographic Characteristics of Respondents

Characteristics	No of respondents	Percentage	Cumulative percent
Age group			
Under 20	12	40.0	40.0
21-30	11	36.7	76.7
31 and above	7	23.3	100.0
Marital status			
Single	10	33.3	33.3
Married	20	66.7	100
No of Children			
1-4	15	50.0	40
5 above	5	16.7	56.7
None	9	30.0	86.7
None response	1	3.3	100.00
Level of education			
High	18	60.0	60
Low	12	40.0	100
Occupation			
Farming	10	33.3	33.3
Self employed	10	33.3	66.6
Civil servant	2	6.7	73.3
Unemployed	8	26.7	100

Table 5. Respondents Business Located within Quarry Area

Closeness to quarry	No of respondents	Percentage
Closer	19	63.3
Farther	11	36.7
Economic status		
Improved	23	76.7
Not improved	4	13.3
Non response	3	10.0

Table 6. Negative Effect of Quarry n=30

Quarry impact	No of respondents	Percentage
Food/cash crops		
Destroy crops	3	10.0
Poor yield	5	16.7
Dust	9	30.0
Disease	3	10.0
Non-response	10	33.3
Vegetation		
Displacement and extinction	4	13.5
Extinction and threaten with disease	12	40.0
Displacement and threaten with disease	9	30.0
All of the above	3	10.0
Non-response	2	6.7

Wild animals		
Displacement	1	3.3
Extinction	6	20.0
Threaten with disease	2	6.7
Displacement and extinction	4	13.3
Extinction and threaten with disease	14	46.7
Displacement and threaten with Disease	1	3.3
All of the above	1	3.3
Non-response	1	3.3
Water bodies		
Turbidity	1	3.3
Taste and colour	2	6.7
Colour and turbidity	6	20.0
All of the above	19	63.3
Non-response	2	6.7
Aquatic animals		
Eutrophication	4	13.3
Dirty	4	13.3
Death	1	3.3
Reduce oxygen	1	3.3
Non-response	20	66.7
Noise level		
Hearing loss	3	10
Communication problem	5	16.7
Sleeplessness	5	16.7
Headache	7	23.3
Non – response	10	33.3

Table 7. Kind of Health Hazards Caused by Quarry Activities

Health problems	No of respondent	Percentage
Eye irritation	14	46.7
Head ache	2	6.7
Partial deafness	2	6.7
Cough	1	3.3
Respiratory disease	4	13.3
Skin irritation	1	3.3
Cold and catarrh	2	6.7
Non-response	4	13.3

Table 8. Kind of Respiratory Disease Predominant in the Area

Respiratory diseases	No of respondent	Percentage
Catarrh	16	53.3
Pneumonia	1	3.3
Silicosis	6	20.0
None of the above	1	3.3
Non-response	6	20.0

Table 9. Relationship between Activities of Quarry and the Health and Socio-Economic of the Inhabitants

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	T	Sig.
(Constant)	2.473	.322		7.674	0.000
HSE	0.367	.093	.432	3.945	0.000

Table 10. Model Summary

				Std. Error	Change Statistics				
Model	R	R Square	Adjusted R Square	of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	0.432[a]	0.186	.174	.977	.186	15.560	1	68	0.000

Y =2.473+0.367X

4. Discussion

There is no significant difference (0.57, 0.44, 0.44 and 0.12) in the level of NO_2 at different distances (100, 200, 300 m and controls) respectively from the quarry (Adam, 2007). However, the mean of the NO_2 (0.012 ug/m^3) falls below the FMEnv Limit of 0.04-0.06 ug/m^3 which suggests that the emission of NO_2 by the quarry was within limit. There is no significant difference (0.48, 0.48, 0.48 and 0.12) in the level of SO_2 at various distances from the quarry (Adam, 2007). Furthermore, the mean of the SO_2 (0.01 ug/m^3) is the same as the FMEnv Limit of 0.01 ug/m^3 which suggests that the emission of SO_2 by the quarry was exactly at its limit and any increase could be hazardous to the environment. There is no significant difference ($p > 0.05$) in the level of CO across various distances from the quarry (EcoSmart, 2011). In addition, the mean of the CO (0.003 ug/m^3) falls below the FMEnv Limit of 10 ug/m^3; which suggests that the emission of CO by the quarry is within the regulatory limit as per the distances considered. Bada *et al.* (2013) opined that concentration of carbon monoxide (CO) was highest in the drilling point followed by other sections of the quarry studied. There is no significant difference ($p > 0.05$) in all distances and control regarding the VOC (EcoSmart, 2011). The mean of the VOC (34.93 ug/m^3) falls below the FMEnv Limit (180 ug/m^3) which suggests that the emission of VOC by the quarry is within the limit in all distances.

There is no significant difference (0.49, 0.12, 0.57 and 0.40) in the level of $PM_{2.5}$ at the different distances (100, 200, 300 m and controls) from the quarry respectively. However, the mean of the $PM_{2.5}$ (2.85 ug/m^3) falls below the FMEnv Limit of 250 ug/m^3 which suggests that the emission of $PM_{2.5}$ by the quarry is within limit. There is no significant difference (0.67, 0.13, 0.61 and 0.29) in the level of PM_5 at different distances from the quarry. The mean of the PM_5 (42.35 ug/m^3) falls below the FMEnv Limit of 250 ug/m^3 which implies that the emission of PM_5 from the quarry was within the limit. Furthermore, there is no significant difference in the level PM_{10} in all the distances from the quarry. However, the mean of the PM_{10} (86.4 ug/m^3) falls below the FMEnv Limit of 250 ug/m^3 which suggests that the emission of PM_{10} from the quarry is within limit. Oguntoke, Aboaba, and Gbadebo (2009) reported that at 25 m away from the quarry sites, mean of PM levels reduced drastically to 4.85±0.20 and 3.67±0.40 mg/m^3.

There is no significant difference (0.25, 0.32, 0.40 and 0.20) in the level of the noise generated from the quarry at the different distances (100, 200, 300 m and control) respectively. However, the mean of the noise of 70 dB(A) falls below the FMEnv Limit of 90 dB(A) which suggests that the noise from the quarry is within limit. Oyinloye and Ajayi (2015) reported that there were noise and air pollution at Oba-Ile in Ondo state around quarry site studied. The reason while most of the results were within the regulatory limit was because of the thick forest around the quarry which absorbed the impact of the noise, gaseous pollutants and particulate matters. Furthermore, it was also observed that $PM_{2.5}$, $PM_{5,}$ and PM_{10} higher at 200 m than any distance monitored, this is because there were no much forest at that distance to absorb the dust, probably cleared for agricultural, developmental or infrastructural purposes.

The data collected through questionnaire administration were analyzed. However, the respondents were able young men and women with sound mind and right judgment based on their ages. The result shows that most of the respondents are married people (66.7 %). However, 50% of the respondents have between 1 to 4 children, 16.7 % have 5 or more children, and 30 % have no children. The result reveals that 60% of the respondents were literates that is, they have some level of education, while 40% were illiterate. Respondents (33.3 %) were farmers, 33.3% were self-employed and 6.7% were civil servants, while 26.7% were unemployed.

Furthermore, 63.3 % of the respondents have their businesses sited around the quarry site, 36.7 % do not have their businesses sited within quarry areas. Also 76.7 % of the respondents businesses were affected positively. According to Sayara (2016) quarry industry contributes approximately 4.5 % to gross national product (GNP) and 5.5 % to gross domestic product (GDP) of Palestine.

The 90.0 % of the respondents said the quarry activities in the area affected water bodies. From the result, it can be concluded that the quarry activities affect water bodies by making the water to have taste, colour and turbidity. The food or cash crops were covered with dust (30.0 %). However, vegetation (40.0 %) and wild animals (46.7 %) were into extinction and threatened with disease. The aquatic animals were negatively affected with eutrophication (13.3 %) and dirty (13.3 %). Inference can be drawn that the noise from quarry activities causes headache (23.3 %) for the people living in the village. Similarly, Guach (2001) reported that quarrying industry often goes with blasting of rocks with explosives in order to extract granite, sand dust etc. that always gives rise to noise and air pollution, biodiversity and habitat destruction.

The kind of health hazard posed by quarry activities to the villagers was eye irritation (46.7 %), which could be as a result of the dusty environment. The respiratory disease that is common in the village was catarrh (53.3 %). In a survey conducted by Melodi (2017), he reported that 91 % of the respondents (staff and residents around quarry) agreed that environmental problems such as land degradation and pollution (including air, water and noise) were linked with quarrying activities in their respective communities. However, the p-value = 0.000, hence there is significance relationship between the activity of quarry and the health and socio-economic of the inhabitants. The activity of quarry and the health and socio-economic of the inhabitants thus, shows a positive relationship.

5. Conclusion

The level at which most parameters were very close to the FMEnv Limit calls for caution; hence, to avert the danger all hands must be on desk. Even at relatively low concentration, the burden of air pollution on health is significant. However, effective management of air quality aiming to achieve FMEnv Limit is necessary to reduce health risks to barest minimum at Western Quarry Limited is urgently needed. However, effort should be made for those parameters not to go beyond the levels they are currently; so as to have good air quality sustainability in the surrounding area. Furthermore, the fact that it improves the socio-economic wellbeing of the surrounding village, is enough for the government to pay attention to the industry and regulate their activities so as not to draw the attention of various stakeholders in the environment, calling for the stoppage of quarry activities in the area regarding the protection of the environment.

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