

# Locational Effect of Quarry Sites on Residents' Satisfaction and Environment of Proximate Residential Neighborhood in Akure

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## Abstract

The use of quarrying products are increasingly demanded for various purposes so as to satisfy the needs of the rapidly growing population. However, the siting of quarry industries had increased the exposure of great percentage of the population to environmental pollutions and the concomitants health hazard in developing countries. With samples from Akure, the study examined the variation of the satisfaction of the people living around quarry site with distance away from the location of the site. 180 questionnaires were administered in two (2) quarry sites while only 90 questionnaires were returned and found good for analysis. Using Geographic Information System (GIS) and Crosstabs' nominal-by-nominal measures, the study found that the farther the distances away from the quarry site, the lower the percentages of high level of environmental pollution; When the effect of fear of health problems exhibited by the residents was introduced, the study found that the variation in the satisfaction level with distance was due to those who did not harboured fear of health problems. The study also found that statistically significant relationship exists between the level of environmental pollution and satisfaction with the quarry site. To alleviate the environmental pollution associated with the location of quarry site therefore, the residents should be provided with unbiased factual information relating to the negative effects on health and other hazards associated with living in close proximity to quarry site.

## Keywords

Quarry Site, Environmental Pollution, Cross Tabulation, GIS, Akure

Received: April 20, 2018 / Accepted: June 15, 2018 / Published online: July 23, 2018

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## 1. Introduction

Considerable growth in the use of quarry products has led to increasing demand for land to site quarry industries and its associated infrastructures [1]. However, quarry operations generally involve drilling, blasting, removal of over-burden, and crushing of rock materials. The various impacts of quarrying are both size and locations dependent. Manifestations of specific impacts are on the air, water, soil, earth surface, flora and fauna, and human beings [3].

Interestingly, quarry activities in the developed countries had undergone rational changes within the purview of sustainable development [5, 6]. In Nigeria, efforts have been made by government to ensure sustainable development through the establishment of Environmental Planning and Protection Division (EPPD) in 1975 under the Ministry of Industry. This led to the enactment of Federal Environmental Protection Agency (FEPA) CAP 131, LFN, 1990 as amended by Decree No 59 of 1992 in which all states in the federation established their own Environmental Protection Agency. However, according to [2] the goals is to ensure a quality environment

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for the health and well-being of the people, to use land and conserve it with its natural resources for the benefits of present and future generations.

However, quarry industries are sited in close proximity to rocky areas, because; the farther, the equipment is located away from the rock, the more the difficulty in carrying out quarry activities. Secondly, if the equipment's are placed too far from the rock, this will cause the quarry operator additional expenses in production of raw materials to its end users. The basic fact is that there are practical limitations to the geographic area that a quarry site can be located and there are instances where those areas are gradually enveloped into built-up areas [1, 9].

## 2. Literature Review

The growing concerns of the general public over the effects of the quarry sites on residential neighborhood stems from the concerns about the negative effect it impacts on health, safety and environment. Therefore, there is a need to review various literatures on the fear originating from health effects of quarry sites and its resultant environmental pollution.

### 2.1. Fear Originating from Health Effects of Quarry Sites

Since Quarry industries must be sited in close proximity to rocks for easy execution of quarry activities; to avoid the resultant effect on people, most quarry sites are located far from inhabited area. According to [9] environmental problems emanating from quarry sites include visual intrusion, damage to landscapes, traffic, smoke, noise, dust, damage to caves, loss of land, and deterioration in water quality. However, the main concern here is blasting which is necessary to break down the rocks from the ground for subsequent processing into aggregates. The results of this anomaly affects the health of the residents depending on the intensity of exposure. In view of this, government authorities have consistently insisted that industries are to be established far from built-up areas at a specific distance from public infrastructure and buildings as stated in various laws to reduce the level of environmental pollution in various communities [7]. Some of the studies on effect of quarry industries on residential neighborhood has revealed that as development/urbanisation sets with time, the areas which hitherto were used for quarrying are gradually enveloped into residential/commercial built-up areas [8, 4]. In this wise, [10, 9] observed that there is extremely strong evidence to conclude that quarry sites are risk factors for:

- i. Collapse of buildings as a result of land vibration during blasting of rocks

- ii. Breeding of mosquito causing malaria as a result of abandoned Open-mine pits.
- iii. Nauseating Stench on the Environment.
- iv. Death of Little Children in the Mine Pits.
- v. Decrease in Farm Products.
- vi. Destruction of Biodiversity.
- vii. High occurrence of erosion

### 2.2. Environmental Pollution Arising from Quarry Activities

Understanding the effects of quarrying activities on environment is important to quarry industries in planning the siting/location, and handling likely opposition from property owners. The literature on environmental pollution arising from quarry activities is still very scanty especially in developing countries. [9] assessed the effects of quarrying activities on residential and water quality of rural households in mining areas of Oyo State, Nigeria. Using descriptive statistics, it was found that the residential environment were affected by noise pollution from heavy machine and land vibration resulting from blasting. In this wise, there is extremely strong evidence to conclude that quarry activities generates environmental pollutions such as [10, 1, 9]:

- i. Degradation of farmland and roads,
- ii. River siltation/farm flooding,
- iii. Pollution of water sources,
- iv. Noise from quarry operations,
- v. Vibrations from rock blasting,
- vi. Air pollution/dust generation and
- vii. Destruction of biodiversity.

## 3. Research Methodology

The data for this study were drawn from a sample of occupiers of residential neighbourhoods located within 2.5 kilometers radius to each of two (2) quarry sites (i.e Mansory and Stone Work quarry companies) in Akure North Local Government Area of Ondo State. A random sample of 15 houses were taken each at estimated distance of less than 0.5km, 0.6km-1.0km, 1.1km-1.5km, 1.6km-2.0km, 2.1km-2.5km and above 2.5km away from each quarry site. In each of the selected houses, questionnaire was administered to an occupant, in all; One hundred and eighty (180) respondents from two (2) quarry sites were investigated. Only 90 questionnaires were returned and found good for analysis. The major question areas include: their satisfaction with the location of the quarry site in their neighborhood, the level of

environmental pollution and whether or not they harbor fear of losing their health due to the sitting of the quarry site in the area. The analysis was done at four levels as follows:

- i. the relationship between satisfaction with the quarry site location and distance away from the quarry site,
- ii. the effect of fear exhibited by the residents on their satisfaction with the quarry site location,
- iii. the relationship between the level of environmental pollution and distance away from the quarry site,
- iv. the effect of environmental pollution arising on satisfaction with the quarry site location.

The choice of the methods of analysis was primarily anchored on the categorical nature of the data. In this regard, Cross tabulation was used to determine the significance and strength of the relationships between the variables (i.e. items i-iv). In this wise, chi square was employed to determine the significance of the relationship while, Directional and Symmetric Measures were used to assess the strength of the relationships. Geographic Information System (GIS) was used to analyze the spatial distribution of quarry sites in the study area while distance of 500 metres was buffered around the quarry sites to reveal the residents in close proximity.

Table 1. Operational Definition of variables.

Variable	Description	Measurement
Quarry site	Satisfaction with location of quarry site	1= Highly not satisfied 2= Somewhat not satisfied 3= Neutral 4= Somewhat satisfied 5= Highly satisfied

Variable	Description	Measurement
Distance	Distance from quarry site	1= less than 0.5km 2= 0.6km-1.0km 3= 1.1km-1.5km 4= 1.6km-2.0km 5= 2.1km-2.5km 6= Above 2.5km
Environmental Pollution	Level of Environmental Pollution	1= Very high 2= High 3= Undecided 4= Low 5= Very low
Fear	Fear of losing their health exhibited by the residents due to quarry activities.	0= Not harboring fear 1= Harboring fear

## 4. Data Analysis and Discussion of Findings

### 4.1. Spatial Analysis of Locational Distribution of Quarry Sites in the Study Area Using GIS

Figure 1 and 2 revealed 2 cases of quarry activities/operation (such as blasting, drilling etc.) overlapping in the study area. These were derived after a buffer area of 0.5km drawn around each quarry site. The implication is that, such overlap of quarrying will culminate in multiplication of any adverse negative effect on its environment (pollution, noise, health hazards and aesthetics) with devastating consequences on residents of the areas. This can be attributed to lack of consultation with Physical Planning Authorities before acquiring land in this environment.

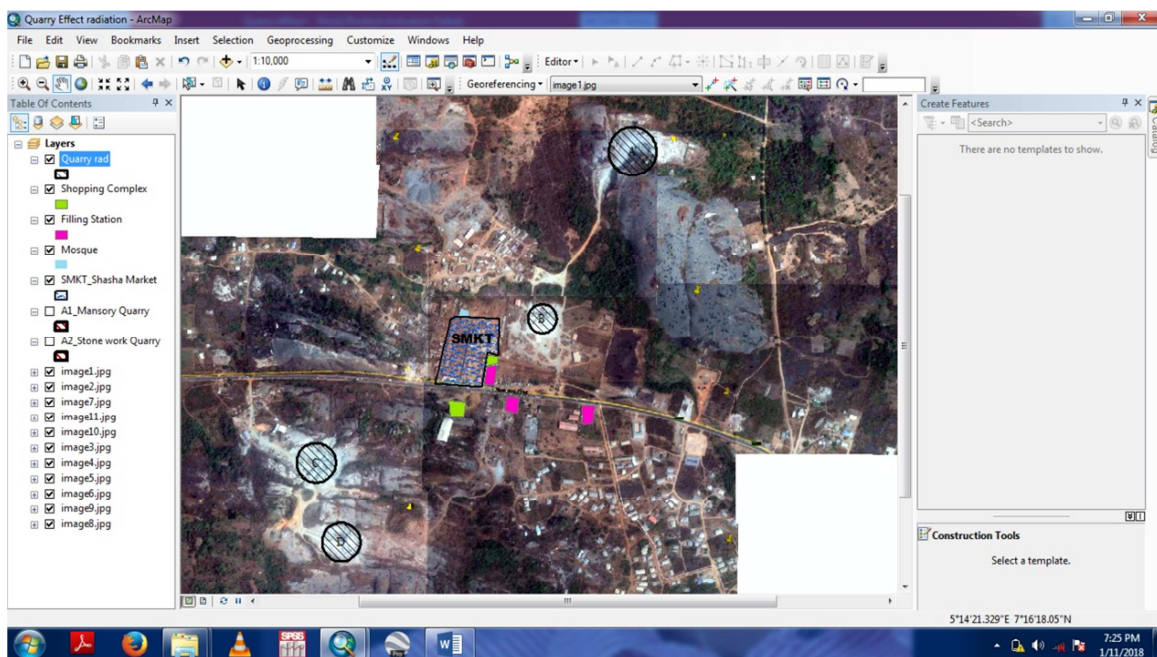
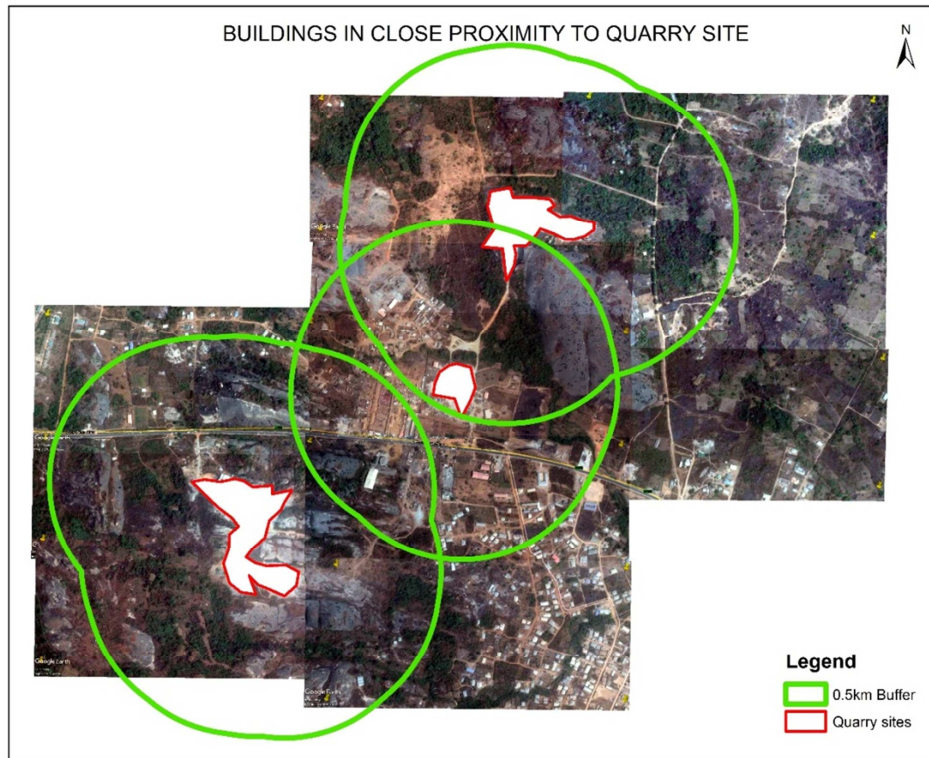


Figure 1. Spatial Distribution of all quarry sites in Akure (the study area).



**Figure 2.** Buffer limits of quarry sites with residents in close proximity at 0.5km distance.

Source: Author’s GIS analysis, 2018.

#### 4.2. The Relationship Between Distance from Quarry Site and Satisfaction with Quarry Sites

Table 2 below shows the results of the cross tabulation of the relationship between satisfaction with the location of quarry site and distance away from it. From this table, the total percentages of those that are not satisfied (i.e. a combination of highly not satisfied with those that are somewhat not satisfied) for distances less than 0.5km, 0.6km-1.0km, 1.1km-1.5km, 1.6km-2.0km, 2.1km-2.5km and above 2.5km are 60.0%, 66.7%, 46.6%, 60%, 60%,

53.3% and 26.6% respectively; this implies that, the further away the distance from the quarry site, the lower the number of those who are not satisfied. On the other hand, the further away the distances away from the base station, the higher the percentages of those that are satisfied; for distances less than 0.5km, 0.6km-1.0km, 1.1km-1.5km, 1.6km-2.0km, 2.1km-2.5km and above 2.5km, the percentages of those that are satisfied (i.e. a combination of highly satisfied with those that are somewhat satisfied) are 13.4%, 13.4%, 13.3%, 13.4%, 26.6% and 66.7% respectively.

**Table 2.** Cross tabulation of Distance from quarry activities and Satisfaction with quarry sites.

		Satisfaction with quarry sites					Total	
		Highly not satisfied	Somewhat not satisfied	Neutral	Somewhat satisfied	Highly satisfied		
Distance from quarry sites (km)	0-0.5km	Count	6	3	4	1	1	15
		% within Distance from quarry activities	40.0%	20.0%	26.7%	6.7%	6.7%	100.0%
	0.6-1.0km	Count	3	7	3	1	1	15
		% within Distance from quarry activities	20.0%	46.7%	20.0%	6.7%	6.7%	100.0%
	1.1-1.5km	Count	2	5	6	2	0	15
		% within Distance from quarry activities	13.3%	33.3%	40.0%	13.3%	0.0%	100.0%
	1.6-2.0km	Count	3	6	4	1	1	15
		% within Distance from quarry activities	20.0%	40.0%	26.7%	6.7%	6.7%	100.0%
	2.1-2.5km	Count	3	5	3	2	2	15
		% within Distance from quarry activities	20.0%	33.3%	20.0%	13.3%	13.3%	100.0%
> 2.5km	Count	2	2	1	6	4	15	
	% within Distance from quarry activities	13.3%	13.3%	6.7%	40.0%	26.7%	100.0%	
Total		Count	19	28	21	13	9	90
		% within Distance from quarry activities	21.1%	31.1%	23.3%	14.4%	10.0%	100.0%

Source: Field Survey, 2018

Table 3. Chi-Square Tests.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.018 <sup>a</sup>	20	.165
Likelihood Ratio	24.808	20	.209
Linear-by-Linear Association	7.765	1	.005
N of Valid Cases	90		

Table 3 reveals that all the significant tests (Pearsons Chi-square = 0.165, Likelihood Ratio = 0.209) are above 0.05, hence we can conclude that a statistically significant relationship does not exist between satisfaction with the location of quarry site and distance away from it.

### 4.3. The Effect of Fear of Health Problems on Satisfaction with Quarry Site Location

Table 4. The Effects of fear of health problems on satisfaction with quarry site.

Fear Of Health Problems			Satisfaction with quarry sites					Total
			Highly not satisfied	Somewh at not satisfied	Neutral	Somewh at satisfied	Highly satisfied	
NO	0-0.5km	Count	6	1	0	0	1	8
		% within Distance from quarry site	75.0%	12.5%	0.0%	0.0%	12.5%	100.0%
	0.6-1.0km	Count	1	4	0	0	0	5
		% within Distance from quarry site	20.0%	80.0%	0.0%	0.0%	0.0%	100.0%
	1.1-1.5km	Count	1	2	3	1	0	7
		% within Distance from quarry site	14.3%	28.6%	42.9%	14.3%	0.0%	100.0%
	1.6-2.0km	Count	2	3	3	1	1	10
		% within Distance from quarry site	20.0%	30.0%	30.0%	10.0%	10.0%	100.0%
	2.1-2.5km	Count	1	4	0	2	0	7
		% within Distance from quarry site	14.3%	57.1%	0.0%	28.6%	0.0%	100.0%
> 2.5km	Count	2	0	1	4	3	10	
	% within Distance from quarry site	20.0%	0.0%	10.0%	40.0%	30.0%	100.0%	
Total	Count	13	14	7	8	5	47	
	% within Distance from quarry site	27.7%	29.8%	14.9%	17.0%	10.6%	100.0%	
YES	0-0.5km	Count	0	2	4	1	0	7
		% within Distance from quarry site	0.0%	28.6%	57.1%	14.3%	0.0%	100.0%
	0.6-1.0km	Count	2	3	3	1	1	10
		% within Distance from quarry site	20.0%	30.0%	30.0%	10.0%	10.0%	100.0%
	1.1-1.5km	Count	1	3	3	1	0	8
		% within Distance from quarry site	12.5%	37.5%	37.5%	12.5%	0.0%	100.0%
	1.6-2.0km	Count	1	3	1	0	0	5
		% within Distance from quarry site	20.0%	60.0%	20.0%	0.0%	0.0%	100.0%
	2.1-2.5km	Count	2	1	3	0	2	8
		% within Distance from quarry site	25.0%	12.5%	37.5%	0.0%	25.0%	100.0%
> 2.5km	Count	0	2	0	2	1	5	
	% within Distance from quarry site	0.0%	40.0%	0.0%	40.0%	20.0%	100.0%	
Total	Count	6	14	14	5	4	43	
	% within Distance from quarry site	14.0%	32.6%	32.6%	11.6%	9.3%	100.0%	

Table 5. Pearson Chi-Square Tests.

		Satisfaction with quarry sites	
		Chi-square	Sig.
Fear of losing their Health	NO	Chi-square	37.799
		df	20
	YES	Chi-square	18.077
		Sig.	.009*

When the effect of fear of health problems exhibited by the residents was introduced, the previous crosstabulation (Table 2) is now split into two parts as shown in table 4. The significance values of the Pearson Chi-Square tests (Table 5) (Chi-Square = 37.799, df = 20 and Sig. = 0.009) for Occupants who did not harboured fear of health problem are less than 0.05, the relationship observed in the

crosstabulation (Table 4) is therefore, real and not due to chance. The same thing cannot be said of those who harbour any fear; in which case, the significant values (Chi-Square = 18.077, df = 20 and Sig. = 0.582) are greater than 0.05. Hence we can conclude that the variation in the satisfaction level with distance is due to those who did not harboured fear of health problems.

#### 4.4. The Relationship Between Distance from Quarry Activities and the Level of Environmental Pollution

Table 6 below shows the results of the cross tabulation of the relationship between the level of environmental pollution and distance away from it. From this table, the total percentages of those that experience high level of environmental pollution (i.e. a combination of very high with those that are high) for distances less than 0.5km, 0.6km-1.0km, 1.1km-1.5km, 1.6km-2.0km, 2.1km-2.5km and above 2.5km are 100.0%, 100.0%, 86.7%, 86.6%, 53.4% and 46.6% respectively. This

implies that, the further away the distance from the quarry site, the lower the number of those who experience high level of environmental pollution. On the other hand, the further away the distances from the quarry site, the higher the percentages of those that experience low level of environmental pollution. For distances less than 0.5km, 0.6km-1.0km, 1.1km-1.5km, 1.6km-2.0km, 2.1km-2.5km and above 2.5km, the percentages of those that experience low level of environmental pollution (i.e. a combination of low with those that are very low) are 0.0%, 0.0%, 0.0%, 13.3%, 26.6% and 40.0% respectively.

**Table 6.** Cross tabulation of Distance from quarry activities and Level of environmental pollution.

			Level of environmental pollution					Total
			Very High	High	Undecided	Low	Very low	
Distance from quarry activities (km)	0-0.5km	Count	14	1	0	0	0	15
		% within Distance from quarry activities	93.3%	6.7%	0.0%	0.0%	0.0%	100.0%
	0.6-1.0km	Count	12	3	0	0	0	15
		% within Distance from quarry activities	80.0%	20.0%	0.0%	0.0%	0.0%	100.0%
	1.1-1.5km	Count	9	4	2	0	0	15
		% within Distance from quarry activities	60.0%	26.7%	13.3%	0.0%	0.0%	100.0%
	1.6-2.0km	Count	8	5	0	2	0	15
		% within Distance from quarry activities	53.3%	33.3%	0.0%	13.3%	0.0%	100.0%
	2.1-2.5km	Count	4	4	3	2	2	15
		% within Distance from quarry activities	26.7%	26.7%	20.0%	13.3%	13.3%	100.0%
	> 2.5km	Count	2	5	2	4	2	15
		% within Distance from quarry activities	13.3%	33.3%	13.3%	26.7%	13.3%	100.0%
Total	Count	49	22	7	8	4	90	
	% within Distance from quarry activities	54.4%	24.4%	7.8%	8.9%	4.4%	100.0%	

**Table 7.** Chi-Square Tests.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	41.499 <sup>a</sup>	20	.003
Likelihood Ratio	49.002	20	.000
Linear-by-Linear Association	29.526	1	.000
N of Valid Cases	90		

**Table 8.** Symmetric Measures.

		Value	Approx. Sig.
Nominal by Nominal	Phi	.679	.003
	Cramer's V	.340	.003
	Contingency Coefficient	.562	.003
N of Valid Cases		90	

The two-sided asymptotic significance of the chi-square statistic is less than 0.05 in Table 7, so it's safe to say that the observed variations in these percentages across the distances are not due to chance. This implies that occupants at different kilometer away from the quarry site experience different levels of environmental pollution. While the values of the chi-square tests indicates a significant relationship; Symmetric measures shows the strength of this relationship. The significance values of all the three Symmetric measures from Table 8 are 0.003, further confirming a statistically significant relationship. However, the values of all the three measures are Phi=0.679, Cramer's V=0.340, and Contingency Coefficient=0.562, indicating that, although the relationship is not due to chance, it is also not very strong.

#### 4.5. The Effect of Environmental Pollution Arising on Satisfaction with the Quarry Site Location

The last factor which was considered was if the satisfaction experienced had a relationship with the level of environmental pollution. In other words, whether the satisfaction with the location of the quarry site could be attributable to the level of environmental pollution (Table 9). The environmental pollution here is assumed to be water pollution, noise pollution from quarry operation, air pollution/ dust generation and destruction of biodiversity.

**Table 9.** Cross tabulation of Level of environmental pollution and Satisfaction with quarry sites.

			Satisfaction with quarry sites					Total
			Highly not satisfied	Somewh at not satisfied	Neutral	Somewh at satisfied	Highly satisfied	
Level of environmental pollution	Very High	Count	19	21	8	1	0	49
		% within Level of environmental pollution	38.8%	42.9%	16.3%	2.0%	0.0%	100.0%
	High	Count	0	7	10	3	2	22
		% within Level of environmental pollution	0.0%	31.8%	45.5%	13.6%	9.1%	100.0%
	Undecided	Count	0	0	3	4	0	7
		% within Level of environmental pollution	0.0%	0.0%	42.9%	57.1%	0.0%	100.0%
	Low	Count	0	0	0	5	3	8
		% within Level of environmental pollution	0.0%	0.0%	0.0%	62.5%	37.5%	100.0%
	Very low	Count	0	0	0	0	4	4
		% within Level of environmental pollution	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
Total	Count	19	28	21	13	9	90	
	% within Level of environmental pollution	21.1%	31.1%	23.3%	14.4%	10.0%	100.0%	

**Table 10.** Chi-Square Tests.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	105.074 <sup>a</sup>	16	.000
Likelihood Ratio	95.503	16	.000
Linear-by-Linear Association	55.126	1	.000
N of Valid Cases	90		

**Table 11.** Symmetric Measures.

		Value	Approx. Sig.
Nominal by Nominal	Phi	1.081	.000
	Cramer's V	.540	.000
	Contingency Coefficient	.734	.000
N of Valid Cases		90	

Table 10, all the significant tests (Pearsons Chi square = 0.000, Likelihood Ratio = 0.000, and Linear-by-Linear Association = 0.000) are below 0.05, hence we can conclude that a statistically significant relationship exist between satisfaction with the quarry site location and the level of environmental pollution. The significance values of all the three Symmetric measures from Table 11 are 0.000, further confirming a statistically significant relationship. However, the values of all the three measures are small (Phi = 1.081, Cramer's V = 0.540, and Contingency Coefficient = 0.734), indicating that, although the relationship is not due to chance, it is also not very strong.

## 5. Conclusion and Recommendations

The research has examined the variation of the satisfaction of the people living around quarry site with the distance away from the location of the site. However, the study has established that the location of the quarry site accompanied by residents that do not haboured fear has led to the increase in the level of their satisfaction. With the increase in the numbers of commercial activities within the environment in

the foreseeable future, there will inevitable be increase in the rate of residential encroachment on quarry site environment. The foreseeable future outcome will definitely lead to more agitations and public concerns for the possible impacts as awareness increases. Therefore, the community should be educated on danger associated with residents' encroachment on quarry site environment in their neighbourhood. However, they should be provided with unbiased factual information relating to the negative effects on health and other hazards associated with living in close proximity to quarry sites.

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