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Stone Quarrying Impact on Air Soil Water in Ebonyi State, Nigeria

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Abstract

This study examine the impact of stone quarrying on air soil and water in Ebonyi State and the magnitude of its impact in Environmental pollution. Earth particles were collected from two major sites of Ishiagu and Akpoha using purposeful sampling method. Findings showed that distance from quarrying site determine the level of pollution in sites. Soil, water, air, bone were also examined to find out the magnitude of pollution. The observation indicated that the Ishiagu (the old quarrying site) had more pollution than new quarrying site at Akpoha.

Keywords: Environment; Impact; Air quality; Stone quarrying; Soil and water

Introduction

Exploitation of mineral resources has assumed prime importance in several developing countries including Nigeria. Nigeria as a country is endowed with abundant mineral resources which have contributed immensely to the national wealth with associated socio-economic benefits. Mineral resources are important source of wealth for a nation but before they are harnessed, they have to pass through the stages of exploration, mining and processing [1,2]. According to Aigbebion [3] different types of environmental damage and hazards inevitably accompany their three stages of mineral development. The complex mixture of gases that make up the earth atmosphere has been altered much more in recent time. Human activities that range from domestic energy utilization to large scale industrial operations are largely responsible for this undesirable status of the atmospheric constituents due to addition of pollutants. Air pollution is a major environmental problem affecting both the developing and developed countries of the world. Its effects on human health are very complex as there are different sources; thereby providing varying effects.

The work of Gunn and Gajen, Gunn et al. [4,5] states that the worldwide production of quarry rocks ranks third in terms of volume and forth in terms of value of all non-fuel mineral commodities. Lutting [6] states that over 70 percent of the crushed stones produced in the United States comes from quarrying rocks and that 75 percent is consumed by the construction industry. Quarry can be located flat on the ground along or into the side of valley and on the side of a hill. In most situations, quarries excavated on flat ground have a relatively small impact on geomorphology which is limited to the removal of sinkholes and cave passage ways.

Gunn J and Gagen [4] states that quarry on valley side can extend laterally along the valley side causing large geomorphic impacts or they can work back into the valley wall, where the impact is less [5]. Quarries on hills generally have large geomorphic impacts which indicate that crushed stone quarrying have removed an entire karsts hill.

The work of Garba [7] states that people living close to the quarries are affected by the activities that go on in that area. In quarrying areas like the village of Pali in India, the safety of human beings is not put into considerations. There is no personal protective equipment being provided to workers, helmet, safety belts, masks, safety shoes are foreign.

The work states that approximately 200 people have been buried alive during the mine blasting operations in the past decade only. The work postulates that the workers and their family who are residing close to these units are more vulnerable to silica exposure. The children, women and elderly are all breathing these toxins regularly.

The WHO (1992) reports states that the growing awareness of both PM10 and PM2.5 is largely associated with the potential damaging effects they can have on the human body. The World Health Organization (WHO) states that particles are affecting more people worldwide than any other pollutant. Primary Health effects include damage to the respiratory and cardiovascular systems. Due to the small size of PMIO and PM2.5 particles, they can penetrate the deepest part of the lungs as well as access the gas exchange regions of the lung via diffusion.

Area of Study

The location of this study is in Akpoha in Afikpo North Local Government Area and Ishiagu in Ivo Local Government area of Ebonyi State. Both areas are in the Ebonyi South Senatorial Zone of Ebonyi State. Afikpo North Local Government Area has a common boundary with Ivo Local Government Area where the two sites are located. The two quarry sites have been chosen due to its large size and all year round production for effective research results (Figure 1).

Akpoha falls within latitudes 5°51¹N and 5°59¹N and longitudes 9°00¹E and 17°00¹E while Ishiagu falls within latitudes 5°51¹N and 5°59¹N and longitudes 7°24¹E and 7°40¹E. Akpoha is accessible through the Afikpo Abakaliki road at kilometer 15 from Afikpo. Ishiagu is accessible through the Enugu-Port Harcourt rail way line which runs North South through the center of the study area, the Kaduna-Port Harcourt oil pipe line which runs North East to South West through the area. Also the Enugu-Port Harcourt express road which passes through the extreme North Western corner of the study area.

The Akpoha river runs from Cross river and it is situated North of the quarry site while Ishiagu has streams like Nwaomaiyi, Obe and Aku

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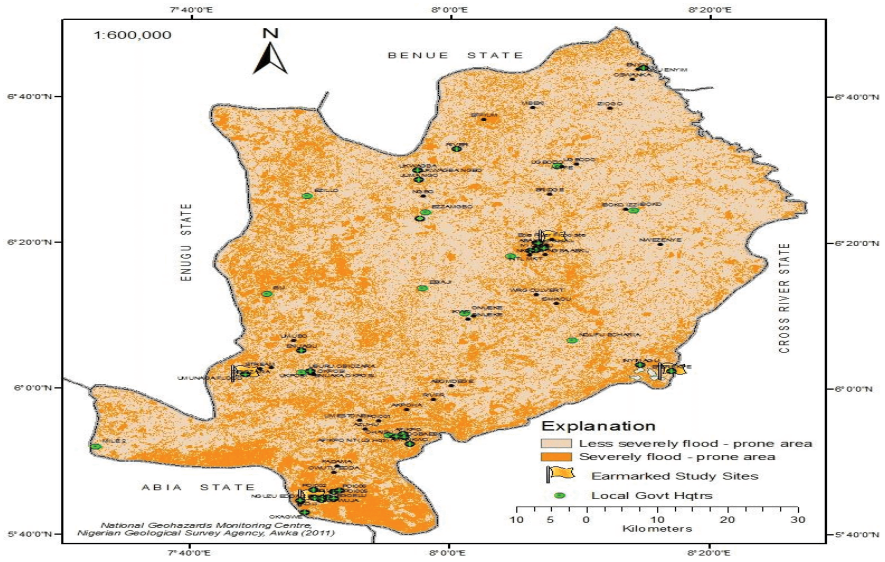

Figure 1: Map of Ebonyi State showing the Study Areas.

(the head stream of the Ivo river) take their origin from the escarpment and attain their shrubs and a few fire-tolerant trees such as parcia claooertoniana, daniella oliviera, afzelia Africana and butryrospermum paradoxxum [8-10].

Particulate air pollution is defined by USEPA as an air suspended mixture of both solid and liquid particles. They are often separated into three classifications; coarse, fine and ultra-fine particles. Coarse particles have a diameter between l0 and 20 μm and settle relatively quickly whereas fine (0.1 to 2.5 μm in diameter) and ultra-fine (0.1 μm diameter) particles remain in suspension for longer. To put things into perspective, human hair has a diameter of 50-25 μm and has a diameter of 90 μm.

When someone talks about PM10, they are referring to particles smaller than 10 μm. These particles include dust, pollen and spores. Conversely, when someone references PM 2.5 they are referring to particles smaller than 2.5 μm. These smaller particles include combustion particles, organic compounds and metals.

According to Birley [11] particulate matter comes from both human and natural sources. Natural sources include sea salt, pollen and mold. As they are natural occurrences, they are harder to control and are usually left unregulated. Human sources however, can be regulated and understanding where PM comes from is very important PM10 is most commonly associated with road dust and construction activities. Wear and tear of brakes and tyres on vehicles and crushing activities at construction sites can all contribute to a rise in PM10. Alternatively, PM2.5 is more associated with fuel burning, industrial combustion processes and vehicle emissions.

Methodology

The air sample was collected using an absolute instrument system (AIS), model Aerocet 5315 to measure the total concentration particulate in the air. The air sample was collected in four points at the edge of the quarrying, 250 m, 500 m and 750 m away from the site. A control was taken 4 km from the site. The instrument was held 2 m above the ground and at stability, a reading was taken.

The data represented above shows the result of air quality data analysis of Akpoha new quarry site (Table 1). At Akpoha site, the impact of the quarrying activities at the edge of the quarry on air quality is 3200 μg/m^3 for suspended particular matter PM10.

At a distance of 250 m, the carbon monoxide is 1600 μg/m^3, volatile organic compound (VOC) 1500 μg/m^3 white suspended particulate matter recorded 500 μg/m^3. This indicates with distance away from the quarry point, the effect decreases. The same applies to distance of 500 m and 750 m. The result of carbon monoxide at the edge of the quarrying is higher than the Federal Ministry of Environment (FME) standard. The analysis of this result also indicates that suspended particulate matters on all the measurement points are higher than the control and FME standard [12-14].

The result of the air quality, data analysis of rainy season at Akpoha is represented in the Table 2 above, the result shows at the edge of the quarrying, the effects of the particulate matter is more effective than other points.

The result of the air quality data analysis for dry season Table 3 in Ishiagu site shows that most of the sample points are higher the control points and Federal Environmental Protection Agency Standard. This can be attributed to the fact that Ishiagu site is an old quarry with greater volume of activities.

The result of air quality during the rainy season at Ishiagu site shows that at the point of the edge, 250 m and 500 m, the results are higher than the control and FME Standard. It should be noticed that the result is lower than the dry season due to the effect of rain [15,16].

The mean difference is significant at the 0.5 level. As indicated in Table 3, when compared to control, air quality parameter is measured in this study are significantly different at 500 m (mean diff. 6.5, $p \leq 0.05$) for the quarry site during the dry season. At 250 m and 750 m there were no significant differences. The same result was also observed for the Ishiagu site in that air quality became significantly different when compared with the control at 500 m ($p \leq 0.05$, mean diff. 5.91) during the dry season. During the rainy season at 250 m, a significance difference in the air quality parameters (when compared to the

Components	Edge	250 m	500 m	750 m	Control	FEPA
CO	3200	1600	650	600	600	1000
NO_x	36.4	25.5	17.01	18.4	18	20
SO_x	120	100	80.5	173	16.4	20
VOC	1800	1500	1000	600	220	1500
PM10	800	500	360	-	20	20

Table 1: Air quality during the dry season (new Quarry Akpoha).

Components	Edge	250 m	500 m	750 m	Control	FEPA
CO	2400	800	400	400	400	1000
NO_x	24.5	20.5	14.4	14	14	20
SO_x	80.8	60	30	15	15	20
VOC	1200	900	500	300	120	1500
PM10	365	250	140	15	15	100

Table 2: Air quality during the rainy season (Akpoha new Quarry).

Components	Edge	250 m	500 m	750 m	Control	FEPA
CO	4100	3800	3000	1230	1000	1000
NO_x	40.5	38.5	30.6	155	15.5	20
SO_x	90.6	75.5	60.4	25	20	20
VOC	2000	1600	1200	200	200	250
PM10	860	650	360	25	25	100

Table 3: Air quality during the dry season (old Quarry, Ishiagu).

Components	Edge	250 m	500 m	750 m	Control	FEPA
CO	3200	2800	1600	500	500	1000
NO_x	30.2	28.5	25	8.6	8	20
SO_x	60	50	40	16	16	20
VOC	1200	780	540	320	120	1500
PM10	270	160	100	20	20	60

Table 4: Air quality during the rainy season (old Quarry, Ishiagu).

control) was observed for the Akpoha site. However, for the Ishiagu site, differences between the controls were recorded at 250 m ($p \leq 0.05$, mean diff. 5.38), 500m ($p \leq 0.05$, 5.58) and 750 m ($p \leq 0.05$) [17-19].

Discussion of Findings

The parameter measured were CO, NOx, SOx, VOC and particulate matter, (PMI0). Analysis of the result obtained showed that at the study site, all the parameters exceeded the recommended limits [20]. This extended to the 250 m sampling point at the new quarry site at Akpoha but reached 500 m point at the old quarry site in Ishiagu (Table 4). This observation indicated that in the old quarry site had its impact extended much more beyond the immediate vicinity of the quarrying company compared to the new company which activities were limited to the immediate surroundings. However, observations showed that there was a clear cut gradient in the values of the properties assessed. This was because parameter values decreased with increasing distance from the premises of the company. This trend has been observed by several authors including Nwaugo et al. [21] who reported that the concentration of pollutants decreases as distance from the sources increased. These authors further classified it that concentration of pollutants is highest nearest ID the sources. Observations in this study agree with this assertion.

The high values of these parameters stated-CO, NOx, VOC and PM10 have been also reported by other researchers working on similar activities. The PM10 was high because the operations blastering the rocks and grinding them further into various sizes generated dust constantly. This dusts generated was measured as particulate matter. The CO, NOx, SOx could come from trapped substances and other ancillary activities taking within and immediately outside the companies while the VOC could be associated with vehicular and machine operations [22-24].

Also reported that a particle in the air does not travel as there is less wind during this period. Furthermore, most quarries reduce their activities during this rainy season because construction work also reduce most construction work involving the use of quarried stones-like road construction, bridge construction and even other operations requiring stones in large quantities decreases during the rainy season. Since the companies reduce their activities in the rainy season, the implication of air also reduces. This assertion agrees also with Nweke and Okpokwesili who reported reduced activities at a quarry company in Abakaliki Ebonyi State.

These results therefore indicate that individuals living at a close vicinity to these quarry sites are exposed to some respiratory illness by damages of inhaling the reported substances. Particulate matters especially PM has been associated with various respiratory diseases [25]. The other substances, CO, SOx, and NOx are said to be acidic oxides which when dissolved in water form acids of various concentrations [26].

Recommendation and Conclusion

Quarry activities should involve removal of over burden, drilling, blasting and crushing of rock materials to reducing the various impacts produced by operatives of size and location dependent as well as reducing the impact of law degradation and quarrying effects like swap, renovation of ground water, erosion of soil, noise and percussions from rock blasting, generation of just smoke and fumes.

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