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ENVIRONMENTAL IMPACT OF STONE QUARRYING ACTIVITIES IN EBONYI STATE, NIGERIA

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ABSTRACT

This study evaluated the effect of quarrying on the environment in Ishiagu and Akpoha in Ebonyi State. The research design employed was purposeful sampling in selecting two quarry sites from the twenty quarry sites in Ebonyi State. These two quarry sites were chosen due to the large size and the all round year production to give a realistic result. Soil, water and air suspended particulate matter from the two sites of Akpoha and Ishiagu were collected at the edge of the quarrying, 250m, 500m, and 750m. Four soil samples were collected at different point with a control collected outside the sites. Water samples were collected from Akpoha and Ishiagu sites with a control at Aku river. The mean concentrations of the physicochemical parameters for water and soil samples were examined. The data for the analysis of air was collected using an Absolute Instrument System (AIS), model Aerocet 53IS and held 2 metres above ground level to measure the total suspended particulate matter. Water samples were collected in two litres plastic containers from the surface water (10 to 20 cm depth). Also borehole water was collected at the depth of 4m. The two samples were collected insitu and transported to the laboratory in an ice-chest container for analysis. Soil samples were collected in one litre glass bottle. The result showed that the mean concentrations of the Physicochemical Parameters and suspended particulate matter were above World Health Organization (WHO), and Federal Ministry of Environment (FME) limits. The result also indicated that distance from the source of quarrying activities determines the magnitude of environmental pollution. Based on the above mentioned findings, an environmental impact assessment should be mandatory for all quarries , compliance monitoring visit to quarry sites should be done monthly so as to minimize the negative effect of quarrying operations, quarry companies should be mandated to adopt modern technology of dust trapping such that a negligible quantity of dust escapes from various operations at quarry. The quarry operators should carryout environmental cleaning of the area already polluted which the Federal Government of Nigeria should enforce.

Key Words: Quarrying, impact on Air, Soil, Water, Seasonality and Distance

1 INTRODUCTION

Man's search for development carries with it problems which are not in oblivion, complaints resulting from Quarrying activities date back to 1890's. The issues of concern include visual intrusion, damage to landscapes, traffic, smokes, noise, dust, damage to caves, loss of land, and deterioration of water quality. Of major concern is blasting which is necessary to break down the rocks from the ground for subsequent processing into aggregates. Environmental safety laws and edicts have been adopted by governments of nations the world over in order to protect the environment from such hazards. However, operators of quarries have abused these laws in order to maximize profit; the abuse is paramount in Nigeria and Africa as stated by (Omosanya and Ajibade, (2011).

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Exploitation of mineral resources has assumed prime importance in several developing countries including Nigeria. Nigeria is endowed with abundant mineral resources, which have contributed immensely to the national wealth with associated socio-economic benefits. Mineral resources are an important source of wealth for a nation but before they are harnessed, they have to pass through the stages of exploration, mining and processing (Adekoya, 1995), and Ajakaiye, 1985). According to Aigbebion (2005) different types of environmental damage and hazards inevitably accompany three stages of mineral development. The complex mixture of gasses that make up the earth atmosphere has been altered much more significantly in the recent time. Human activities that range from domestic energy utilization to large scale industrial operation are largely responsible for this undesirable status of atmospheric constituents due to addition of pollutants. Air pollution is a major environmental problem affecting both the developing and developed countries of the world. The effects of air pollution on human health are very complex as there are different sources; thereby producing varying effects.

Although industries such as power plant, cement, refineries, petro-chemicals and mines have been identified as major sources of air pollutants, the emission of particulates is quite outstanding from quarries. Generally, the effects of dust emission from quarries have both micro and macro dimension. Air pollution and ground vibration arising from blasting, crushing and emission of noxious gases have negative impacts on human health and well being. Quarry products are increasingly demanded for industrial, domestic; agricultural and other purposes so as to satisfy the needs of the rapidly growing population.

Quarrying operation generally involve removal of over burden, drilling, blasting and crushing of rock materials, the various impacts produced by these operations are both size and locational dependant. Manifestations of specific impacts are on the air, water, soil, earth surface, flora and fauna, and human beings, (Enger and Smith, 2002).

Suspended particulate matter may be affecting more people globally than any other pollutant on continuous basis (Birley, 1998). Going by epidemiological studies, a close-response relationship between exposure to particulate matter (PM_{10}) and respiratory morbidity and mortality are established due to inhaling of suspended particulate matter (Larger 2001, Listori 2001, and Lucca, 2009) likewise is the role of PM_{10} in the Causation of asthma, lung cancer, cardiovascular issues, and rural premature death. Even at relatively low concentration (not exceeding standard guideline of 150ug/m^3 for 24 hours), inhalable Particulate matter (Pm_{10}) have adverse effects on human health. Indeed, an increase of 50 mg/m^3 in particulate levels is shown to induce increase death rate from 2 to 8 percent in several countries (Bart, 1993, and Chin 2000).

According to Adekoya,(1995),the circumstances surrounding most developing countries, Nigeria inclusive, is more pathetic in view of the utter disregard of pollution limits by most industries, low knowledge of environmental laws by quarry operators and the general poor living standard which affect people's nutritional status. Focus of this study is on the effect posed by granite mining activities to the Akpoha and Ishiagu communities in whose community the quarries are domiciled. Hence, this study therefore examined the environmental effect of stone quarrying activities on the soil, water and Air quality within the communities. Stone quarrying activities has resulted in environment issues in Nigeria and Ebonyi State inclusive. This activities has affected Air, Water and Soil quality around the host communities

Today demand for granite continues to increase at a geometric dimension. Before granite get incorporated into the structures, it undergo series of processes which entail multiple handling, involving various type and grades of labour and machines. Thus, doubtlessly gives rise to multiplier effect on the socio economic life of the society (Adekoya, 2003), as many people get employed; more families have increased income and so on. As a matter of fact, Adekoya (2003) asserted that in 2001 alone, a total of 7,131 granite mining companies were in operation as reported by Nigerian Mining and Geosciences society. The unanswered

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question however, is at what expense to the environment are these multiplier effects being achieved. Exposure to increased level of suspended particulate matter, especially over a long period of time could have adverse effect on the environment, Aigbedion(2005) and Adekoya (2003).

Akabzaa and Darimani(2001), states that airborne particulates are of major concern to most mining communities which includes dust, sulphur dioxide(SO_2), Nitrogen dioxide(NO_2), Carbon monoxide(CO), and black smoke. Nduka, (2010) postulates that suspended matter may be affecting more people globally than any other pollutants on a continuous basis. The work states the negative potential environmental impact of quarrying.

This work will carry out an assessment of the environmental concern within the study area which will identify characteristics of surface water, soil and air quality, identify sources of heavy metal contamination, pollution in order to show the extent of the impact on water and soil. The activities of the stone quarrying in some parts of Ebonyi State has generated some environmental issues which needs to be investigated so that mitigation mechanism can be recommended and awareness created on health hazards of the quarrying activities.

Engineering Impacts of quarrying

Backsdale (1991) and Kestner(1994) state that some of the environmental disturbance created by quarrying is caused directly by engineering activities during aggregate extraction and processing. It also states that most obvious engineering impact of quarrying is a change in geomorphology and conversion of land use, with the associated change in visual scene.

Further, Barksdale(1991), Smith and Collins(2001) noted that the major impact may be accompanied by loss of habitat, noise, dust, vibrations, chemical spills, erosion, sedimentation and dereliction of the mined sites.

IMPACT ON AIR

The works of Azad and Ashish (2006), states that people living close to the quarries are affected by the activities that go on in that area. This study states that in village Pali in India, the safety of human beings is not put into consideration. There is no personal protective equipment being provided to the workers such as, helmet, safety belts, masks, safety shoes which are regarded as foreign things.

The work of Garba(2001) reveals that dust from quarry mining operations in the Nigerian limestone quarries are discharged daily into the air. This work also states that a lot of air-bone particulate matter is generated by the numerous stone crushing industries in Nigeria. He goes further to say that when the air is laden with such dust; it causes health hazards for some people. He states that the pollution studies around sagamu and Ewekoro in Ogun state have shown that several people are suffering from eye pain, which is due to the dust-laden air that prevail within a few kilometers radius of the factories.

The work of Nwaugo et al, (2007) examined the bacterial species associated with eye contamination and infections in school children from quarry mining communities in south eastern Nigeria. This work discovered that the suspended particulate matter from stone quarrying causes eye contamination in children living around the quarrying sites.

Akabzaa and Darimani(2001), states that Airborne particulates are of major concern to most mining communities which includes dust, sulphur dioxide(SO_2), nitrogen dioxide(NO_2), Carbon monoxide(CO), and black smoke. He also states that the discharge of these airborne particulate matters into the environment principally as minute dusts and gas poses health threats to the people in mining communities and its surroundings. Omasanya and Ajibade(2011), carried out a research on the environmental impact of quarrying on Otere village in Ogun state of Nigeria. The result of the research work indicate the prevalence of the

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respiratory diseases among the quarrying communities due to the presence of suspended particulate matter in the air.

IMPACT ON WATER

According to Asaad and Jordan (1994), states that quarrying substantially modifies the routing of recharge and water quality degraded. This work went to say that the first impact of quarrying is to remove the overlaying vegetation and soil. The work continued by stating that measures must be taken to control runoff, sedimentation and deterioration of ground water.

Moore and Hughes(1979), investigated the impact of quarry blasting in ground water quality and discovered that there was no relationship between blasting of stone and quality of water in wells in situation that he studied.

Ekemeci(1993), carried out a research on the impact of quarries in Karsts ground water systems. He reported that blasting associated with quarrying closes existing Karst ground passages and open up new passage resulting in change in direction of ground water flow. The work also discover that large amount of silt and other effluents from quarries pollute rivers as well as underground water bodies within and far beyond the boundaries of the quarry area.

IMAPCT ON SOIL

According to Nwaugo et al (2007), they carried out a research on post operational effects of quarry mining on soil quality in Ishiagu. The study discovered that there are presence of lead, Zinc, Nitrate, Cadmium and other metals in the soil due to quarrying activities in the area. The quarrying activities contaminates the soil leading to high presence of metals. According to Lucca(2009), he carried out a research on the impact of quarrying on flow of ground water, he reported that a flow of 2525 litres per second is recorded when a surface quarry intersected a conduit that was in hydraulic connection to a nearby river. He recommended pumping the water from the quarry which reduces hydraulic head and thus draws down water levels in the rock draining into the quarry.

PARTICULATE MATTER (PM)

Particulate air pollution is defined by the 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 of between 10µm and 2.5µm and settle relatively quickly due to size whereas fine (0.1 to 2.5µm in diameter) and ultra fine (0.1µm in diameter) particles remain in suspension for longer time.

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

CONCEPTUAL FRAMEWORK

The conceptual framework for this work is a synthesis of components from a developed conceptual framework for integrated monitoring, namely Integrated Environmental and Health Monitoring (IEHM) framework developed by World Health Organisation (WHO), 2014 on the principal components of the environment. This states that human beings are part of the biosphere or its ecological components and play a central role in modifying and interfering with the physical environment through their activities. Human activities tend to influence these environments, whereby socio-economic aspect that include demography, knowledge, economic development and lifestyle among others, directly or indirectly influence what we do. It also state that Government needs to intervene when physical environment are altered. Quarrying is one of the development system with aspects of the physical environment and the natural system that includes physical phenomena that do not originate from human activities, including water, air and climate.

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The ecosystem as part of the natural system is also affected. Human beings as the sole generator of these effects are also affected, where the effect in the physical environment can also impact in the socio-economic aspects of quarrying. Quarrying as an activity that involves the extraction of earth material for economic value takes place within the physical and therefore has impacts both on the physical and socio-economic environment as stated by Johnson(1979)

The aim of the study is to assess the environmental effect of the stone quarry operation in Akpoha and Ishiagu community. This can be achieved through the following objectives:

1. To assess the effect of quarrying activities on air quality in the study area of Akpoha and Ishiagu.
2. To assess the effect of physicochemical properties of quarrying activities on water quality in the study area of Akpoha and Ishiagu.
3. To assess the effect of quarrying activities on soil quality within the site of Akpoha and Ishiagu
4. To assess the effect of distance on the environment from the quarrying activities at the site of Akpoha and Ishiagu.
5. To determine the seasonality of the quarrying effects on the parameters measured at Akpoha and Ishiagu.
6. To determine the relationship between the parameters examined, air, water and soil.

2. MATERIALS AND METHODS

This research was necessitated by the activities of quarrying companies in some parts of Ebonyi State that have affected the environment. There is one important challenge on how to effectively address the impact of stone quarrying. To achieve this aim, a field research work was carried out in two quarry sites of Akpoha and Ishiagu.

RESEARCH DESIGN

This study is principally an experimental study on Akpoha and Ishiagu quarry sites. Data were collected at the study area and analysed at the laboratory. This study adopted purposeful sampling in carrying out the study. Primary data was collected and subjected to exploration design for laboratory testing in arriving at inferences to answer the research question.

POPULATION OF THE STUDY

For this study, the population comprises of all the quarry sites in Ebonyi state. There are 20 quarry sites scattered in Ebonyi state but only two quarry sites carryout large scale quarrying operations. These are the quarry site at Akpoha and Ishiagu operated by Julius Berger and Crushed Rock Industry respectively. This work concentrates on Apkoha and Ishiagu quarry sites due to its age and all round year production for effective research results to determine the environmental effect of quarrying activities.

DATA SOURCES

The air, water and soil samples generated from Akpoha and Ishiagu quarry sites formed the primary data while Secondary data sources included stone quarry journals, International Associations publication on stone quarries, textbooks and articles on the internet. This led to the identification of potential environmental impact factors arising from stone quarry activities.

DATA COLLECTION PROCEDURE

The data for the analysis of air was collected using an absolute instrument system (AIS), model Aerocet 531S to measure the total suspended particulate matter (Pm_{10}) that measures the concentration of particulate in the air. Measurement were done by holding the sensor at a height of two meters in the direction of the prevailing wind and reading recorded as stability. Air, water and soil samples were collected both in dry and rainy season to ensure reliable result.

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Particulate concentration at the two drilling and crushing operation areas were monitored away from the major operation areas. The effect of rainfall on the result of the analysis was eliminated by carrying out the analysis both in dry and rainy season to establish if there was any difference in the result.

Water samples were collected in two liters plastic containers from the surface water(10 to 20 cm depth). Also borehole water was collected at the depth of 4meters. The two samples were collected insitu and transported to the laboratory in an ice-chest container for analysis. Samples for total hydrocarbon contents (THC), and heavy metal analysis were collected in one liter glass bottle. The collection of the sample were at the edge of the quarrying, 250m, 500m, and 750 m from site to examine the effect on distance. The samples were carried out both in dry and raining seasons, in the month of November 2017 and June 2018.

SAMPLE AND SAMPLING TECHNIQUE

The main study of this work was at Akpoha and Ishiagu sites in Afikpo North local government area and Ivo local government area of Ebonyi state. The two sites were selected due to its large size and all round year production of quarry for effective research results to determine the environmental impact of quarrying. Samples were taken at four points at the edge of the quarry, 250m, 500m and 750m from the source of quarrying.

Air Sampling

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

Soil Samples

Soil samples were collected from four designated points: edge 250m, 500m, and 750m away. The control was collected from 4km away. The soil samples were collected with the aid of an auger into labeled polythene bags and sterile plastic containers. The samples were taken to the Laboratories in ice chambers for physicochemical analysis. Sampling was carried out for one wet and one dry seasons for one year. The dry and wet seasons sampling were carried out in the months of December to March and May to July respectively throughout the study. Sampling was done three times for each sampling season and a total of twelve times throughout the study. The soil samples for physicochemical analysis prior to analysis were air –dried and sieved using a two millimeter (2mm) micro sieve . The sieved soil samples were stored in tight glass containers for further analysis. The stored soil samples were analyzed within two weeks of collection.

Water Sampling Technique

Sampling Technique

Water samples were collected with sterile sampling bottles from the upstream and borehole during the sampling season. The water samples were collected into sterile sampling bottles packed in ice chambers and transferred to laboratories for physicochemical analysis. The water samples were analyzed within 24 hours of collection. The river flows South east towards the Ivo river. The Ivo river is the major tributary to the Ezeaku River system of the cross River Basin.

Statistical Analysis of Result

Test of homogeneity was carried out, from the ANOVA, a Shapiro-wilks test was performed which shows that the assumptions of normality was met across the data collection points.

The post Hoc test of Air quality of dry and rainy season of Akpoha and Ishiagu site indicate that air quality parameters measured in this study in the two sites are significantly different.

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During the rainy season, at 250m, a significant difference in the air quality parameters was observed for Akpoha quarry site. For the Ishiagu site, significant differences between the controls were recorded at 250m and 750m.

Test of Homogenity

Results of the one-way ANOVA was conducted to evaluate the level of independence of the air and physicochemical properties collected across all the sites. From the ANOVA, a Shapiro-Wilks Test was performed in order to evaluate the normality of the data collected from the sampling points.

3. RESULTS AND DISCUSSION

Discussion of Findings

The effect of quarry mining-rock blastering was investigated in some parts of Ebonyi State. This investigation covered the impact on some aspects of air quality, water quality involving rainwater, surface water (River) and ground water including soil quality. This discussion therefore was set out in sections relating to the particular type of sample analyzed.

Air Quality

The parameters measured were CO, NO_x, SO_x, VOC and particulate matter (PM_{10}). Analysis of the results obtained showed that at the study sites, all the parameters exceeded the recommended limits. This extended to the 250m sampling point at the Akpoha Quarry site at Akpoha but reached 500m point at the old Quarry at Ishiagu. This observation indicated that the old Quarry 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.

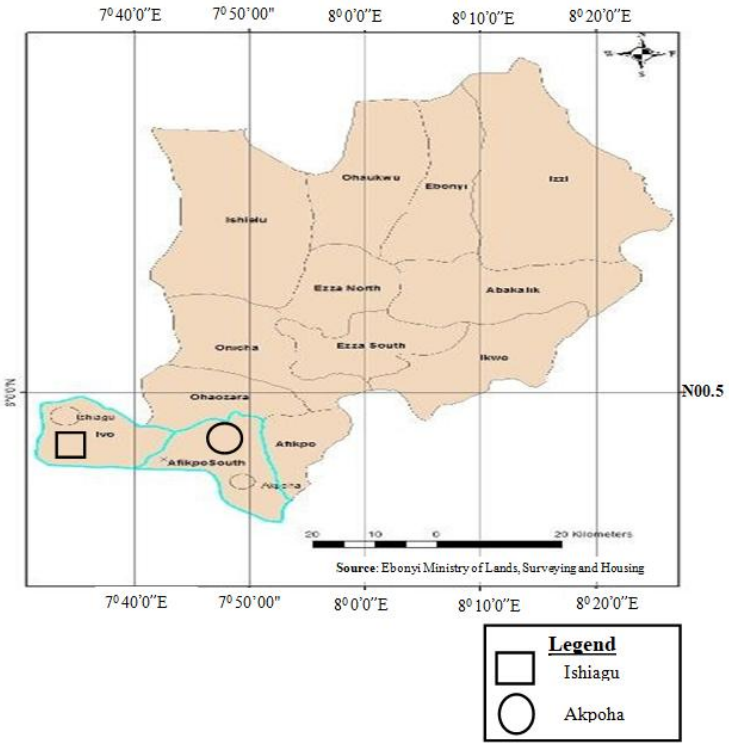

Fig 1: Map of Ebonyi State Showing Study Areas

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Table 1; Air quality during the dry season (New Quarry Akpoha)

	Air quality (ug/m^3)					
Component	**Edge**	**250m**	**500m**	**750m**	**Control**	**FME**
CO	3200	1600	650	600	600	1000
NO_x	36.40	25.50	17.01	18.40	18.00	20
SO_x	120	100	80.5	17.3	16.4	20
VOC	1800	1500	1000	600	220	1500
PM_{10}	800	500	360.0	20.0	20.0	100

Table 2: Air quality during the rainy season (New Quarry, Akpoha)

Component	**Edge**	**250m**	**500m**	**750m**	**Control**	**FME**
CO	2400	800	400	400	400	1000
NOx	24.50	20.50	14.40	14.00	14.0	20
SOx	80.80	60.00	30.0	15.00	15.00	20
VOC	1200	900	500	300	120	1500
PM_{10}	365	250	140	15	15	100.

Observations showed that the impact was higher at the old quarry site at Ishiagu than at the new one – Akpoha. This observation indicated that the effect accumulated with time. Though the particles did not stay waiting in the air as they were carried away by wind, time allowed for generation of more wastes. Some of the machines used at the old quarries were old , lacked efficiencies and effectiveness hence released some of the particles inappropriately utilized.

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

Component	Edge	250	500m	750m	Controle	FME
CO	4100	3800	3000	1230	1000	1000
NOx	40.5	38.5	30.6	15.5	15.5	20
SOx	90.6	75.5	60.4	25.0	20.0	20
VOC	2000	1600	1200	200	200	250
PM_{10}	860	650	360	25	25	100

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

Component	Edge	250m	500m	750m	Controle	FME
CO	3200	2800	1600	500	500	1000
NOx	30.2	28.5	25.0	8.6	8.0	20
Sox	60.0	50.0	40.0	16.0	16.0	20
VOC	1200	780	540	320	120	1500
PM_{10}	270	160	100	20	20	60

Further observations indicated seasonality in the effects reported as all the parameters had higher values during the dry season than the rainy period. All the substances are soluble in water as they are all acidic oxides except VOCs and the dust particles to some extent. This therefore means that the rain water will wash them down and out of the air as it descends to the earth. This phenomenon has been described as air cleansing by Nitesh*et al.*, (2011).

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Also reported that a particle in the air does not travel far during rainy season as there is less wind during this period. Furthermore, most quarries reduce their activities during this rainy season because construction companies also reduce most construction involving the use of quarried stones – like road construction, bridge construction and even other operations requiring stones in large quantities decrease during the rainy season.s

These results therefore indicate that individuals living at close vicinity to these quarry sites are exposed to some respiratory illness by damages of inhaling the reported substances. Particulate matter especially PM_{10} has been associated with various respiratory diseases. The other substances, CO, SO_x, and NOx are said to be acidic oxides which when dissolved in water form acids of various concentrations, Deborah (1996).

Water Quality

Assessment of the rainwater quality at the study area showed that the water was slightly acidic, hard, turbid and containing various amounts of phosphates, nitrates and sulphates. This could be linked to the air quality as earlier reported. The solubilization of NO_x, SO_x, and CO in water produced nitrates, sulphates and carbonates in the rainwater. These substances alone with the particulate matter caused the consequent hardness and turbidity observed. These substances were equally responsible for the high TSS and TDS reported. It has already been stated that CO, NOx and Sox are acidic oxides which dissolve in water to form various acids.

Observation showed that the values of the various parameters decrease with distance away from the source. Again, values were observed to be higher at the old Quarry at Ishiagu than the new one at Akpoha. However, the quarry at Ishiagu is also older than that at Akpoha. This therefore, indicates that size and age of the quarry are important factors in the level of impact experienced from their activities. In addition, observations showed that all the parameters decreased in values during the rainy season compared to the values in the dry season. The only exception to this was the pH which increased values indicating a decrease in acidity and a shift towards neutrality.

Analysis of the metallic elements in the rainwater indicated that Ca, Mn and Fe had higher values than the other metals.

However, it has been generally reported that lead is a common soil metal found at this concentration as reported. This high concentration of Pb and Zn could occur at Ishiagu as various parts of Ebonyi have experienced Pb and Zn mining. Cr, Cd and Pb have been described as common contaminants of various stones especially in areas where heavy metals of Ba, and Mn are mined. Nwaugo *et al*., (2009) reported the presence of these heavy metals in Ishiagu.

The assessment of the physicochemical properties of the surface water bodies in the areas were acidic, high pH values, high EC, high hardness and including high concentrations of nutrients of PO_4, SO_4 and NO_3. The TDS and TSS were also high. These parameters were highest nearest the various plants but gradually decreased with distance away from the quarries.

The high EC resulted from the solubility of the substances generated by the quarries in addition to the discharge of effluent from the mining pits. The seasonality of the observation of the physicochemical properties and metallic ion concentrations again remain very significant. The rains washed down much debris into the rivers including humus and other non-metallic substances which diluted the level of the metallic ions in the water.

Borehole water physicochemical properties and metallic ion concentration assessment showed less ion values compared to surface water and rainwater. This could be the case as the contaminants took time to migrate through the various soil layers that acted as filters for the substances.

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The results obtained in this study indicate that the borehole water physicochemical properties still maintained the trend of sampling points nearest the quarries having highest parameters values than the ones away from these companies' premises.

General observation of the water quality analysis showed that while the surface water from the rivers were the most contaminated, the borehole water sources were the least.

Soil Quality

The soil was observed to be acidic during rainy season as the pH values increased. The PO_4, NO_3, and SO_4 values all increased in the rainy season compared to the dry season values. However, the EC and CEC decreased in the rainy season. The increase in PO_4, SO_4 and NO_3 could be attributed to the alternation and diluting effect of the water on the parameters measured.

Further analysis showed that the effects were higher in the old Quarry at Ishiagu compared to the new one of Akpoha. Again, the metallic ion concentrations followed the same pattern of increasing during the rainy season.

Further observations showed that these parameters were affected by the seasons, as all the metallic ions assessed in this study were affected. This observation indicates high level of metallic ions in the investigated soil. However, only Fe was observed to be low in concentration.

4. CONCLUSION

1. Quarry activities have negative impact on surface water quality (physicochemical) which contaminates the water.
2. Quarrying activities have negative impact on the ground water quality (physicochemical properties), this affects borehole water.
3. Quarrying have negative impact on soil quality within the site which affects quality of the soil for cultivation.
4. Distance from the source of quarrying activities determines the magnitude of environmental effects as there are significant differences on the air quality and physicochemical properties from result of samples away from site. This means that quarries should be sited distance away from communities.
5. Quarrying activities have negative environmental impact on air quality which when inhaled can cause respiratory diseases..
6. The result of the suspended particulate matter Pm_{10} is above the Federal Ministry of Environment Standard. This needs mitigation to reduce impact
7. The result of the findings indicates that individuals living at close vicinity to these quarry areas are exposed to the damages of respiratory organs of the body by inhaling the reported PM_{10} substances which could affect health.
8. The result of the analysis of variance using ANOVA indicated that the two sites on the average, the variables are independent and the soil sample in those two sites are also in variance which can be attributed to the experience of lead and zinc mining in some parts of Ebonyi including Ishiagu.
9. Seasonal variations have influence on air quality and physicochemical properties at the quarry sites as the rain dissolves some of the suspended particulate matter which adds more impact on the soil and surface water,

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