

Barford Quarry

The Impact of Quarrying

Likely Adverse Impact of Proposed Barford Quarry on the Local Residents' Health and the Region's Biodiversity

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Quarry Dust

Dust from quarry sites is a **major source of air pollution**, although the severity will depend on factors like the local microclimate conditions, the concentration of dust particles in the ambient air, the size of the dust particles and their chemistry, for example limestone quarries produce highly alkaline (and reactive) dusts, whereas coal mines produce acidic dust.

The air pollution is not only a nuisance (in terms of deposition on surfaces) and possible effects on health, in particular for those with **respiratory problems** but dust can also have physical effects on the surrounding plants, such as **blocking and damaging their internal structures** and **abrasion of leaves and cuticles**, as well as chemical effects which may affect long-term survival.



Other areas adversely impacted by Quarrying:

- **Damage to Biodiversity** - One of the biggest negative impacts of quarrying on the environment is the damage to biodiversity. Biodiversity essentially refers to the range of living species, including fish, insects, invertebrates, reptiles, birds, mammals, plants, fungi and even micro-organisms.
- **Quarry Waste** - Again, like many other man-made activities, quarrying involves the production of significant amounts of waste. Some types of quarries do not produce large amounts of permanent waste, such as sand and gravel quarries, whereas others will produce significant amounts of waste material such as clay and silt.
- **Noise Pollution** - Unfortunately, quarrying involves several activities that generate significant amounts of noise. It starts with the preparatory activities, such as establishing road or rail access, compound and even mineral processing facilities. Next is the process of exposing the mineral to be extracted and this is usually done by removing the top soil and other soft layers using a scraper, or hydraulic excavators and dump trucks. The excavation of the mineral itself will involve considerable noise, particularly if blasting methods are used. Following this, the use of powered machinery to transport the materials as well as possibly processing plants to crush and grade the minerals, all contribute even more noise to the environment.
- **Transportation** – Quarry products have to be transported and the dust on the roads and the vehicles is significant and can and does have direct and indirect adverse impacts on the well-being of those who come in contact with it.



Key Concerns

Quarry dusts, like dusts in general, affect vegetation by both physical and chemical processes.

Physically, dust may cover the leaf surface and reduce the amount of light available for photosynthesis, or may occlude stomata. Occlusion may lead to increased resistance to gas exchange, or may prevent full stomatal closure, leading to water stress. Increased transpiration is a common response to dust exposure.

Chemically, quarry dusts may be relatively inert (from operations involving hard acidic rocks or some sandstones) or may be strongly alkaline (limestone). Alkaline quarry dusts may have detrimental chemical effects on leaf surfaces. Infestation by pests and pathogens is likely to be enhanced.

Indirect effects may be caused through the soil, especially for the deposition of alkaline quarry dust on acid soils, which can increase the pH and available calcium, leading to changes in vegetation and invertebrate community composition. For unmanaged ecosystems which have been acidified by atmospheric deposition of sulphuric and nitric acids, there may be local beneficial effects if the quarry dust is alkaline, or can supply limiting minerals (e.g. calcium or magnesium). The subject has been reviewed by Farmer (1993).

In another paper a notable negative impact of quarrying on the environment is also the **damage to biodiversity**, in which plants (vegetation cover) represent the main component of the ecosystem as they are playing a major role in maintaining the balance in the volume of oxygen and carbon dioxide through photosynthetic activities [6]. Such vegetation changes are the main concern of environmental botanists and ecologists in recent years who have advocated the careful and cautious approach to activities promoting such changes. The paper concludes that the **deposition of dust resulted in the extinction of different types of trees and vegetation cover along with reduction in crop yields**. Also, these activities affected water and soil which are vital resources for agriculture and thus exacerbating.

Tahseen Sayara ¹, Yamen Hamdan ², Rezaq Basheer-Salimia ³, Impact of Air Pollution from Quarrying and Stone Cutting Industries on Agriculture and Plant Biodiversity Resources and Environment, p-ISSN: 2163-2618 e-ISSN: 2163-2634, 2016; 6(6): 122-126, <http://article.sapub.org/10.5923.j.re.20160606.04.html>.

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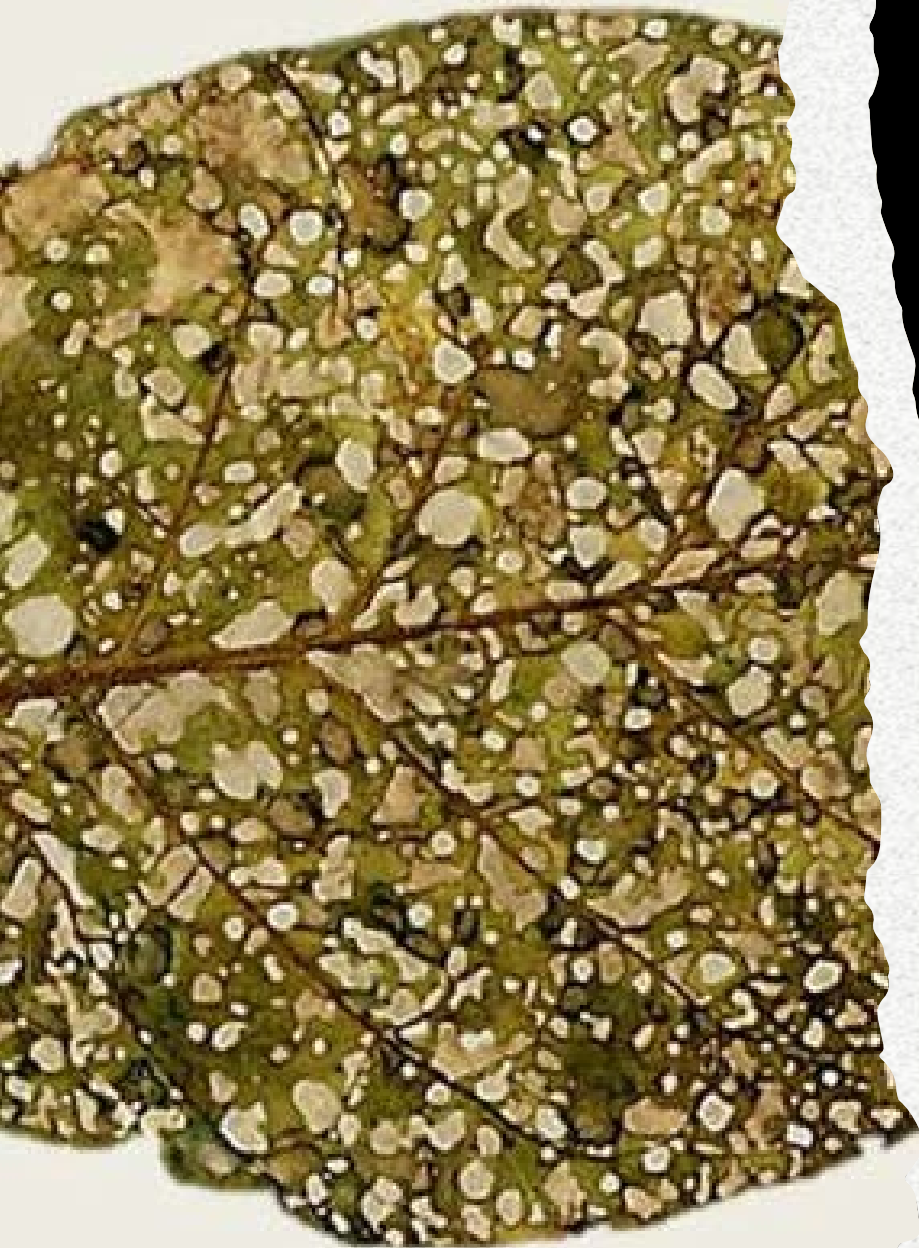
Notable Papers

With regard to the importance of planning to reduce the impact of quarrying a paper has studied the effect of air pollution from quarry activities on agriculture and plant biodiversity in South-Eastern Nigeria. In this study it has been found that there are several quarry activities spread across South-eastern Nigeria contributing 8.7% GDP annually to the economy.

However, these industries are usually associated with air pollution. To assess the impact of quarry dust on plant biodiversity, **PM2.5, PM10** and some meteorological parameters were measured using Aeroqual 500 series as well as taking a social survey. High amounts of particulate matters that exceeded the international standard were recorded at the four chosen quarry locations in Ebonyi State.

The correlation coefficient between the particulate matters with the meteorological parameters of the locations all show a strong relationship with **temperature recording a stronger value of 0.981**. Similarly, the coefficient of determination 0.962 shows that temperature has the highest meteorological percentage variation on PM2.5 and PM10. Furthermore, a notable **negative impact** of quarrying on **plant biodiversity, habitat destruction and plant survival** are also revealed based on respondents' results where wide range of local plants were affected with **vegetables** been the most with respondent of 30%.

From the obtained results, it is **highly recommended** that there should be an establishment of **dust control mechanism** - by developing green belt around the quarrying using pollutant-tolerant trees in order to restrict spreading of dust and regulating the industry as a self-regulatory mechanism. To assess the effect of quarry dust on agriculture and plant biodiversity, 400 structured questionnaires were distributed to local farmers.



The result obtained revealed different ranges of affected local farm crops due to quarry activities and the respondents show:

- - 26% for Yam
- - 15% for Cassava
- - 30% for Vegetables
- - 7% for Plantain
- - 27% for other crops

The result shows that vegetable was the most affected crop with 30% (Fig. 6). Concerning the effect on crop yield, majority of the respondents (93%) stated that **crop yield decreases to about 30% annually** (Fig. 7). Physiological mechanism behind these could be attributed to one or combination of the following factors; that dust might cover the leaves with white layer resulting to decrease in chlorophyll cells exposed to light thus, **reducing the total photosynthesis** activities (Missanjo et al 2014: Raina et al, 2008); dust also reduces plant growth (number of leaves, leaves surface and size) therefore affecting **photosynthesis, respiration and transpiration**, (Prajapati and Tripathi 2008); Some release toxic compounds(fluoride, magnesium, zinc, lead, copper, sulphuric acid and hydrochloride acid) Page 6/14 that are damaging to vegetation (Iqbal and Shafiq 2001b).

Leaf trichomes (hair) are affected by dust thereby decreasing the natural defense mechanism against pest and diseases (Missanjo et al 2014b). In addition to the earlier mentioned effect, 80% and 70% respondents stated that effect of quarry activities had led to **soil erosion and water contamination** respectively with both contributing to **decrease in crop yield** (Fig. 7). The accumulation of these activities over the years might have resulted to change in soil properties such that soil in and around the quarry areas (0- 1km) may be found to be more of alkaline. Attributing it to the high concentration of hydroxyl, carbonate and bicarbonate present in mined materials as confirmed by Haritash et al 2007.

In a recent paper, Ibrahim et al (2018) investigated the variation of air pollutants associated with the quarry activities prior to classified distance from quarry site.

Air pollutants were monitored with the use of instruments which are Rae System Multirae Lite Pumped (PGM-6208) to measure indoor air quality while TSI 8533 Dusttrack Drx Desktop Aerosol Monitor to measure outdoor air quality. Sampling was replicated two times. The locations of quarry are at Bandar Saujana Putra and Taman Kajang Perdana 2, Selangor. The objectives of this study was to investigate the impact of quarry mining by preparing the suitable Indoor Air Quality Index and to prepare preventive measure for residential that caused from quarry mining activities.

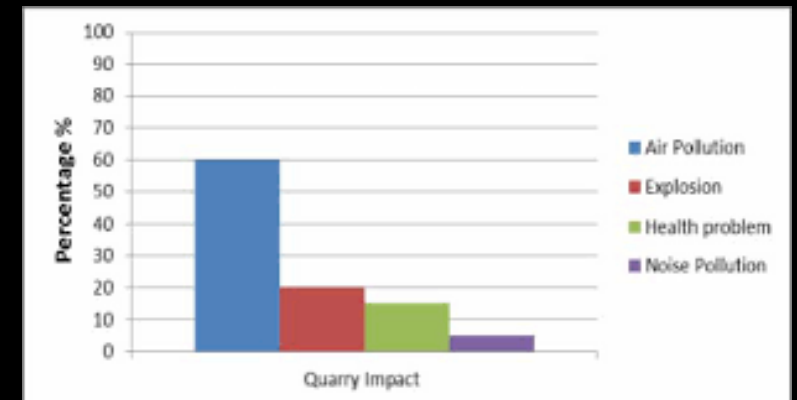
Both **Qualitative and Quantitative** approaches were implemented in this study, which employed case study and interview survey. Both quarries identified previously were the main case study. The Respondent's interviews are from Local Authority and Quarry Management Staff while questionnaire surveys from selected residences. Measurement method used to measure the Particle Matter (PM_{2.5}) for indoor and outdoor in selected resident's area. However, this paper was primed to discuss the method used in this study. It does not only present the beneficial information for future research on methodologies employed but also it is anticipated the benefit to environment which can increased residents' well-being in the vicinity of quarry sites.

Quarry activities at the four locations produced high amount of **PM_{2.5} and PM₁₀**, far more than the recommended WHO Air Quality Index standard. The high amount of this dust resulted to decrease in local crop production such as vegetable, yam and cassava. Many plant species that are present in the locations are climax type, meaning a slight change in their environmental need due to quarry activity might result to complete loss or retardation of the plant. This is because such climax species are more specialize in their environmental needs and less adaptable. Correlation coefficient between the particulate matters and meteorological parameters shows a strong relationship with temperature recording the strongest value. Similarly, the coefficient of determination shows that temperature has strongest meteorological percentage influence on **PM_{2.5} and PM₁₀**. The quarry activities also affected water and soil texture of the locations which are vital ingredient for agriculture thereby, aggregating the problems.

However, further studies are needed to investigate the effect of quarry activities on the physiological mechanism of the plants and the physiochemical properties of soil and water.

W H W Ibrahim et al 2018, Air quality assessment on human well-being in the vicinity of quarry site, IOP Conf. Ser.: Earth Environ. Sci. 117 012010

Ibrahim et al (2018)



Findings

From the results obtained, the following are some of the recommendations that are feasible for quarry activities which are necessary for regular assessment of environmental impact that can mitigate the effect of the problems

1. To develop a green belt surrounding the quarry using pollutant- tolerant trees; especially with broad leaves in order to restrict spreading of the quarry dust through intercepting, filtering and absorbing pollutants.
2. Formation of a code of conduct for the industry as a self-regulatory mechanism
3. Specialize training for owners of the quarries, crop farmers and community chiefs living in the affected areas on mitigations to these dust problems.

In another investigation it has been stated that quarry activity in a limestone quarry includes explosions, quarrying and passage of heavy duty-vehicles.

These processes typically cause high rates particulate matter (PM) emissions. Therefore, quarries located in populated areas, may be an important cause of exposure to particulate air pollution. In order to quantify this phenomenon, it is important to have a good understanding of the effects of quarries on ambient concentrations of PM.

This study aimed to characterize the particle emission and dispersion, caused by a limestone quarry, located about 500 meters from a populated area in central Israel. Since wind speed and direction has a great effect on the particle emission and dispersion, these two parameters were measured half-hourly measurements of solar radiation, ambient temperature and precipitation. Based on the results of the wind measurements, PM sensors were located at the expected hotspots. For control measurements, some sensors were located upwind, and next to the closest main road. The wind measurements were kept going during the PM measuring period as well. Spatiotemporal patterns of the measured PM fit well with our prior knowledge of local sources and their interactions with the meteorological parameters that were measured simultaneously. It seems that the **population exposure to PM depend heavily on the meteorological conditions and the geographic distance from the main sources**, as well as the activity of these sources.

[Dana Drahler](#) and [Barak Fishbain](#), (2108) Studying the Effects of a Limestone Quarry on the Nearby Population's Exposure to PM, The International Society for Environmental Epidemiology (ISEE) , 2018

<https://ehp.niehs.nih.gov/doi/abs/10.1289/isesisee.2018.P01.1370>

Studying the Effects of a Limestone Quarry on the Nearby Population's Exposure to PM



CONCLUSION

There is unrivalled and undisputable information about the harmful impact of the main culprit viz., PM2.5, resulting from quarry operations on human health. There is also sufficient information about the adverse impact of quarry on vegetation and plants.

The first aim is to ascertain if the quarry is absolutely necessary and if so, questions need to be asked regarding the adverse impacts, including the level and type of pollutants and their impact on local population and agriculture. One thing that is often ignored is the deposit of pollutants on the local roads and the transportation which while may not seem an important issue, it is of considerable importance to study what role they play in harm they do to human and plant health.

There are also a range of mitigating issues which need to be considered if the quarry proposal is to be allowed to materialise. This includes air flow modelling and an action plan to minimise the impact of resulting additional air pollutants.

The key is **air quality measurements** with actual and reliable sensors before and after the quarry is in place to ensure pollutant levels do not exceed and if so, action is taken to remedy the situation. A Quality assurance and control system is needed to correspond what is planned and what actually take place. Furthermore, areas for improvement and areas for concern should clearly be reviewed on regular basis.

Further Research

<https://www.eeer.org/journal/view.php?number=1060>

Investigation was carried out to assess the effect of cement dust deposition on the physico-chemical properties of soil near some cement plants in Jaintia Hills, Meghalaya. Soil samples were collected and analysed and compared with the control site. Comparison of various soil physico-chemical parameters revealed that cement dust emanating from cement plants has changed the soil quality in the surrounding areas of cement plants. The normal soil pH in the area is generally acidic. However, due to the continuous deposition of cement dust soil pH was found slightly alkaline near the cement plants. The higher values of soil parameters such as electrical conductivity and bulk density were also noticed near the cement plants. However, lower values of water holding capacity, soil moisture content, soil organic carbon and total nitrogen content were found compared to the control sites. The effect of cement dust deposition on soil is more in areas nearer to the cement plants. At present the changes may not be so serious but if this trend continues, soil properties of a vast area around the cement plants are likely to change leading to multiple effects on flora, fauna and socio-economy of the area.

<https://www.encyclopedie-environnement.org/en/life/impact-air-pollutants-on-vegetation/>

Plants are at the forefront of air pollution because they are fixed organisms at the basis of the functioning of terrestrial and aquatic ecosystems. The nature and extent of the impact of air pollutants on plants will depend on the physiological and biochemical characteristics of the affected plant, and the properties of the pollutant(s) encountered. According to the nature of the pollutant, various physiological disturbances can be observed on plants, over areas ranging from the local scale to the entire planet. They will immediately affect ecosystem functioning and in particular plant-insect relationships. They can also have effects on human health, as plants are the source of many food chains. This article explores the complex consequences that air pollutants have on the environment.

