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ENVIRONMENTAL IMPACTS OF LIMESTONE QUARRYING ON THE BIOPHYSICAL ENVIRONMENT IN ASHAKA, FUNAKAYE LOCAL GOVERNMENT, GOMBE STATE, NIGERIA

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ABSTRACT

Limestone quarrying is a major industrial activity in Ashaka, Funakaye Local Government of Gombe State, Nigeria, contributing significantly to cement production and economic development. However, its environmental implications are increasingly becoming a concern. This study assesses the environmental impacts of limestone quarrying on the biophysical components of the ecosystem in Ashaka. Using field surveys, remote sensing, structured questionnaires, and laboratory analysis, key biophysical variables such as soil composition, vegetation cover, water quality, and air quality were examined. Satellite imagery from 2010, 2015, and 2020 revealed a steady decline in vegetation cover within a 10 km radius of the quarrying site. Laboratory results indicated increased pH, heavy metal content, and suspended solids in nearby water bodies. The study also found that quarry dust led to a reduction in soil fertility and a rise in respiratory ailments among residents. Data were analyzed using descriptive statistics and ANOVA to establish the significance of the changes observed. The results highlight the need for a robust environmental management strategy. It is recommended that the cement industry adopt environmentally sustainable mining techniques, enforce proper Environmental Impact Assessments (EIAs), and implement periodic restoration plans. This research contributes to the growing body of evidence on the environmental trade-offs of mineral extraction and calls for policy reforms aimed at balancing industrial development with ecological integrity.

Keywords: Limestone Quarrying, Biophysical Environment, Environmental Impact, Ashaka, Gombe State

INTRODUCTION

Limestone, a sedimentary rock composed mainly of calcium carbonate, is a critical raw material for cement production and a cornerstone of the construction industry globally (Oyinloye & Ajayi, 2013). In Nigeria, limestone mining has gained prominence due to rising infrastructure demands and economic diversification efforts. Ashaka, located in Funakaye Local Government Area of Gombe State, is home to Ashaka Cement Company, one of the nation's largest cement producers. While the quarrying activities have contributed significantly to local and national economic growth, they also pose serious threats to the surrounding biophysical environment (Adekoya, 2003; Bello & Makinde, 2020).

Environmental degradation associated with limestone quarrying includes deforestation, topsoil erosion, biodiversity loss, and the release of dust and particulates into the atmosphere (Mokhtar et al., 2015). Furthermore, quarrying alters land use patterns, depletes groundwater resources, and disrupts aquatic systems through runoff and sedimentation (Lameed & Ayodele, 2010). These changes may reduce ecosystem services and threaten the health and livelihoods of local populations (OlaleyeOluyemi, 2010).

Limestone extraction processes such as drilling, blasting, and crushing release particulate matter (PM10 and PM2.5) that can cause respiratory ailments and contribute to atmospheric pollution (Chakraborty et al., 2002; Oguntoke et al., 2013). Also, the leaching of heavy metals like lead, cadmium, and zinc into nearby water bodies compromises water quality, with long-term ecological and health consequences (Adie & Osibanjo, 2009; Onwuka et al., 2013). Despite growing concerns, environmental assessments of limestone mining in Ashaka remain limited in scope and depth.

In light of these challenges, this study aims to comprehensively assess the environmental impacts of limestone quarrying on the biophysical environment in Ashaka. Key components evaluated include vegetation cover, soil characteristics, air quality, and water resources. By integrating remote sensing analysis, field sampling, and community surveys, the research seeks to quantify environmental changes and propose actionable recommendations for sustainable resource management. The findings are expected to inform stakeholders, including policymakers, environmental agencies, and the mining industry, on how to balance economic development with environmental stewardship.

MATERIALS AND METHODS

Study Area

Ashaka is located in Funakaye Local Government Area of Gombe State. The region is characterized by savannah vegetation and tropical climate. The limestone deposit in Ashaka has been actively mined for over three decades.

2.2 Data Collection

The study utilized a mixed-method approach:

- Remote Sensing: Landsat images (2010, 2015, and 2020) to analyze vegetation changes.
- Soil and Water Sampling: Samples collected at 3 km, 6 km, and 10 km from the quarry site.
- Air Quality Monitoring: Particulate matter (PM10 and PM2.5) measured using handheld detectors.
- Questionnaires: Administered to 120 households within the vicinity.

2.3 Data Analysis

Descriptive statistics, ANOVA, and spatial analysis in QGIS were employed to assess trends and variations.

RESULTS AND DISCUSSION

3.1 Vegetation Loss

Satellite analysis revealed a decline in vegetation over a 10-year period.

Table 1: Changes in Vegetation Cover between 2010 and 2020

Year	Vegetation Cover (ha)	% Change
2010	1,200	—
2015	850	-29.2%
2020	600	-29.4%

Vegetation decline indicates habitat destruction and biodiversity loss due to quarry expansion.

3.2 Soil Characteristics

Soil tests indicated significant changes in soil pH and fertility:

Table 2: Soil Properties at Different Distances from Quarry

Distance from Quarry	pH	Organic Matter (%)	Bulk Density (g/cm³)
3 km	8.2	1.3	1.68
6 km	7.6	1.8	1.55
10 km	6.9	2.4	1.42

High pH and low organic matter near the quarry suggest adverse impacts on soil productivity.

Water Quality
Water samples from streams close to the quarry showed elevated suspended solids and heavy metals like lead and zinc.
Table 3: Water Quality Indicators

Parameter	WHO Standard	Sample 1	Sample 2	Sample 3
pH	6.5–8.5	8.7	8.9	9.1
Lead (mg/L)	0.01	0.04	0.05	0.06
Suspended Solids (mg/L)	30	54	65	71

These values indicate contamination likely due to runoff and quarry effluents.

Air Quality and Health
PM10 levels in the study area exceeded permissible limits, causing respiratory issues reported by residents. Dust from blasting and crushing units is a major source.

CONCLUSION AND RECOMMENDATIONS
Limestone quarrying in Ashaka has resulted in significant degradation of the biophysical environment, including deforestation, soil depletion, and pollution of air and water. The environmental costs of quarrying outweigh the economic benefits if not managed sustainably.

Recommendations:
- Implement strict environmental regulations and periodic EIAs.
- Adopt dust suppression and noise control technologies.
- Rehabilitate mined-out areas through afforestation.
- Engage local communities in environmental monitoring and restoration.
- Establish a quarry buffer zone to protect farmlands and settlements.

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