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ACHEIVING SUSTAINABLE ENVIRONMENT IN SOLID MINERIAL EXPLORATION IN ANAMBRA STATE, NIGERIA

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Abstract
Achieving a sustainable environment during mining activities within Anambra State has been a serious threat due to its potential impact on communities and ecological units. The study aimed at suggesting outlines that are very necessary in considering and planning for a sustainable environment in solid mineral exploration within the study area. The methodology adopted in this study is ground-truthing approach for effective documentation of the impact of mining activities within the area. The outcome of the study reveals that most of the populace within Nsugbe and Umueri areas have been dispersed as a result of the dynamite explosion during the extraction of the iron stone for various civil engineering purposes. Also, most building foundations within the study area have been disturbed and faulted due to ongoing mining activities in the area. The result shows that the extraction of laterites within Awka, Enugu-Ukwu, Ukpo, Agulu, Nanka, Ekwulobia, Oko and others have accelerated gully erosion within the study area. The outcome also established the importance of integrating all viable approaches to curb the incessant extraction of solid minerals without adequate environmental impact assessment and preventive measures. The study suggests workable environmental laws that will solve economic, social and environmental issues across the life span of mining activities within the study area in order to achieve UN-SDGs 11.
***Keywords**: Mining Activity, Iron Stone, Laterite, Gully Erosion and Nsugbe.*

Introduction

A mineral is any naturally occurring element or chemical compound that is crystalline in nature and was created as a result of geological processes Nickel (1995). They exist as aggregates, which are often called rocks. Based on their composition and applications, minerals can be divided into the following groups: industrial minerals (limestone and baryte); construction minerals (gravel sand and rock aggregates); gemstones (emerald and topaz); metallic minerals (e.g., iron and gold); and mineral fuels (coal). Any mineral that is to be used for production has to be explored. A geological survey, an aerial geophysical survey, a geochemical study, and a reserve estimate are all part of the exploration phase.

Usually, once a mineral deposit has been established to be commercially viable, exploitation activity may commence, which include but not limited to the mining of the relevant mineral. In the words of Omotehinse and Ako (2019), mining could be open-pit when the mineral deposit occurs at shallow depths (such as coal and tin) and underground mining (coal). All the stages of mining result in different environmental damages (Al-Usmani, 2011). Nigeria is a country endowed with vast and varied solid mineral resources which are widely distributed in virtually all of the states within the federation, including Abuja. Generally, there have been a series of negative reports from illegal mining of mineral deposits across Nigeria including Anambra State, our study area. If mining activities are not monitored and best practices are not put into place, the consequences can be devastating.

Furthermore, surface mine reclamation best management methods could be implemented. Previous research on the environmental effects of solid mineral discovery and exploitation in Nigeria focused on certain environmental factors, such as ecology and water, and rarely examined the total environment. Musa and Jiya (2011) used Normalized Differential Vegetation Index to evaluate the effects of mining activities on the vegetation in the Jos Plateau and came to the conclusion that tin mining activities had a significant negative impact

on the natural ecology of the study area and that many organisms and plants were deprived of their natural habitat.

Finally, mining inevitably disturbs the environment and mining of minerals in Anambra State has always left behind a devastating effect on the environment. Then, aachieving a sustainable environment during mining activities within Anambra State (Fig. 1) has been a serious treat due to its potential impact on communities and ecological units. Generally, it is worth mentioning that some of these mineral resources in Anambra are illegally mined and exported to the international markets with no official records. Thus, the study aimed at suggesting outlines that are very necessary in considering and planning for sustainable environment in solid mineral exploration within the study area. This study hopes to adopt the United Nations (UN) Sustainable Development Goals 11 ((SDGs-11) which focuses Sustainability, to Make cities and human settlements inclusive, safe, resilient, and sustainable as the standard which Anambra State should achieve with respect to the mining activities.

Geological Setting

Geologically, the study area is underlain by five lithological units: Nsukka Formation, Imo Formation, Nanka Formation, Ogwashi-Asaba Formation, Benin Formation and Alluvian Sands (Fig. 1). Nsukka Formation belongs to Anambra Basin while the rest belongs to Niger-Delta Sedimentary Basin of Nigeria (Nwajide, 2013). Actually, Nsukka Formation is the oldest geological units within the study. The Palaeocene Imo Formation which happens to have a sand member called the Ebenebe sandstone, which is overlain by the Eocene Nanka Formation (Figure 1). The Imo Formation is the basal unit of the Niger Delta Basin (Nwajide, 2013). The formation is essentially a mudrock unit consisting of dark grey to bluish grey shale, with occasional admixtures of clay, ironstone, thin sandstone bands, and limestone intercalations. The Nanka Formation overlies the Imo Formation in the southwestern part of the study area. The formation has an upper unit, which is composed of loose sand with fine to medium grains and mudrocks. The lower subunit consists of well-sorted, clayey, fine-grained, unconsolidated sandstone, with very thin claystone towards the top. The Ogwashi-Asaba Formation overlies the Nanka Formation while Benin Formation overlies the Ogwashi-Asaba Formation (Anakwuba *et al*., 2022, Anakwuba *et al*., 2021, Chinwuko *et al*., 2016, Chinwuko *et al*., 2015, Anakwuba *et al*., 2014)

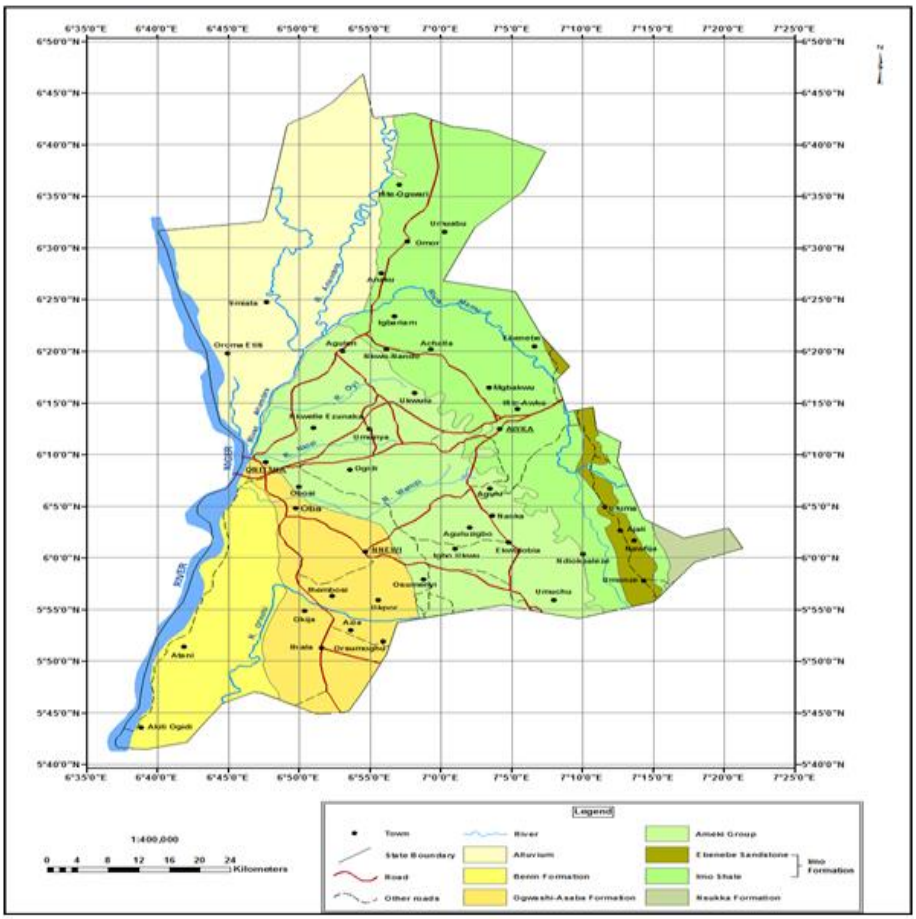


Fig. 1: Geologic Map of Anambra State (After, Anakwuba et al, 2022)

Methodology

The methodology adopted in this study is ground truthing approach for effective documentation of impact of mining activities within the area. The ground truthing approach used for this research included a field survey by visual inspection and land surveying; direct mapping of mining activities; assessment of exploration and exploitation impacts (which was carried out by visiting the site, analyzing and assessing each impact on the atmosphere, landscape, lithosphere and hydrosphere); documentary analysis by reviewing literature; and observations (physical). Each method presents various opportunities for gathering as much information as possible on the potential environmental implications of mineral exploration and exploitation activities. Anambra State was chosen because of active mining activities which are ongoing within the study area.

Results and Discussion

Mapping of Mining Activities and Its Impact on the Environment

Direct mapping of mining activities and the field survey exploration for minerals include geological mapping, of which rarely impact the environment. Detailed geological mapping adopted traverse techniques which reveals various pitting, trenching and drilling across the study area. These activities have minimal impact on the environment, except for the destruction of vegetation, noise and vibration, groundwater aquifer contamination through drilling, and fluid disposal (Ezeaku, 2012). Exploitation of solid minerals consists of site preparation, mining, mineral processing, transportation of raw materials to processing site(s) and mine closure or abandonment. The environmental impact of exploitation includes air, land and water pollution,

damage to vegetation, ecological disturbance, degradation of the natural landscape, radiation hazards, geological hazards and socio-economic problems (Aigbedion and Iyayi, 2007).

On the Anaku area, where active mining of clay deposits is taking place, a post mining environment scarred by few occasional mine ponds and devastated landscape were left behind. Excavation and removal of sands, laterites and lateritic soils from various geologic outcrops within the area create a lot of environmental degradations; in some places, people in quest for quick money, remove up to 30 feet of earth material without caution and even go too deep in search of sharp sands that are buried in the subsurface. In such areas, deaths occasionally occur, nearby fences and electric poles and even roads are in danger of collapsing into the valley created by means of the excavation. This is the case of NTA fence at Enugwu-ukwu, Agu Awka, Isiagu, Umuchukwu sand excavation sites (Fig.2a-b).

The environmental impact of incessant use of explosives (dynamite) in blasting of iron ores at Nsugbe (Fig. 2c) is enormous:

i. It weakens the soil and makes them vulnerable to soil erosion and gullies.
ii. It affects the buildings
iii. Air and noise pollution prevalent.
iv. The eco system is being destabilised.



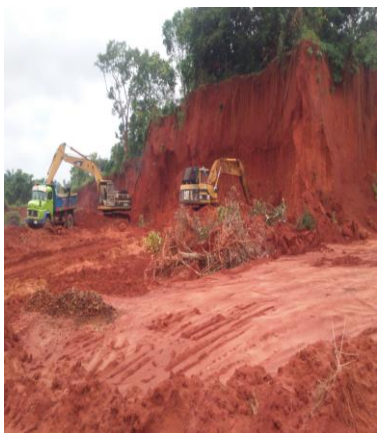
a) NTA Fence 3meters away from collapse at Enugwu-Ukwu



b) Gully erosion site as a result of mining at Enugwu-Ukwu



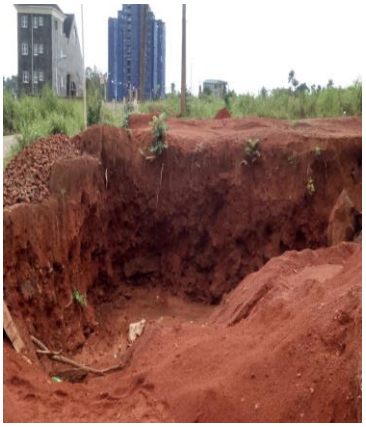
c) Effect of dynamite on iron ore deposit at Enugwu-Nsugbe



d) Deforestation as a result of mining of laterite deposit at Nawfia



e) Ongoing illegal mining of iron ore deposit at Umuchukwu, Orumba South Judicial Quarters



f) Ongoing illegal mining of iron ore deposit at Umuchukwu

Fig. 2: environmental impact of mining activities within the study area

Furthermore, assessment of exploration and exploitation impacts within the study area have gone through the exploration stage, and exploitation has been ongoing for many years, therefore, the effect of their exploration and exploitation is quite apparent. It is hoped that the observed impacts on the environment from the exploitation of mining activities in the area will be useful antecedents in putting together a comprehensive environmental management standard for the mining industry within Anambra State and Nigeria at large.

Implication of the Findings with SDGs

Achieving a sustainable environment which is a key word in the United Nations (UN) Sustainable Development Goals 11 ((SDGs-11) in this era of rampant artisan mining for riches in Anambra State requires two basic dimensions: an appropriate balance between the benefits of mining and the associated damages or costs; and new and better methods of mining and mineral processing be developed to reduce both production costs and environmental damages. Thus, the environmental hazards at the mine site itself are matched by potential adverse effects of off-site processing. These effects may be removed from the mining area, but must be considered as one consequence of mineral production. As with activities at the mine site itself, technical advances may be able to reduce and minimize adverse environmental off-site (Omotehinse and Ako , 2019). Anambra as a promising economic stream in Nigeria, must have concrete effort to ensure safe operational activity by artisans in mining industries. This is necessary so as to avoid effort in futility were the health and environmental burden credited to odd mining process which could override its economic benefit. With these prevailing consequences of mineral exploitation such as abandoned sites, vegetative loss and deforestation and land degradation, attention on the possible ways of limiting its progressive damage on health and environment is paramount. However, utilizing green-based biotechnology, an eco-friendly remediation strategy and natural settings of the environment must be harnessed. The study suggests workable environmental laws that will solve economic, social and environmental issues across the life span mining activities within the study area in order to achieve the United Nations (UN) Sustainable Development Goals 11 ((SDGs-11) which focuses on the sustainability in order to make cities and human settlements inclusive, safe, resilient, and sustainable as the standard which Anambra State should achieve with respect to the mining activities (Chinwuko *et al*., 2022).

Conclusions

From the studies carried out, it was concluded that the mining activities have huge environmental implications. It was evident that the landscape of the of study area contains a lot of dangerous mining ditches that have degraded the area and serve as contaminants for both humans and animals. The natural ecology was greatly impacted by deforestation and the mine sites became prone to erosion due to a lack of vegetation in the areas. The awakening interest in solid minerals exploitation in the State, if not properly controlled, will release further havoc on the environment. The outcome also established the importance of integrating all viable approaches to curb the incessant extraction of solid minerals without adequate environmental impact assessment and preventive measures. The study suggests workable environmental laws that will solve economic, social and environmental issues across the life span mining activities within the study area in order to achieve UN-SDGs 11. However, urgent attention should be paid to the implications of these exploitation activities such as abandoned sites, loss of biodiversity, and the use of chemicals with potential health risks to mine workers and communities.

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