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Metal Mining in Nigeria: Critique on it's Environmental, Socio- Impacts and Mitigation Measures

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Abstract

Mining refers to the extraction of earthy minerals and substances with commercial value from the earth's crust. Globally, Nigeria is one of the highly endowed countries with an abundant mineral. Examples of these minerals are metallic minerals, energy minerals, and gemstones. Deposits of several commercially important metals are spread across various parts of Nigeria. These metals include iron, gold, nickel, chromium, copper, uranium, silver, and tin. Mining types are surface mining, placer mining, underground mining and in-situ mining. Despite the commercial and economic benefits of metal mining, it has several adverse impacts on the environment, including pollution of air and water, loss of vegetation/deforestation, degradation of land, defacement of landscapes, and displacement of local people. Available measures to mitigate adverse impacts include the implementation of mining best practices, the closure of illegal mines, improved legislation and regulation of mining operations, the reclamation and restoration of abandoned mine sites via various forms of phytoremediation, and encouraging recycling. To ensure that the adverse metal mining impacts on the receiving environment are curtailed, government has a crucial role to play, as do non-governmental agencies. Also, further research into more sustainable mining practices is required.

1. Introduction

The process of extracting beneficial geological minerals and other elements that are of economic treasured from the earth deposit is known as mining [1]. Uncontrolled and regulated mining venture is regards as a notorious and destructive business, with the impacts of a single mining operation having a significant environmental impact. Although there are certain rules in place to prevent destruction, they are insufficient to permit mining and wildlife to coexist, especially when standards and regulations are poorly monitored and implemented. To achieve sustainable goal, the conversion of natural capital must give rise to the creation of comparable social and economic capital. Mineral mining activities globally must entail scraping away earth and rock surfaces in order to reach minerals buried under or near the surface.

In many cases, mountains are literally blasted apart to reach mineral deposits within. This activity tends to leave permanent scars on the landscape, thus giving rise to adverse environmental issues [2].

Nigeria is frequently described as having 'abundant' or 'huge' solid mineral resources, including but not limited to precious, ferrous, and base metals, energy minerals, and a range of industrial (non-metallic) minerals and rocks [1] (plate 1). Distinct types of solid minerals have been documented in different places across Nigeria. Several of these are, however, might legitimately be viewed as "mineral showings" with little or no commercial promise [3]. The notable economic valued solid minerals in Nigeria are classified and listed into;

a. Metallic minerals: - iron ore, gold, tin, niobium- tantalum, lead-zinc, manganese, copper, tungsten, titanium, nickel, zirconium and chromium (molybdenum, silver, tungsten, bismuth).
b. Non-metallic minerals (and rocks): - barite, gypsum, phosphate, talc, salt, bentonite, clays, kaolin, zircon, marble, mica, tourmaline, beryl, kaolin, glass sand, gemstones. Industrial rocks are limestone, shale, granite, dolerite, sand and laterite.
c. Energy minerals: - coal, bitumen/tar sand and uranium.

Mining for metallic minerals is scattered throughout broad sections of the nation, with tiny and artisanal operations employing panning, pitting, or excavation of low bulk but high value minerals such as gold, lead-zinc, tin, columbite, and manganese. Eluvial/alluvial placers, mechanized and hand dug pitting, and excavation via both legal and illicit (unlicensed) activities are examples of mining settings [3].

Exploration activities are generally known to live an unmistakable footprint in their locations which notably modify the natural surroundings. With enormous deposits of natural resources strewn over Nigeria, from Jos (tin and columbite) in the north to Edo (lead) in the south and Enugu (coal) in the east to Ogun (limestone) in the west, stories of mining's harmful impact on the environment abound. According to data, the solid mineral sector is the second most polluting industry after crude oil. As enormous heaps and dumps of solid waste, tailings and effluent are emitted as a consequence and disrupting natural sanity and quality of biological life and the regular functioning of the ecosystem structure [4]. One of the constants associated with mining activities is the influx of people, which frequently puts further pressure on an existing constrained environment. Because local artisans are frequently ill-equipped with expertise and machinery, as well as a lack of appropriate laws or regulations and environmental standards that governs mining operations, resulting in the noticeable environmental degradation such as soil erosion, landscape damage, deforestation, loss of vegetation, loss of cultivable land, and ecological imbalance. Mining operations are known to be linked with several negative environmental phenomenon such as ear-threatening noise and vibrations from rocks blasting explosion. Air pollution, chemical spills, radioactive liquid and solid waste, deforestation and soil erosion are notable examples of environmental degradation [5]. The aim of this study is to critique the environmental, socio- impacts and mitigation measures of metal mining in Nigeria.

2. Metal Mining and Deposits In Nigeria

The Nigeria mining history is dated back to 1903 when the Mineral Survey of the Northern Protectorates was first established by the British colonial administration and thereafter the establishment of the Mineral Survey of the Southern Protectorates in response to this development in the Southern part of Nigeria. The proceeding decades saw an invasion of international mining corporations from the European Nations which included United Kingdom and Germany, with

companies such as merged Tin Mining Company of Nigeria, Exlands, Gold and Base Metals, and so on. Because no regulation was put in place by the colonial authority to guide mineral extraction, these corporations introduced automated mining, which resulted in increased mine productivity and, as a result, land destruction. Nigeria was a major producer of tin, columbite, and coal by the 1940s. The rising global demand for petroleum products, along with the collapse of the international market for mineral commodities and the early 1970s indigenization edict, hampered Nigeria's capacity to maintain the pace of mineral growth [6].

The British Geological Survey has identified many significant uranium resources in Cross River State, Adamawa State, Taraba State, Plateau State, Bauchi State, and Kano State. The Nigerian Federal Government had named 2007 the 'Mineral and Mines Year'. Nigeria has significant substantial mineral reserves, and the government is opening up the industry to international investors through proper reforms. The nation is thought to have 76 minerals spread over all of the federation's states (Fig 1). Energy minerals, industrial minerals, metallic minerals, semi-precious minerals, and gemstones are all part of Nigeria's mineral inventory. Foreign investment increased dramatically in Nigeria following independence. Nigeria, like many other countries throughout the world, offered advantageous monetary and fiscal incentives to attract international investment. Trade agreements also ensured the protection of such investments. The fall of mining in Nigeria was caused by two primary factors: the discovery of oil in 1956 and the implementation of the 1972 Indigenization Decree. The Nigerian Mining Corporation (NMC) and the Nigerian Coal Corporation (NCC) were established as a result of this order [6].

Nigeria has been identified as one of the continent's countries endowed with an abundance of solid minerals. It has some of the greatest known deposits of various precious metals, stones, and industrial minerals such as coal, tin, gold, marble, limestone, and others. Even though they have yet to be effectively utilized on a substantial scale, the core of these mineral resources spread across the nation remains a key attraction for both informal and traditional mining activity [2]. The occurrence of some important metallic mineral deposits in Nigeria is shown in Table 1.

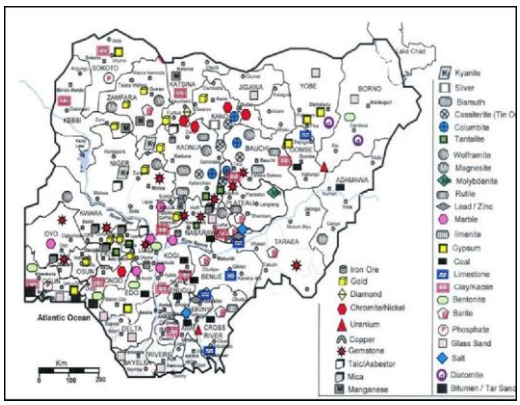

Fig 1: Nigeria map showing distribution of metal and other mineral deposits [3]

Plate 1: Environmental degradation due to mining activities in Banega

Table 1: List of metallic minerals in Nigeria and their locations [3]

S/N	Metal	States of occurrence
a.	Iron	Kogi, Nasarawa, Enuu, Kaduna, Katsina, Zamfara, Kebbi, Oyo
b.	Gold	Osun, Kwara, Kogi, Niger, Kaduna, Kebbi, Zamfara
c.	Tin	Plateau, Kano, Bauchi, Nasarawa, Kaduna, Ekiti, Cross River, Kogi
d.	Niobium	Plateau, Kano, Bauchi, Kaduna, Kwara, Cross River, Ekiti
e.	Tantalite	Plateau, Kano, Kogi, Kaduna, Kwara, Cross River, Ekiti, Taraba
f.	Manganese	Kaduna, Katsina, Kebbi, Niger, Zamfara, Cross River
g.	Lead	Cross River, Ebonyi, Imo, Benue, Nasarawa, Plateau, Taraba, Zamfara
h.	Zinc	Cross River, Ebonyi, Benue, Nasarawa, Plateau, Taraba, Zamfara
i.	Copper	Plateau, Zamfara, Nasarawa, Kano, Bauchi, Yobe
j.	Nickel	Kaduna
k.	Chromium	Zamfara, Katsina, Kaduna. Kogi
l.	Titanium	Bauchi, Cross River, Kaduna, Katsina, Nasarawa
m.	Tungsten	Bauchi, Kaduna, Kano, Nasarawa, Niger, Plateau
n.	Molybdenum	Kano, Plateau
o.	Bismuth	Kaduna
p.	Silver	Kano, Ebonyi, Plateau
q.	Platinum	Niger
r.	Barite	Benue, Cross River, Ebonyi, Nasarawa, Adamawa, Plateau, Taraba
s.	Limestone	Abia, Benue, Cross River, Ebonyi, Gombe, Kogi, Ogun, Sokoto, Borno
t.	Dolomite	Kogi, Edo
u.	Lithium	Ekiti, Kaduna, Nasarawa, Niger, Zamfara
v.	Zircon	Plateau, Kano, Bauchi, Nasarawa
w.	Uranium	Cross, River, Bauchi, Taraba

3. Types of Metal Mining

3.1 Surface Mining: One of the earliest mining techniques is surface mining and it is the most common technique used worldwide. They are mostly mined using open pit or open cast techniques. Making an open pit and then digging the ore underneath it allows for access to ore deposits that are closer to the surface for further processing. The overburden, which is a layer of rock or soil that covers the deposit, must often be removed in substantial amounts. Surface mining encompasses aqueous techniques like placer and solution mining as well as mechanical excavation techniques like open pit and open cast (strip mining). Open pit mining is a kind of mechanical extraction. Each thick deposit is mined using this approach in a sequence of benches, whereas any thin deposit may only need one bench or face. Open cast mining is another name for open pit mining. It is often used to extract an ore with a low stripping ratio or a deposit that is close to the surface. Although it frequently necessitates a sizable capital investment, it typically yields excellent production, low operating costs, and favorable safety conditions [7].

3.2 Underground Mining: In order to reach the reserves of buried ore, subsurface mining entails excavating tunnels or shafts below the soil. Tunnels and shafts are used to transport waste rock and ore to the surface for disposal as well as processing of the ore. The kind of shafts utilized, the method of extraction, or the approach strategy used to access the deposit may all be used to categorize subsurface mining. Vertical access shafts are used by shaft mining, whereas horizontal access

tunnels are used by slope mining and horizontally sloping access shafts are used by drift mining. With hard and soft rock formations, mining needs distinct methods. Because of the fact that these deposits often have significantly greater ore grades than open-pit mining, they need less waste rock removal and have less of an impact on the environment [7, 8].

3.3.Placer Mining: Placers are resource deposits that are often generated by weathering caused by water and/or wind activity. Placer mining is used in river channels, beach sands, or other environments to sift valuable metals from sediments. Placer mining often includes sorting precious minerals from sediments in riverbeds, sands, or other sedimentary settings. The well-known placer mining technique known as "panning for gold" can be used. The collected sedimentary material is cleaned and sluiced in placer processes to extract the necessary minerals. In addition to gold, placer mining may be used to recover gemstones, platinum, tin, and other commodities. This kind of mining activity provides at least 50 % of the titanium in the world [7, 8].

3.4 In-situ Mining: In-situ mining, also known as solution mining, does not entail extracting entire ore from deep inside the soil. Instead, it entails pouring chemicals down to dissolve ore holding resources, and then pumping the resulting "pregnant solution" back up to the surface, where it may be treated to recover minerals. The primary use for this method is uranium mining. In addition to producing extremely little waste rock, this method also disturbs the surface very little. This method requires the ore body to be permeable to the extraction liquids and the ability to carry out the procedure without significantly increasing the danger of polluting neighboring groundwater [8].

4. Cases Of Environmental Impacts Of Metal Mining

4.1 Water Pollution: The Zamfara State, Nigeria sad event of year 2010 when the death of more than 200 children under the age of five years has stayed fresh and difficult to forget. Numerous saw it as a single, well-publicized incident among many pockets of associative death that had happened around the country. Research conducted at Itakpe community, Kogi State, linked nearly three decades of iron ore exploration to gastro-intestinal inflammation, catharsis, dehydration, dry skin, and tooth discoloration in the local population. During rains, the waste stack from mining operations composing of several geological and chemical components such as zircon (metal zirconium), ilmenite (titanium-iron oxide mineral), magnetite (iron ore), monazite (reddish-brown phosphate mineral), silica sand, thorite and amethyst (Plate 2a-g) poses a public health risk due to seepage or probable flow to a neighboring water source. As a result of this occurrence, the water's turbidity or acidity level rises, rendering it unsafe for aquatic life and residential usage [9]. According to emerging evidence, several of the abandoned mining ponds have become death traps due to unintentional falls. In distant places where potable water is scarce, residents are forced to divert runoff rainfall into existing mine pits for irrigation, farming, and other household purposes. This unusual activity, along with heavy metal consumption through the food chain and mining waste leaking into groundwater, will undoubtedly have a negative influence on human health given the significant amount of exposure and bioaccumulation. A striking environmental challenge of the mining location is the occurrence of groundwater encroachment and pollution during exploration activities, which results in increased sulphate-metal content, and resultant acid mine drainage [5].

4.2 Air Pollution: Different studies [10, 11, 12] had shown that has shown that in the course of blasting activities, crushing of large geological substances into smaller sizes, minute and fine particle sizes are released and dispersed into the surroundings. These particulate matter (PM) which are in less than 10 microns sizes appeared as dust particles when found in the ambient air and they are known to pose serious environmental and respiratory health threats to people [10, 12]. Study by

[12] has shown the impact of particulate matters arising from marble and granite processing on nearby vegetable gardens grown around factories and mining sites in Auchi, Edo State.
At significant exposure of site workers as occupational hazards to particulate matter through inhalation is known to result to several life-threatening ailments such as respiratory disorders, silicosis, and lung diseases [10]. Gold mining activities are doubt the major cause of silicosis and silico-tuberculosis that has been reported in mining areas in Zamfara, Oyo, Ishiagu and Enyigba, where dust from gold mining sites has high silica content. Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Carbon monoxide (CO) and black smoke at sufficient contact can exacerbate the condition of people with asthma and arthritis [5]. The release of volatile elements and compounds during combustion causes significant pollution in the environment and can lead to health problems such as pneumoconiosis [14]. Records of individuals living with eye discomfort, asthma, and respiratory attacks of various types have subsequently emerged from surrounding communities in Sagamu and Ewekoro, Ogun state, as a result of the industrial schemes such as the case of cement plants and other mining activities in the locality [5].

4.3 Loss of Vegetation and Deforestation: The adverse impacts of mining exploitation in every location are usually first viewed when there is loss of vegetation and deforestation. Typically, vegetation degradation happens during mine construction. Emerging research indicates that exurban populations in the northern section of Edo State have suffered greatly as a result of these environmental issues. Archives of damage to flora and plantations such as oil palm trees caused by crude oil exploration activities have long existed in an oil spill prone area (Ogoni land). In the investigation [14], attributed the drop in kola nut crop yield in Shagamu to the nearby cement factory placement. This problem, together with the progressive advance of the Sahara Desert into the tropics and the consequent depletion of the Lake Chad basin, is to blame for rising atmospheric carbon dioxide concentration and global warming. With sufficient arable lands rapidly depleted as a result of clearing vegetation, establishing campsites, installing excavators and heavy machinery, and building roads for easy traffic, many protective plants, cash crops, and plantations are lost due to accelerated soil erosion and flooding, resulting in economic loss [5].

4.4 Land Degradation and Soil erosion: The aesthetic character of every area is related to the construction of its landscape. In Nigeria, the existence of thousands of abandoned mine pits, such as those seen in the Jos mining zone, has disrupted the tranquility of the area. Examples include the destruction of natural landscapes, the formation of pits, and the uncontrolled dumping of waste piles at Imeke, Igara, and Ikpeshi, where granite and marble quarries are being explored. The stories are similar in Nkalagu, Gboko, and Ashaka, where some of the gaping holes act as an artificial lake for local populations. Apart from the dreadful landscape that followed this activity in Jos and Bukuru metropolis in the 1970s, certain parts of its environment, such as Gyel and Sarbobarki, are still feeling the consequences of mining. As difficult as it is to restore the landscape after mine, one possible alternative remains, waste filling of the pits once mining is over. However, this is impossible to do because most miners do not own property and hence care less about the community [5]. With the world's population on the rise and technological and innovative advancements, there has been a concurrent reduction in environmental quality and life sustenance capabilities. Mining operations, which include excavation, have unearth the entire terrain to severe erosion since it is underlain by crystalline rocks, where on a regular basis play host to quarrying operations [5].

4.5 Displacement of Local Communities: Mining activities often involve blasting which is a source of vibrations. These vibrations cause damage to structures including buildings, roads, bridges, etc. in the vicinity of the quarry. This could lead to local inhabitants vacating their homes for fear of safety. Other damages to the environment may lead to decreased agricultural productivity and poor environmental quality which can cause the people to migrate [12].

5. Socio-Economic Impact of Mining

5.1 Impacts on Water Resources: Studies has shown that unregulated mining activities lead to erosion and water pollution with consequent negative impact in poor water quality and adverse effects on breeding aquatic organisms [10, 16,17]. Suspended solids reduced light penetration in the water body by scattering and absorption of light. Mining activities also affected the quantity and quality of groundwater supplies (Plate 3-4). Tackling landscape denudation and improper closures of abandoned mine sites. A study by [10] assessed the environmental impact, risks, challenges and mitigation strategies employed in Ameka illegal mining sites and environs situated in Ebonyi State, Nigeria.

5.2 Socio-Economic Impacts: According to [10, 18], the possible financial benefit of mining operations in an area will result to increased number of persons coming into the sector as miners and the consequent establishment of overcrowded camps, uncontrolled relocation of individuals leading to sexual trade and vulnerability of female persons, unwanted marriages and pregnancies resulting in increased cases of abortions, high incidences of sexually transmitted diseases (STDs) and spread of communal diseases and ghetto settlements.

Plate 2 a: Zircon

Plate 2b: ilmenite

Plate 2c: Monazite

Plate 2d: amethyst

Plate 2e: magnetite

Plate 2f: silica sand

Plate 2g: thorite

Reference: iStock google image

The socio impact will be as well include abandonment of houses (Plate 5), marked increase in child labour involving many young persons and many out-of-school children, aversion of illegal mining due to uprising from the youth. Challenges associated with areas of illegal mining are; tackling landscape denudation and improper closures of abandoned mine sites, poor enforcement or watery environmental legislation, difficulties in monitoring and enforcing penalties for environmental violations and reckless abandon of the open-pit mines.

Plate 3: Excavated Earth caused defaced landscape [4].

Plate 4: Artificial lake formed due to mining activity [4]

Plate 5: Houses abandoned due to cracks from seismic activity [4]

6.0 Mitigating the Adverse Environmental Impacts of Metal Mining

6.1 Reclamation and Restoration Efforts: Various remediation strategies can be used in the reclamation and restoration of mining-contaminated soils and water. One of the most feasible methods for accomplishing this is phytoremediation. Plant based remediation has shown to be a potential technology due to the inherent benefits of employing fast growing and high biomass crops, including phytoextraction, phytostabilization, rhizodegradation, phytodegradation, rhizofiltration, and phytovolatilization as feasible techniques of choice.

a. Phytoextraction: This is the transport of pollutants from the plant root to the harvestable area. Its operation is based on pollutant absorption, build-up, and transfer to plant biomass. It is largely used to remediate and rehabilitate abandoned mining sites since it restores the sanity, fertility, and structure of soil when appropriately handled. The mode of action of phytoextraction is dependent on metal mobility/bioavailability, metal absorption rate, soil metal concentration, translocation, and plant tolerance to metals. This method has had tremendous success in cleaning up sites contaminated with copper, zinc, and nickel [19].

b. Phytostabilization: This is the prevention of harmful substances such as heavy metals from migrating vertically and horizontally in soil, sludge, and sediment. It is a method of contaminant inactivation and long-term containment. Significantly, by keeping pollutants from entering groundwater and the food chain, the mobility of pollutants is considerably decreased. Phytostabilization is preferred over traditional remediation processes (chemical and physical) due to its cheap cost and ease of usage. This method is the most ideal eco-friendly technique for re-vegetation of deforested mining sites. Plants that resistant to heavy metals and thick root architecture and canopies are preferred. Its action mechanisms include metal immobilization, precipitation, and valence reduction inside the rhizosphere [20].

Rhizodegradation and phytodegradation: The process of rhizodegradation is initiated by protein presence in the soil which is known to be generated by plants and bacteria, yeast, and fungi. The method of rhizodegradation has to do with dissolving of organic compounds inside the rhizosphere with the help of rhizobacteria. Plant-microbe interactions result in effective pollutant absorption, metabolism, and destruction. Plants release nutrients such as sugars, amino acids, and flavonoids, which stimulate microbial activity and thereby reduce soil pollutants. Phytodegradation is the breakdown of organic base contaminants by plants using enzymes. This operation is unaffected by rhizospheric bacterial activity [5].

Rhizofiltration: Plant roots employ this method to absorb and precipitate metal pollutants in aqueous media, generally at low concentrations. Using vast and massively rooted aquatic plants, it is successful in cleaning practically all aquatic environments. Hydroponic producing plants with sufficient root biomass and wide surface area can be adopted to employed as metal mitigating terrestrial plant. Rhizofiltration has been used to clean up acid mine drainage, industrial discharge, and agricultural runoff. The introduction of rhizofiltration phytoremediation technique had shown a successful remediation of heavy metal such as cadmium, lead, chromium, zinc, copper, and nickel polluted water bodies [5].

c. Phytovolatilisation: This is the absorption of a soil pollutant such as Volatile organic compounds (VOCs), selenium (Se), and mercury, by a plant which is thereafter transformed into a gaseous form and further transpired into the atmosphere. Substances that are primarily absorbed through the roots of plant make their way into aerial tissues such as the leaf, where they eventually released from the pores (stomata). Research has shown that volatilized mercury deposits are re-deposited into the ecosystem via precipitation [11], and this clean up method has advantage which cub the challenge of pollutants migration to another medium.

6.2 Proper decommissioning of illegal mines sites and reclamation: There is a general environmental abuse associated with unregulated mining operations in Nigeria, and Federal and State Government hosting this menace are clamping on such industries through enforcement of closure of illegal mining sites in order to promote global environmental management standard. As a policy, land reclamation to it pristine condition should be considered after decommissioning of mining operation. The reclamation process is expected to include the removal of hazardous substances, restoration of topsoil, afforestation and reshaping of land topography [2].

6.3 Scrapping and recycling of metal waste: Mining industries in Nigeria like their global counter parts should work towards reducing its generated waste and focus on global best practice in waste management. In the puissance of green environment, several environmental advocates are emphasizing on reduction of usage of raw material such as metals, plastic and other non-degradable xenobiotics during production and focusing towards achieving sustainable goods that are reusable and recycled [2].

6.4 Machinery for regulatory standard and guideline: It's a known fact that the activities of mining sector in Nigeria is poorly regulated due to lack of efficient policy framework. In managing this sector therefore, its pertinent for the government to set machinery in motion to come up with a regulatory standard and guideline for proper enforcement by the appropriate governmental agencies. According to [2], appropriate legislation should be enacted to curb any possible abuse of the environment through mining operations.

6.5 Systematic review of environmental performance: A policy frame work in sector should consist of a systematic, documented, periodic and objective evaluation of environmental performance to mitigate all associated mining impacts to their receiving environment [2].

6.6 Funding research and development in mining sector: The solid mineral mining sector is expected to do well and meet global standard if governmental policies drive and encourage research especially in area of sustainability [2]. The need for deliberate funding of research to unlock key potentials of the sector where feasible and unbundled opportunities lie and where best practice technology should be encouraged and adopted in Nigeria just as its practice in developed Countries.

7. Conclusion

Metal mining activities is established to have a detrimental influence on the ecosystem. As a potential economic stream in Nigeria, crafts people in mining industries must work together to ensure the environmental safety of their operations. This is vital, as the health and environmental costs associated with unsafe mining processes may outweigh the economic benefits. Also considering the predominant repercussions of mineral extraction, emphasis must be focused on viable measures to prevent progressive damage to environmental health.

8. Recommendation

I. The Nigeria tiers of government and their respective agencies must synergize with local community leadership cutting across age structure, in whose jurisdiction the mines deposits are located, to ensure proper environmental management.
II. Established governmental agencies and commissions entrusted by law with responsibilities of regulating mining activities should be sufficiently empowered and strengthened, both politically and financially to meet up with their schedule.
III. Sustainable institutional framework should be model to promote policy formulation, strategic and capacity development, sufficient legislation and coordinated mechanisms so as to ensure appropriate rehabilitation/reclamation and zero tolerance to unsustainable activities within the sector and location of mining operations.
IV. Educational awareness of the resident of mining operations through awareness campaigns and institutional programmes both at schools and communities should be vigorously pursuit.

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