EVALUATION OF THE ABATEMENT AND CONTROL MECHANISMS OF ENVIRONMENTAL AND HEALTH HAZARDS IN THE MINING INDUSTRY IN NIGERIA*

Abstract
The earth is naturally endowed with various mineral resources providing huge economic benefit to human beings; both mine owners and the government. For instance, grant of applications for license to mine and payment of royalties are ways of generating revenue by the government, while the masses are employed and paid to work at the mines as the mine owners generate income and make profits. Nevertheless, the process of extracting these minerals from their ores (naturally occurring state) triggers a chain of events which are hazardous to both the aquatic and terrestrial habitats, affects the ecological life, air quality, soil nutrient, Land mass etc, as well as human health (life in extreme cases). This underscores the importance of establishing appropriate measures to regulate this activity. Therefore, this paper seeks to evaluate the various proactive measures for controlling and abating the hazardous effect of mining activities on the Environment and Human health. The findings made are to the effect that adequate Environmental Impact Assessment must be made and submitted for vetting according to the legal provisions, before commencing any mining operation to minimize these undesired effects. However, the implementation of the process is another kettle of fish. Being that some damage to the environment is inevitable the mine owners should have commensurate compensation plans for the affected individuals or communities.

Keywords: Environmental and Health Hazards, Abatements, Control Mechanisms, Mining Industry, Nigeria

1. Introduction

Mining activities yields obvious socio-economic benefits, but has also caused both health and environmental hazards to mankind. Such as ecological disturbance and distortion, air, land and water pollution, landscape degradation, exposure to radiation, waste of arable land, economic crops and trees. Like any other country where such industrial activities as mining are carried out, Nigeria is faced with challenges of the adverse impact of mining. Since much of the harm from mining is inevitable, the principle of non-maleficence should come to play, to mitigate or abate its undesirable impact on the society. For instance, in Sagamu, Lagos state in Nigeria, blasting of limestone in the quarry and dust pollution from the cement work is causing incalculable damage to life, crops and buildings. Although the cement manufacturing company (West African Portland Cement Company) is the cause of the health and environmental harms, it is the Sagamu citizens that suffer these hazards.[1] The Federal Government of Nigeria has enacted some legislations as well as regulations to protect human health and the environment in this regard. These regulations constitute the mechanisms for monitoring compliance and enforcement of the laws regulating mining activities, so as to minimize and or prevent environmental pollution and other harmful adverse effects of mining. To that effect, this work evaluates the mechanisms, vis-a-vis precautions and remedies that are applied in mining activities, by: i) Analysing the scope of mining activities, ii) Determining the legal framework for regulating mining activities in Nigeria, iii) Streamlining the environmental hazards of mining, iv) Identifying the health hazards of mining, v) Examining the measures for abatement or control of the identified hazards. Though there is an existing regulatory framework to checkmate mining activity in Nigeria, the vehicle for enforcing the legislative enactments is either faulty or shackled with resource constraint to effectively perform its function, thereby giving room for non- compliance and undesirable evidence of adverse impacts.

2. Meaning and Kinds of Mining

It is appropriate at this juncture to highlight the meaning of mining. Mining is the extraction of valuable minerals or other geological materials from the earth, usually an ore.[2] It is preceded by geologic investigations to locate the mineral deposit and economic analyses to ascertain its financial value. Upon extraction of the industrial mineral, metallic ore, or fuel, the run-of-mine material is generally cleaned or concentrated. Next, the mineral is prepared (beneficiation) into a higher-quality product through mineral processing. The mineral products so produced may then undergo further concentration, refinement, or fabrication during conversion, smelting, or refining to provide consumer products, which is the last step in converting a mineral material into a useful product for marketing.[3] Mining Activities therefore consist of exploration, extraction, and processing of naturally occurring solid minerals from the earth, such as: coal, metals like zinc, iron, and industrial minerals like kaolin, limestone etc.[4] The government grants title to search for or exploit mineral resources. The title holders then pay royalties and tax to

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[1] J Adekoya, 'Environmental Effect of Solid Minerals Mining. (2003*) J. Phys. Sci.* Kenya, 625.
[2] See <https://www.geologyin.com. >Accessed 4 April 2019.
[3] See <http://www.cienciaviva.pt/img/upload/Introduction to mining>. Accessed 1 June 2019
[4] See <https://www.energy.gov/eere/amo/mining-industry-profile>. Accessed 4 April 2019.

the government for exploiting the minerals. Title (right) to engage in mining operations can be granted to an individual, a company or a co-operative (partnerships) outfit. For instance, pursuant to the grant of mining rights in 2017, crisis raged between Dangote Group and BUA Group over the mining right in Obuh community, in Okpella, Etsako East Local Government Area of Edo State, the Federal Government has ordered the parties involved to vacate the site, so as to avoid break down of law and order in the area.

Types of Mining: There are four main techniques of mining. Namely: underground, open surface (pit), placer, and in-situ mining. Underground mining is often used to access deeper mineral deposits and also more expensive.[5]

What can be mined? Mineral (Natural) resources. Nigeria is quite endowed with various mineral resources, though they are not all available in commercial quantities. There are about 44 different mineral resources in 500 locations in Nigeria.[6]

What is a Mineral? A mineral is a naturally occurring substance that is solid and inorganic, representable by a chemical formula and has an ordered atomic structure.[8] Therefore, mineral resources are naturally occurring materials or substances that can be exploited for economic gain. In addition, Mineral resources refers to substances whether in solid, liquid, or gaseous form occurring on the earth, formed by or subjected to geological processes including occurrences or deposits of rock, coal, bitumen, tar sands, any substances that may be extracted from coal or tar sands, mineral water and components in tailings and waste piles but with the exclusion of petroleum and waters without mineral content. They can be classified into the following groups:

- Metallic ores: those ores of the ferrous metals (iron, manganese, molybdenum and tungsten)
- Base metals (copper, lead, zinc and tin).
- Precious metals (gold, silver, the platinum group metals).
- Radioactive minerals (uranium, thorium and radium).
- Nonmetallic minerals (industrial minerals): the nonfuel mineral ores that are not associated with the production of metals. These include gypsum, phosphate, potash, halite, sand, gravel, limestone, sulfur, etc.
- Fossil fuels (mineral fuels): the organic mineral substances that can be utilized as fuels, such as coal, methane, gilsonite and tar sands.[7]

However, the Ministry of Mines and Steel Development (MMSD) in Nigeria, grouped these minerals into the following categories:[8]

- Industrial minerals: These include limestone, marble, clay, mica, silica sand, gypsum, kaolin, talc, magnesite, phosphate rock, fluorine etc.
- Low world demand minerals: These include bismuth, argentite, molybdenum, lithium etc.
- World class minerals: These include gold, coal, bitumen, gemstones, iron ore, columbite, manganese etc.
- Newly discovered minerals: These include chromium, uranium, vanadium, cobalt, lanthanum etc.

Some terms used in the mining sector, are defined below.[9]

- Small Scale Mining: means Artisanal, Alluvial and other forms of Mining Operations involving the use of low level technology or application of methods not requiring substantial expenditure for the conduct of Mining Operations within a Small Scale.
- Quarry: means a surface working or uncovered excavation used for the purpose of extracting Mineral Resources for Construction.
- Reconnaissance: means the operations and works to carry out research for Minerals through physical observation, rock sampling, geological surface analysis, geophysical surveys, geochemical surveys, photogeological surveys by other non obstructive surveys or studies of surface geology or by other remote sensing techniques, laboratory testing and assays.

[5] See< https://www.americangeosciences.org/critical-issues/faq/what-are-main-mining-methods.> *Accessed 4 April 2019.*
[6] See <http://www.minesandsteel.gov.ng/wp-content/uploads/2016/09/Nigeria-Ministry-of-Solid-Minerals-Investment-BrochureV11>. *Accessed 4 April, 2019.*
[8]<https://guardian.ng/energy/solid-minerals-in-nigeria-an-overview>.*Accessed 4 April 2019.*
[7] See <http://www.cienciaviva.pt/img/upload/Introduction to mining. > Accessed on 4 April, 2019
[8] See <https://uk.practicallaw.thomsonreuters.com>. Accessed on 4 April 2019.
[9] Minerals and Mining Act, 2007, s 164

- Pollution: means any, change in the environment caused by substances, radioactive or other waves noise, odours, dust or heat emitted from any activity, including the storage or treatment waste or substances, construction or the provision of services where that change has an adverse effect on human health or well being or on the composition or resilience and productivity of natural or managed ecosystems or on materials useful to people, or will have such an effect in the; future and Pollutes shall be construed accordingly.

3. Regulation of Mining in Nigeria

Mining is regulated in Nigeria through Legislative (National legislations & policies, International and regional Conventions) and Judicial Mechanisms. Nigeria has obligations to protect the environment through various commitments to the following treaties:[10] The African Convention on the Conservation of Nature and Natural Resources, (The African Convention) 1968; The Convention Concerning the Protection of the World Cultural and Natural Heritage, (The World Heritage Convention) 1972; The Basel Convention on the Control of Transboundary Movement of Hazardous Waste and Disposal, 1989; The Framework Convention on Climate Change, Kyoto Protocol, 1995; The Convention on Biological Diversity, 1992; The Convention on the Prevention of Marine Pollution by Dumping of Waste, MARPOL, 1972. The Constitution of the Federal Republic of Nigeria (CFRN) 1999[11] provides that the state should protect and improve the environment and safeguard the water, air, land, forest and wildlife in the country. Pursuant to this, some legislation were promulgated, regulations and regulatory agencies were also established to safeguard the Nigerian environment. Such as: Harmful Wastes (Special Criminal Provisions) Act 1988 (Harmful Wastes Act), Environmental Impact Assessment Act (EIA) 1992, National Environmental Standards and Regulations Enforcement Agency Act (NESREA) 2007, National Environmental (Noise Standards & Control) Regulations 2009.

In Nigeria, ownership and control of all mineral resources is within the purview of the federal government being that it is contained in the exclusive legislative list of the constitution, who regulates the types of titles that may be acquired for mining activities, health and safety measures in the mines as well as environmental management. This is achieved through the following legislative tools discussed hereunder: Minerals and Mining Act (MMA)No. 20 of 2007, Minerals and Mining Regulations 2011, National Minerals and Metals Policy (2008), Constitution of the Federal Republic of Nigeria, 1999, Environmental Impact Assessment Act Cap E12 LFN 2004 (EIAA), Land Use Act 1978, Companies and Allied Matters Act, CAP C20, LFN, 2004 (CAMA), Nigerian Investment Promotion Commission Act, CAP N117, LFN, 2004 (NIPC), Companies Income Tax Act, CAP 60, LFN, 1990 (CITA).

Constitution of the Federal Republic of Nigeria (CFRN) 1999

The Constitution of the Federal Republic of Nigeria 1999 (as amended)[12] places Mines and Minerals activities under the Exclusive Legislative List. Thus, vesting the federal government with exclusive jurisdiction over all matters relating thereto. As such, all taxes and royalties generated from the mining sector go to the federation account, instead of the various States in whose territory such mining operations are done.

Minerals and Mining Act (MMA) No. 20, 2007

The Minerals and Mining Act (MMA), 2007, repealed the Minerals and Mining Act, No. 34 of 1999. It is the principal legislation that regulates all aspects of exploration and exploitation of solid minerals in Nigeria. Ownership and control of property in Minerals, is by virtue of this Act,[13] vested in the Federal Government, as represented below:

> 1. The entire property in and control of all mineral resources in, under or upon any land in Nigeria, its contiguous continental shelf and all rivers, streams and water courses throughout Nigeria, any area covered by its territorial waters or constituency and the exclusive economic zone is and shall be vested in the government of the federation for and on behalf of the people of Nigeria.
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> 2. All lands in which minerals have been found in commercial quantities shall, from the commencement of this Act be acquired by the government of the federation in, accordance with the provisions of the land use Act.

[10]Federal Republic of Nigeria - World Bank Documents & Reports. *documents. <worldbank.org/ .../> Accessed 3 May, 2019.*

[11] CFRN 1999 s 20

[12] CFRN 1999. Section 251 (1)(n)

[13] MMA 2007 s 1 (1)-(3)

> 3. The property in mineral resources shall pass from the Government to the person by whom the mineral resources are lawfully won upon their recovery, in accordance with this Act.

Various forms of Mineral title/Permit/License are granted in the mining industries, provided that the requirements of the MMA 2007[14] and the Nigerian Mining Regulations 2010 are met. Basically, the right to search for or exploit mineral resources may be granted to individuals, companies or co-operatives,[15] through the following titles:[16]

Reconnaissance permit: A reconnaissance permit confers on its holder, a non-exclusive right of access, to fly over or enter any land within the Nigerian territory that is designated for mining activities, in other to search for mineral resources. Reconnaissance permits are granted for one year and renewable annually, but it is not transferrable.

Exploration license: This confers on the licensee, an exclusive right of exploring an area of land not exceeding 200km^2. Exploration licence are granted for three years, renewable for a term of two years, but all together must not exceed seven years.

Small scale mining lease (SSML): This confers an exclusive right to carry out mining operations on an area that must not exceed 3km^2. They are granted for a period of five years and are renewable for further periods of five years, provided that the minimum work obligations have been met. There is no maximum limit on the number of times an SSML can be renewed.

Mining lease: This confers the exclusive right to carry out all mining operations within the mining lease area. The lease area cannot exceed 50km^2. A mining lease is granted for a term not exceeding 25 years and is renewable for further periods not exceeding 24 years, provided that the holder has complied with the minimum work obligations and other regulatory requirements. There is no maximum limit on the number of times a mining lease can be renewed.

Quarry lease: The area of land covered by a quarrying lease cannot exceed 5km2. Quarrying leases are granted for five years and can be renewed for further periods of five years. The application for renewal must be made three months before the expiration of the initial lease.

Water use permit: The area of land covered by a water use permit cannot exceed the area reasonably required for the purpose of the permit. A water use permit remains in force as long as the original mining lease or quarrying lease for which it was granted remains valid.

Minerals and Mining Regulations 2011

This Regulation was issued by the ministry of mines and industry, with the aim of achieving a more coordinated solid minerals sector in the country and abolish the discretionary grant of mineral titles. The Regulation streamlined the rules, procedure and process for the acquisition of mineral title and grant of license to investors.

National Minerals and Metals Policy 2008

This policy is an instrument, developed by the MMA, for restructuring and charting an improved direction for the sector as enjoined by the Minerals and Mining Act, 2007,[17] To enhance its performance, four new technical units were established. Namely: the Mines Inspectorate Department, Mining Cadastre Office, Mines Environmental Compliance Department, Artisanal and Small-Scale Mining Department. The relevant regulatory authorities include the:[18] Mining Cadastre Office, Nigerian Customs Service, Mines Inspectorate Department, Mines Environmental Compliance Department, Artisanal and Small Scale Mining Department, Nigerian Investment Promotion Commission, Corporate Affairs Commission, Nigerian Export Promotion Council, Federal Inland Revenue Service.

Environmental Impact Assessment Act (EIAA) Cap E12 LFN 2004

This Act makes it mandatory to conduct an Environmental Impact Assessment (EIA) in respect of any proposed project. Section 2 specifically prohibits commencement of any public or private project without prior consideration of the possible environmental effects. It Further provides that projects on the mandatory study list, which includes mining, are expressly prohibited from being carried out without the Nigerian Environmental Protection Agency taking a decision or issuing an order that such project can be carried out (with or without conditions).

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[14] Ibid s 71.
[15] Ibid s 23
[16] Ibid s 46
[17] Ibid ss 47-52.
[18] See< https://uk.practicallaw.thomsonreuters.com>. Accessed 4 April 2019.

Land Use Act (LUA) 1978

This Act provides among others, that:

i. All lands comprising the territory of each State in the Federation are vested in the Governor of that State, who shall hold it in trust for use, administration and common benefit of all Nigerians in accordance with the provisions of this Act.[19]

ii. All land in urban areas shall be under the control and management of the Governor of each State, while all other land shall be under the control and management of the Local Government, within the area (jurisdiction) the land is situate.

iii. Each State shall have a body known as the Land Use and Allocation Committee which shall advise the Governor on any matter related to land management, resettlement of persons affected by the revocation of rights of occupancy on the ground of overriding public interest and determining disputes arising from the amount of compensation payable under this Act for improvements on land.

In the suit between *Joseph* Otunuya *Odili* v *Nwapa Anene & Ors*,[20] the issue for determination at the supreme court among others was the party entitled to be paid compensation by the oil company. The court in deciding on this issue, had to resolve the issue of title/ownership of the land in question. Consequently, the court found that the owner of the land in question is entitled to the compensatory sum of money. In terms of compensating a holder of right of occupancy for revoking his right based on overriding public interest, section 28 of this Act is *in pari materia* with section 22 of the MMA, 2007.

Nigerian Investment Promotion Commission Act (NIPCA), CAP N117, LFN, 2004

The NIPC Act 2004, established the Nigerian Investment Promotion Commission, to encourage and promote investment in the Nigerian Economy, and for matters related thereto. **T**he MMA 2007[21]**,** provides that the conditions stipulated in the NIPC Act 2004, shall apply to any foreign investment made in respect of any mineral title granted pursuant to the MMA. This means that the provisions of the NIPC Act that apply to foreign investors in other sectors in Nigeria, shall also apply to the investors in the mines and mineral sector. The NIPC Act is particularly useful in the area of dispute resolution related to mines and mineral.[22] The MMA[23] provides that where a dispute is not settled amicably through mutual discussions, the provision of the NIPC should be applied, such that the aggrieved party may opt for arbitration. Nevertheless, where there is disagreement between an investor and the Federal Government as to the dispute resolution method to be adopted, the International Centre for Settlement of Investment Dispute (ICSID) Rules shall apply.[24] But, it must be noted that ICSID arbitration is only feasible where the parties; especially the international investors, voluntarily submit to its jurisdiction.

Companies and Allied Matters Act (CAMA), CAP C20, LFN, 2004

The Companies and Allied Matters Act 2004 (CAMA) regulates company formation and operation in Nigeria and provides that no foreign company may carry on business in Nigeria, except it incorporates a local subsidiary in the country.[25] The MMA incorporates this requirement by providing that no person shall be qualified for the grant of any mining title unless the person is a body corporate duly incorporated under CAMA.[26]

Companies Income Tax Act (CITA), CAP 60, LFN, 1990

The following taxes are required to be paid by a mining company: corporate income tax; education tax; personal income tax of its staff; value-added tax; capital gains tax; and pension tax (for paying the employees their pension). Companies involved in mining activities are assessed to tax under the Companies Income Tax Act (CITA), while individuals and partnerships engaged in mining activities are liable to tax under the Personal Income Tax Act (PITA).[27]

The last but not the least is the judicial regulatory role. Judicial regulation involves extra judicial and judicial proceedings, as discussed below.

i. Extra Judicial/ Alternative Dispute resolution:[28] Amicable dispute resolution measure(s) must be exhausted in all mineral related disputes, before recourse is made to any judicial proceeding, such as arbitration or mediation.

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[19] LUA 1978, s1.
[20] Suit No. HOG\181\77, decided at the Supreme Court.
[21] s 29 (2).
[22] See< http://www.completefmc.com/2017/02/regulating-solid-mineral-industry> Accessed 4 April, 2019.
[23] section 141
[24] See< http://www.completefmc.com/2017/02/regulating-solid-mineral-industry>. Accessed 4 April, 2019.
[25] Ibid
[26] MMA 2007, s 46.
[27] See <http://www.completefmc.com/2017/02/regulating-solid-mineral-industry>. Accessed 4 June, 2019.
[28] MMA 2007, s 141

ii. Litigation & Judicial Jurisdiction: This involves instituting a legal action in the court. The MMA 2007[29] and CFRN 1999 (amended)[30] vests exclusive jurisdiction of disputes arising from mineral and mining related activities on the Federal High court of states. In *Shell Petroleum Dev.(Nig) ltd v Amaro*,[31] the court invoking the doctrine of *res ipsa loquitor* found for the plaintiff/respondent and awarded damages against the defendant/appellant for lack of proper care in managing the waste produced by the company's activities.

4. Hazards Associated with Mining Activities in Nigeria

The adverse effects of mining activities are evident in our environment, affecting the air, land, water, human health, wildlife and also responsible for global warming.[32] If care is not taken, the long-term effects on humanity could be irreparable. These hazards manifest in various forms though the gravity depends on factors like; the depth of the mine or quarry, the mining method in use, the chemical composition of the mineral ore and surrounding earth, proximity to the source of hazards, mobility and bioavailability of the contaminant and of course, the efficiency of the available hazard control methods.[33] The environmental hazards are manifest on the water bodies, Air, terrestrial habitat, soil, biosphere, with obvious health implications on human beings.[34] The impact of mining activities on the afore mentioned environmental factors is as a matter of necessity duly discussed hereunder, to bring to the lime light the preventable harm of this economically beneficial activity. Water may be contaminated by metal pollutants such as mercury, copper, arsenic, cadmium, chromium, nickel, lead, following increased sediment levels in streams and acid mine drainage.[35] The abnormal concentrations of these chemicals in the water, makes it unsafe for human consumption.[36] It also affects irrigation of plants and crops, local dams and the ocean, aquatic animals, as well as domestic water supply. The acid rock drainage and the transportation of heavy metals influence groundwater and pollute water surface. In the MMA 2007[37], copious provisions were made for water protection and purification. Air borne hazards in the mining industry include several types of particulates, naturally occurring gases, engine exhaust and some chemical vapours. These pollutants released to the soil surface become airborne upon exposure to wind (atmosphere). When such toxic particles are inhaled, they get absorbed into the body, causing ailment.[38] The criminal code Act 1990,[39] makes it an offence for anyone to vitiate the atmosphere with anything that is injurious to human health.

The mining industry has a significant impact on biodiversity, caused by the destruction or drastic modification of the pre-mined landscape in a particular area. It leads to massive habitat loss, which further affects micro-organisms, vegetation and animals in that location. The effects of these activities are determined by the level of concentration, extent, and the nature of the contaminant. Temperature modifications can disrupt the source of livelihood of the communities that live in proximity to the site.[40] Some species of animals and endemic plants are resistant to environmental disturbances in their habitats, while some species are highly sensitive and require specific environmental conditions to survive, such that any disruption in their habitats can render them extinct.

Mining causes physical destruction of the land (top soil). This ranges from open pits to waste dumpsters that significantly impact the environment. This pollution will then go on to affect the fauna and flora around us, and depending on how big the disruption is, whatever was there before cannot be restored. Further disruption can affect our roads and buildings, cause landscape degradation and can result in land slide as well.[41]

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[29] MMA 2007, ss 88 & 142.
[31] CFRN 1999, s 251 (1)(n)
[32] [2000] 10 NWLR (Pt 675) 248.
[32] S Warhate and others, 'Impacts of Mining Activities on Water and Soil'(2006) 4. *J Environ Sci Eng* 81.
[33] N Haddaway and others, 'Evidence of Impacts of Metal Mining and Effectiveness of Mining Mitigation Measures on Socio-Ecological Systems in Arctic and Boreal Regions: A Systematic Map Protocol' (2019) Environ Evid <https//doi.org/10.1186>
[34] The 'Impact of the Environment on Reproductive Health,' a paper presented at an international workshop (1991) in Copenhagen, reveals that chemical poisoning including those from mining can affect human physiology which is manifest as a medical condition. For instance, reproductive health can be affected leading to conditions such as in/sub fertility, intrauterine growth retardation of fetus.
[35]Ana Marie and others, 'Environmental Health and Safety Hazards of Indigenous Small-scale Gold Mining Using Cyanidation in the Philippines. (2016) 10 *Environ Health Insights*. 125.
[36] A Donoghue, 'Occupational health hazards in mining: An Overview'. (2004) 54 *Occupational Medicine* 283.
[37] ss 123 -124.
[38] Ana Marie (n 35) 131.
[39] s 245
[40]See<http://www.miningsafety.co.za/dynamiccontent/154/the-environmental-impacts-of-the-mining-industry.> Accessed 5 June, 2019.
[41] Ibid

Other hazards from mining activities that can be physically perceived are thermal emissions, noise, vibrations, changes in barometric pressure and ionizing radiation. Among some groups of miners who live together in isolated locations, there is also risk of transmitting some infectious diseases by contact. E.g tuberculosis, hepatitis (B and E), and the human-immunodeficiency virus (HIV).[42] Mining poses occupational health hazards to the miners in form of respiratory and skin diseases. Depending on the type of mine, they may suffer from silicosis, asbestosis, cyanide poisoning. For instance, severe cases of cyanide poisoning may cause unconsciousness, convulsions, pulmonary oedema or death.[43]In addition, traumatic injuries may occur due to falls from height, entrapment, rock fall, fire explosions, mobile equipment accidents, and electrocution.[44] Apart from pollutants that are directly released into the air and water during the mining process, bio-accumulation of toxic contaminants in the plants and lower animals consumed by humans can lead to residual poisoning in the body.[45] For instance in Zamfara state, the desire to make extra income has led to many engaging in artisanal gold mining around residential compounds in the community, which releases tons of lead dust gold ore into the air. This is deposited on soil surfaces, drinking water, edible plant leaves and fruits. Upon investigations alarming levels of lead concentrations in the environment and soil was over 100,000 ppm, while the mean blood lead level concentration of 119 μm/dL found in more than 100 children diagnosed with severe lead poisoning in Dareta and Yargalma villages. Meanwhile scientifically it is established that 10 μg/dL blood lead level is associated with impaired neurological development in young children.

The impact of these hazards from mining operations may ground liability in law. For instance, an action may be brought against a governmental agency/authority for failure to act in accordance with the provisions of the EIA, as was the case in *Oronto Douglas v Shell Petroleum Development Company & 5 ors.*[46] Also, cause of action may arise from Negligence and Nuisance (public or private) under the law of Torts, or enforcement of environmental rights as a fundamental right. Though right to a clean and healthy environment is contained in chapter II of Constitution of the Federal Republic of Nigeria (CFRN) 1999, justiciability of environmental rights in Nigeria is hinged on ratification of the African Charter on Human and People's Rights 1989 and the subsequent enactment of the African Charter on Human and People's Rights (Ratification and Enforcement) Act Cap A9 2004 by the National Assembly in compliance with section 12 of the CFRN 1999. The issue of locus standi was also resolved in favour of plaintiffs to allow persons who have sufficient interest in the environment being degraded to institute private or class actions in a representative capacity. This was the *ratio* in *Gbemre v SPDC Ltd & ors* and *Oronto Douglas v Shell Petroleum Development Company & 5 ors.*

5. Evaluating the Measures for Abating or Controlling Environmental and Health Hazards in the Mining Industry

The measures for abating and or controlling the hazards of mining processes in Nigeria are duly discussed in this section, with the purpose of determining the adequacy or otherwise and making recommendations where necessary.

Statutory Provisions: Prevention is said to be better than the act of curbing. Given that mining operations are necessary for economic growth of a state, adequate effort should be made to keep its hazardous side effect to the barest minimum. To this effect, the Environmental Impact Assessment (E.I.A) Act of 1992 was enacted. According to Onyeabor,[47] E.I.A is a procedure that seeks to ensure the early acquisition and report of adequate information on likely environmental consequence of development projects sought to be undertaken, measures to mitigate the harm and proffer possible alternative actions.[48] The Act mandates the implementation Authority to call for environmental assessment from the stake holders in the field of proposed activity, the relevant government agencies and indeed the general public,[49] to ensure a wide coverage of information sources. These persons are to submit reports which are made public at known designations[50] so that any person who has objection could register same and have it duly considered before a final report (recommendation) is made on the issue. The outcome of this compulsory assessment determines the decision to approve or commence the desired projects; be it private or

[42] A Donoghue (n 36) 289.
[43] Anna Marie (n 35) 125.
[44] Donoghue (n 36) 283.
[45] Anna Marie (n 35) 125
[46] Suit No: FHC/25C/573/93(Un reported) Delivered on Feb,17 1997 by FHC PH.
[47] Emmanuel Onyeabor: 'Expanding Scope of E.I.A Requirements in the Nigerian Urban and Regional Planning Act, 1992.' (2005) 5 (1) *Unizik Law Journal* 275.
[48] Environmental Impact Assessment (E.I.A) Act, 1992, s 7.
[49] Ibid s 24.
[50] Ibid s 38.

public,[51] especially those projects contained in the mandatory study list of the EIA Act.[52] The National Environmental Standards and Regulations Enforcement Agency Act (NESREA) 2007, regulates (through its agency) and makes provision for the protection of air[53] and water[54] quality to ensure and promote public health. Most importantly, the act stipulates penalties for any person or corporate entity that discharges wastes in harmful quantity into the environment.[55] The sanction here is punitive if implemented accordingly. The Minerals and Mining Act No. 20 of 2007, is also aimed at checking the hazardous effect of mining from the industries. The Act provides in Section 11(1), that the holder of mineral title shall, in exercise of his rights under the mineral title have regard, to the effects of the mining activities on the environment and take the necessary steps to prevent or minimize pollution of the environment. The Act[56] therefore mandates the operators to: (1) Make reservations for environmental protection, mine rehabilitation, reclamation and mine closure costs, to curtail hazards, (ii) Take adequate precautions to protect the existing communities, and habitats before commencing mining operations, for example, entering into a community development agreement and payment of compensation to the endangered persons/community. These pre and post-grant conditions ought to be met or must be seen to have been met before commencing mining or granting an application for renewal of mining license/ permit. This discourages artisanal mining which is highly detrimental to health.

The National Minerals and Metals Policy 2008 is designed to take active cognizance of the three tiers of government in Nigeria, in relation to the distribution of proceeds of mining, not necessarily curbing the hazards but offering a compensation for the harm suffered. For instance, Section 5.0 provides for the implementation of the policy objective which is aimed at addressing the neglect of the masses that bear the immediate risk of the hazards posed by mining activities, respond to new and global developments in the mining industries and consider possible areas of future action, such as: Ensuring compliance with environmental best practices, etc. The Policy,[57] also aims at promoting National economy through enforcing the use of domestic metal products that can be re-used or recycled with minimal side effects on the environment, for the development of the nation's infrastructure.

Every holder of an exploration license, small scale mining lease (SSML), mining lease, quarry lease or water use permit, must before the commencement of mining operations, on application for a term extension or on conversion, submit the following to the Mines Environmental Compliance Department: (i) An environmental impact assessment statement for the operations, approved by the Federal Ministry of Environment; (ii) An environmental protection and rehabilitation programme for the operations, the Mine owners are also obligated to make arrangements for the treatment of mine waste before it is finally disposed of, to minimise air and water pollution.

In addition to the legislative checks, incorporating safety policies like compelling the companies to provide adequate technological equipment and technical training support to local miners promotes safety in mineral exploration activities.[58] Also, procedures requiring less use of chemical and permits easy conversion of mine wastes into non-harmful products should be given first priority in mining permit or license applications. To achieve these, government and mining companies should encourage research on the development of new technologies that would have minimal side effects on human beings and his environment.

Law enforcement mechanism: This involves immediate closure of the illegal mines and prosecution of the offenders. Illegal mining activities is criminalised in section 131 of the MMA 2007 and sanctions for non-compliance with the stipulated conditions for mining operations in Nigeria include payment of fine and or imprisonment on conviction by a court of law. In addition, the Criminal code Act in section 245, criminalises water fouling of vitiating the atmosphere with injurious substances. The later offence upon conviction attracts a six-month imprisonment, which is deterring enough, if the offenders are prosecuted. Enforcing regulations and strict maintenance of other mining legislations and procedures will set and sustain the appropriate standard for mining operations within the sector.

Closing and reclaiming sites of shut-down mines: When active mining ceases, mine facilities and the site are reclaimed and closed. The goal of mine site reclamation and closure is to return the site to a condition that most

[51] Ibid s 2(1).
[52] Ibid s 12.
[53] National Environmental Standards &Regulations Enforcement Agency Act (NESREA)2007, ss 20(1)-(4)
[54] Ibid s 23 (1) &(2)
[55] Ibid s 27.
[56] Ss 71, 118 -120
[57] S 8(1).
[58]https://www.researchgate.net/publication/311923886_Environmental_and_social_issues_of_solid_mineral_development_in_Nigeria. Accessed on September 4th 2018.

resembles the pre-mining condition. Changes in topsoil characteristics which occur during mineral exploitation have the capacity to alter the soil ph. and nutritive content. Site reclamation (environmental replenishment) basically involves: the removal of hazardous materials and cleaning of excess waste, reshaping the land, replenishing topsoil and vegetation, replanting trees to encourage natural forestry. These actions can stimulate ecosystem repair, revive and sustain life in the terrestrial environment.[59] An open pit mine from which stones or gravel has been extracted (quarry site) may result to erosion; as is the case in Amuzukwu, Abia State. After exploration of solid minerals, the pits may become filled with water, large holes and heaps of debris often remain, thereby making the land difficult to reclaim. This underscores the importance of mine reclamation and for closure plans to provide sufficient detail on how the mining company will restore the site to a condition as near as possible to the pre-mining ecological status and permanently abate further hazards and contamination from the mine.

Water Treatment: There are five main techniques used in the monitoring and controlling of water flow at mining sites. These techniques include subsurface drainage systems, groundwater pumping systems, diversion systems, subsurface barriers and contamination ponds.[60] When mine waters are discharged into water bodies, it causes severe degradation of water quality, destruction or disruption of aquatic life and damage to physical structures/ building.[61] This is due to Acid mine drainage (AMD). Acid mine drainage occurs when sulfide minerals in the sink holes, mine pit or waste rock react with air and water to form sulfuric acid**.** The acid dissolves harmful metals out of the surrounding rocks, which are toxic to fish, other aquatic life and humans.[62] To avert this hazard, the contaminated water is pumped into a facility for treatment that eventually neutralises the contaminants. This technique can help turn contaminated water to fresh water animals, domestic and commercial use.[63] Acid mine contaminant is particularly harmful because the damage can continue indefinitely, due to the severe consequence of (toxic minerals) acid on water quality that will necessitate perpetual water treatment.

Recycling/re-use of mine waste: Mining industries around the world are devising technologically efficient ways to exploit mineral, with minimal adverse effects on the society. Thus, much emphasis is placed on the manufacture of products that are reusable and can be recycled. For instance, aluminum can be substituted as a recyclable material rather than using bauxite ore, which is a rare and less reusable capacity than aluminum.[64] Also, metals like steel, copper, which takes less energy may be recycled in lieu of processing the ore.[65] Steering production towards the sole use of durable goods that can be easily re-used (re-manufactured) or recycled will ultimately reduce the negative impact of mining operations in the communities by reducing the quantum of toxic wastes produced from mining activities. Moreover, the invention of scrap mining was borne out of the global recognition of the need to curb the severe and sometimes irreversible adverse effect on health, air and water quality, terrestrial and aquatic habitat, and the community.

Environmental impact monitoring:[66]The process of excavation in mining operation, disrupts the food chain in the mine habitat, and some proximal communities by altering the natural process of decomposition. Non decomposition of biodegradable substances not only endangers man's health, but deprives the plants of soil nutrients for growth, which affects availability of food to the community. However, a systematic monitoring of the environmental occurrence and degree of these hazards as well as adopting the appropriate measures to mitigate these impacts, can make mining less destructive of the environment by incremental efficiency.

Documentation/reporting mechanism:[67]It is not enough to monitor the impact of these hazards on the environment without further action. There should be a defined mode of documenting/reporting the level of toxic mining waste produced from a particular mine. Mining industries should be guided to comply with same so as to

[59] Mining. Top 10 ways to make mines more environmental friendly <.https://www.miningglobal.com/top-10/top-10-ways-make-mines-more- environmentally-friendly>. Accessed on 3 April 2018.
[60]See<http://www.miningsafety.co.za/dynamiccontent/154/the-environmental-impacts-of-the-mining-industry> Accessed on 20 April, 2019.
[61]https://www.researchgate.net/publication/311923886_Environmental_and_social_issues_of_solid_mineral_development_in_Nigeria Accessed 20 April 2019.
[62] www.sosbluewaters.org/epa-what-is-acid-mine-drainage%5B1%5D.pdf. Accessed on 20 April, 2019.
[63]See http://www.miningsafety.co.za/dynamiccontent/154/the-environmental-impacts-of- the-mining- industry. Accessed on 20 April, 2019.
[64] <https://www.miningglobal.com/top-10/top-10-ways-make-mines-more-environmentally-friendly. > Accessed 25 April, 2019.
[65] Donoghue (n 35) 283.
[66] I Aigbedion, I and S Iyayi, 'Environmental effect of mineral exploitation in Nigeria', (2007) 2 (2) *International Journal of Physical Sciences* 33.
[67]Key challenges facing the Nigerian mining sector. <https://home.kpmg.com/ng/en/home/insights /2017 /08/key-challenges-facing-the-nigerian-mining-sector.html.> Accessed on 25 April, 2019.

accurately report the amount of toxic waste being dumped into the environment. This will assist in devising a measure to abate its effect in the society.

Despite the above physical measures, the legal framework is the structure that coordinates other activities. Having analysed the measures for control and abatement of hazards from mining activities, below is the summary of the evaluation/findings made:

All taxes and royalties generated from the mining sector go to the federation account, instead of the various states in whose territory such mining operations are done. The author believes that part of this revenue should go to the state's internally generated fund to assist the state and local government in whose territory mining activities are carried out to develop and improve infrastructure in that state, generally. In addition, curbing the hazardous effect of mining in those localities and or compensation, may involve resettling some families, not just the land owners on which mining is carried out in a community. This certainly requires much funding.

By the provisions of Environmental Impact Assessment Act, 2004, a land user (leasee) must enter into a community development agreement; part of which must incorporate the environmental impact assessment made, as well as the environmental rehabilitation program, which should also be submitted to the Mines Environmental Compliance Department (MECD). The snag here is, whether the Mines Inspectorate Department monitors how the implementation of this agreement is made, as mandated by the MMA 2007[68]. Any legal documentation without an enforcement mechanism is a mere piece of paper, because the legal teeth lie in its enforcement.

The Land Use Act, 1978 vests all land comprised in the territory of each state in the governor of the state who holds such land in trust for the people. The Governor of a state can revoke a right of occupancy for an overriding public interest.[69] Hence, where a mineral deposit is found in commercial quantity in any area of land, it occasions a public interest which overrides the individual (personal) interest represented in the statutory or customary right of occupancy already granted to the person in occupation of such land. As such, the state government has to revoke such certificate of occupancy, and compensate the right holder. In the same vein, the MMA 2007,[70] provides that where a mining or quarry lease is granted over a land subject to an existing right of occupancy, the governor of the state shall within 60 days of such grant, revoke such right of occupancy.

The provision for compensating revoked rights is really applaudable, provided that there is a specific parameter for measuring the extent of development and value of the property in question, to make sure that the compensation is adequate in equity. Such assessment must always be made by a government licensed valuer in accordance with the MMA 2007[71] and should not be left at the discretion of the Land use allocation committee and cadaster office.

The immediate negative impacts of mining activity on the environment are obvious and may be abated easily. However, the long-term effects are often glossed over. For instance, long term effects of Coal dust inhalation cause black lung disease among miners and those who live near the mine, unlike mine accidents that may result in obvious injury. While ensuring physical safety in the mine, no commensurate care or preparation is made for the latent effects that may manifest in the future. For instance, regular health assessment for early detection of these side effects on health so that treatment can commence early enough.

The MMA 2007 made copious provisions for payment of compensation by a mining title holder. However, the penalty for noncompliance is merely suspension of title,[72] which in the author's opinion lacks stringent capacity that will deter defaulters.

The term 'injury' is aptly defined in the MMA, 2007.[73] The Act[74] also provides a mechanism for reporting injuries related to mining activities, while S 88 guarantees an enquiry into the cause and nature of the injury. Compensation for revoked right of occupancy, pollution of water and environmental degradation are quite amplified in the MMA 2007, dishearteningly, no commensurate compensatory provisions was made statutorily, in respect of the health hazards that are more life threatening, as they directly affect human life. This leaves much to be desired.

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[68] s 17
[69] s 28 (1) (c).
[70] s 22 (2)
[71] s 108
[72] s 109.
[73] s 89
[74] s 84

6. Conclusion and Recommendations

Erosion, formation of sinkholes, loss of biodiversity, contamination of soil surface and groundwater by chemicals are some of the negative impacts from mining operations. If not properly controlled, contamination resulting from leakage of chemicals can also affect the health of the masses whose residence are proximal to the mine. Mining companies in most countries are required to follow stringent environmental and rehabilitation measures, in order to minimize the health and environmental hazards of mining. Such as environmental impact assessment, environmental monitoring, development of environmental management plans, mine closure planning (which must be done before mining operations commence), and during operation and after closure. However, in some areas, particularly in the developing world, government regulations may not be complied with and defaulters are not prosecuted to enforce compliance. Though mining activities in Nigeria generate economic benefit to the nation, the adverse effects emanating therefrom cannot be swept under the carpet. Both the government, her agents and the stake holders in the mining industry must be involved in taking precautionary and remedial measures that can minimize these adverse effects of mining. The mandatory precautions, remedies or compensation for the damages as provided in the legal enactments regulating mining in Nigeria should be enforced to ensure compliance. By carefully planning projects, implementing pollution control measures, monitoring for the negative effects of mining in the environment and rehabilitating mined areas, are steps to abating the adverse impact of mining activities in the society or communities proximal to mining sites.

In order to minimize the undesirable impacts of mining on health and environment, it is recommended that: Use of modern technological equipment in mining should be maximized and less use of manual workers. Adopting a recycling policy by which waste materials maybe recycled and reused for another product, will also reduce the demand for minerals and metals, for instance, instead of using bauxite ore, a material more common like aluminum can be used. Another way to minimize health impact is for workers to develop and integrate safe practices into their operations, for instance, the use of protective gadgets or shields to help minimize noise or prevent falls. Every Mine title holder should be required to submit in addition to other requirements, a documented welfare package for the mine workers. The value should be able to compensate for any injury, loss or demise of the worker, as a result of involvement in mining activities. There is need for the reformation of the Mining sector in Nigeria to incorporate policies that will support sustainable mining measures. This will go a long way in reducing the undesirable impacts of mining in the society, for instance, processing an ore result in emission of higher energy and pollutants, than recycling steel or copper. The law enforcement agents of the state and implementation Units should check illegal or unregulated mining activities in the communities. Site reclamation after mining should be monitored for compliance with the stipulated standard and legally enforced in the event of any deviation or default in compliance.