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ISSUES, PROSPECTS AND CHALLENGES OF EDUCATING MINERS ON MINING POLLUTION ON THE ENVIRONMENT IN NIGERIA

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Abstract

Mining activities in Nigeria have significantly contributed to the country's economic development but have also led to severe environmental degradation due to lack of educating the miners. This study explores the issues, prospects, and challenges of educating the miners on mining pollution on the environment in Nigeria. The primary aims of environmental education on mining include soil erosion, water contamination, air pollution, and deforestation, which threaten biodiversity and the health of surrounding communities. Despite these challenges, there are prospects for mitigating the environmental education impact of mining through the adoption of cleaner mining technologies, the implementation of stricter environmental regulations, and the restoration of degraded land. However, challenges such as inadequate enforcement of policies, insufficient funding, and a lack of technical expertise hinder the effectiveness of these efforts. The paper recommends that awareness of environmental education should be created for stronger regulatory frameworks, increased community involvement, and the promotion of sustainable mining practices to mitigate the environmental risks associated with mining activities. It concludes that balancing economic growth with environmental

sustainability is essential for the future of mining in Nigeria, and concerted efforts from government, mining companies, and local communities are necessary to achieve this balance.
Keywords: Challenges, Environment, Prospects, Mining, Pollution

Introduction

Mining is a vital economic activity in Nigeria, contributing significantly to the country's gross domestic product (GDP) and providing employment opportunities for many citizens. The extraction of solid minerals such as gold, coal, limestone, and lead-zinc play an essential role in the industrial development of the nation (Adekoya, 2003). However, the rapid expansion of mining activities especially artisanal and small-scale mining has raised concerns about its environmental implications due to lack of environmental education awarness. Unsustainable mining practices have resulted in widespread pollution of water bodies, deforestation, soil degradation, and disruption of local ecosystems (Salau, 2012). The environmental impact of mining pollution is particularly alarming in mining-dense regions such as Zamfara, Plateau, Ebonyi, and Niger States, where toxic chemicals like mercury and lead have been used without adequate environmental safeguards (UNEP, 2011). These activities often take place in rural areas where regulatory enforcement is weak or non-existent, leaving communities vulnerable to health hazards, contaminated drinking water, and the loss of arable land (Olusegun *et al*., 2014). The cumulative effects of mining pollution have further worsened the challenges of climate change and environmental sustainability in Nigeria.

Despite the obvious environmental risks, mining holds promising prospects for national development if it is well regulated and monitored. The Nigerian government, through institutions like the Ministry of Mines and Steel Development and the National Environmental Standards and Regulations Enforcement Agency (NESREA), has introduced frameworks aimed at promoting sustainable mining.

However, the challenges of weak enforcement, corruption, limited technological capacity, and low public awareness continue to hinder progress (Ezekiel & Adesina, 2019). Therefore, this study aims to examine the core issues, potential benefits, and persistent challenges associated with mining pollution in Nigeria, while proposing strategies for minimizing its environmental impacts.

Concept of Mining and Types of Mining Activities in Nigeria

Mining is fundamentally defined as the process of extracting valuable minerals or other geological materials from the earth, typically from ore bodies, lodes, veins, seams, reefs, or placer deposits. It includes the extraction of metals, coal, oil shale, gemstones, limestone, and other mineral resources that are essential for industrial, technological, and economic development. Mining activities are classified into surface (open-pit, strip, quarrying) and underground mining, depending on the location and depth of the mineral deposit (Onyedika & Eze, 2020). In Nigeria, mining plays a significant role in the economy, with vast reserves of resources such as gold, tin, limestone, and coal found across different regions (Aigbedion & Iyayi, 2007). While mining contributes to economic growth and industrialization, it is also widely recognized as a major source of environmental pollution and degradation. The environmental impact of mining includes deforestation, loss of biodiversity, soil erosion, contamination of water bodies with heavy metals, and air pollution due to dust and gaseous emissions. These environmental issues arise from improper waste disposal, use of harmful chemicals, and lack of adherence to environmental safety regulations (Ololade & Annegarn, 2013). In Nigeria, many mining operations, especially artisanal and illegal mining, are poorly regulated, exacerbating their negative environmental footprint (UNEP, 2011).

Types of Mining Activities in Nigeria

Mining in Nigeria is broadly categorized into artisanal and small-scale mining (ASM) and large-scale mining. These mining activities contribute significantly to the economy but also pose serious environmental challenges.

Artisanal and Small-Scale Mining (ASM): This is the most prevalent form of mining in Nigeria, involving individuals or small groups using rudimentary tools to extract mineral resources. Commonly mined materials include gold, tin, columbite, and lead. ASM is often informal and poorly regulated, leading to significant environmental degradation such as soil erosion, water pollution, and deforestation (Ogundele, Okorie & Adejumo, 2016). According to Ibrahim and Omotehinse (2019), ASM accounts for about 90% of the mining workforce in Nigeria but contributes only a fraction to national revenue due to illegal activities and lack of monitoring.

Large-Scale Mining: This refers to mechanized and industrial mining carried out by formally registered companies. These operations involve significant investment and advanced technology to extract minerals such as coal, limestone, and iron ore. While large-scale mining has the potential to boost Nigeria's GDP, it often leads to extensive land disturbance and displacement of local communities (Adekoya, 2003).

Open-Pit Mining: Open-pit or surface mining is commonly used for extracting minerals close to the surface. This method is prominent in Nigeria's coal and limestone extraction industries. However, it results in large excavated pits, dust pollution, and habitat destruction (Akande, 2018).

Underground Mining: This involves digging tunnels to access deep-seated mineral resources. It is less common in Nigeria due to the high cost and technical requirements but is used in areas with deep gold deposits. Although it has a smaller surface footprint, underground mining still poses risks such as subsidence and groundwater contamination (Oladipo & Omisore, 2017).

Quarrying: This is the extraction of construction materials such as granite, gravel, and sand. Quarrying is widespread across Nigeria and contributes significantly to infrastructure development. However, it often leads to noise pollution, air pollution, and the destruction of arable land (Ezeaku, 2011).

In however, Nigeria's mining sector comprises a mix of informal and formal activities, each with unique environmental and socio-economic implications. Effective regulation and sustainable practices are necessary to mitigate the adverse effects associated with each mining method.

Mining Pollution

Mining pollution refers to the contamination of the environment as a result of the extraction and processing of mineral resources. This form of pollution encompasses a wide range of environmental hazards, including the discharge of toxic chemicals, heavy metals, tailings, and sediments into nearby water bodies, air, and soil. The impact of mining pollution is particularly severe in regions where regulatory frameworks are weak or poorly enforced. In Nigeria, both artisanal and large-scale mining operations have been linked to the degradation of the environment and the loss of biodiversity (Aigbedion & Iyayi, 2007). Mining pollution typically arises from processes such as open-pit mining, underground mining, and ore processing, which involve the use of chemicals like mercury and cyanide. These substances can persist in the environment for decades, affecting soil fertility, groundwater quality, and public health. As noted by Ogundele, Oladipo, and Aina (2016), communities situated around mining sites in Nigeria often face challenges such as contaminated drinking water, deforestation, and increased respiratory ailments due to dust emissions.

Dimensions and Sources of Mining Pollution

Mining activities in Nigeria, particularly in regions like Zamfara, Plateau, and Niger states, are major sources of environmental pollution. One significant source is

the use of chemicals such as mercury and cyanide in gold and other mineral processing. These substances are often improperly disposed of, leading to water contamination in surrounding rivers and streams. For instance, illegal artisanal miners often wash ore directly in water bodies, releasing heavy metals into aquatic ecosystems, which affects both biodiversity and human health (Obaje, 2019). These pollutants accumulate in the food chain and pose long-term health risks to local populations who rely on these water sources for drinking and agriculture (Oluduro & Aderiye, 2017). Soil pollution is another major consequence of mining in Nigeria. The removal of topsoil, overburden, and tailings during mining exposes land to erosion and degradation. Contaminants such as lead, arsenic, and cadmium are often found in high concentrations around mining sites, rendering the soil infertile and hazardous (Adie & Osibanjo, 2019).

This is particularly evident in lead mining areas like Bagega in Zamfara State, where the soil has been rendered toxic, leading to several cases of lead poisoning in children and livestock (UNEP, 2011). The long-term impact includes a loss of agricultural productivity and disruption of livelihoods in farming communities. Air pollution from mining operations in Nigeria is also of growing concern. Dust particles from blasting, excavation, and ore transportation are frequently released into the atmosphere, leading to respiratory issues in nearby communities. In addition, the burning of fossil fuels by heavy machinery and the release of sulfur dioxide and particulate matter during ore processing contribute to atmospheric pollution (Ogola, Mitullah & Omulo, 2012). These airborne contaminants can travel long distances, affecting both local and regional air quality, and have been associated with increased incidences of bronchitis, asthma, and other pulmonary diseases.

Overall, the nature of mining pollution in Nigeria is multifaceted, impacting water, soil, and air through both direct and indirect pathways. The unregulated and often illegal nature of artisanal mining further exacerbates these issues, as

environmental safeguards are frequently ignored. The persistence of heavy metals in ecosystems means that the effects of mining pollution can linger for decades if remediation efforts are not undertaken. Consequently, there is an urgent need for stronger environmental governance and the adoption of sustainable mining practices to mitigate these environmental risks (Adekoya, 2013).

Impact of Pollution on the Environment in Nigeria

Soil Degradation: Mining activities, particularly in Nigeria's Niger Delta region, result in significant soil degradation due to the exposure of heavy metals and toxic chemicals (Ogunyemi, 2021). These pollutants, such as mercury and lead, contaminate the soil, making it unsuitable for agriculture. Soil fertility declines, leading to reduced agricultural productivity, which adversely affects local livelihoods and food security. The introduction of these harmful substances also disrupts the natural soil composition, creating long-term environmental challenges for land restoration.

Water Pollution: Water bodies in Nigeria, especially those surrounding mining regions, suffer from contamination due to the leaching of hazardous substances such as arsenic and mercury into rivers and lakes (Nwilo & Badejo, 2020). These pollutants not only harm aquatic life but also affect human health as polluted water becomes a source of drinking water for surrounding communities. The contamination can lead to waterborne diseases, disrupt local fishing industries, and affect biodiversity. This has become a pressing concern in areas like the Niger Delta, where artisanal mining is prevalent.

Air Pollution: Mining operations in Nigeria, particularly those involving the extraction of minerals like coal and gold, release dust and harmful gases into the air (Oladele, 2019). These emissions contribute to air pollution, which can cause respiratory issues for local populations, including asthma and bronchitis. The smog

and particulate matter from these activities also contribute to global warming and climate change, making air quality a major environmental issue in mining zones.

Biodiversity Loss: The destruction of natural habitats due to mining activities in Nigeria leads to a significant loss of biodiversity. Forests are cleared to make way for mining operations, and the disruption of ecosystems leads to the extinction of species and the reduction of biodiversity (Udo & Imo, 2021). This not only harms local wildlife but also reduces the ecological services provided by these ecosystems, such as carbon sequestration and soil stabilization, which are crucial for maintaining environmental balance.

Health Hazards: The environmental pollution caused by mining activities in Nigeria poses severe health risks to local communities. Toxic chemicals released into the environment can lead to long-term health problems such as cancer, neurological disorders, and reproductive issues (Akinbami *et al*., 2020). These pollutants also contaminate the food chain, as plants and animals ingest the toxins, which are then consumed by humans. Poor regulation and lack of awareness exacerbate the impact on public health in affected areas.

Climate Change: Mining operations, particularly those that involve the burning of fossil fuels like coal, contribute significantly to the emission of greenhouse gases (GHGs) in Nigeria (Akinyemi & Asalu, 2022). These gases, including carbon dioxide (CO2) and methane (CH4), contribute to global warming and climate change. As temperatures rise and weather patterns become more erratic, Nigeria faces more frequent and intense weather events such as floods and droughts, which negatively impact agriculture, water resources, and overall human well-being.

Issues and Challenges of Educating Miners on Mining Pollution on the Environment in Nigeria

Mining activities in Nigeria have become a significant part of the nation's economic development, particularly in the extraction of minerals like gold, tin, coal, and

limestone. However, the environmental impact of mining has raised concerns due to its pollution of land, air, and water resources. Mining pollution in Nigeria poses numerous issues, ranging from land degradation to adverse health effects on local populations. Below are some of the critical issues and challenges associated with mining pollution in Nigeria.

Land Degradation and Soil Erosion: Land degradation is one of the most prominent environmental issues caused by mining activities in Nigeria. The excavation process leads to the destruction of natural landscapes, and the removal of vegetation exacerbates soil erosion (Oberhauser & Bauer, 2016). The destruction of forest cover, coupled with poor land reclamation practices, leaves the soil exposed and prone to erosion, reducing its fertility and damaging the ecosystem. This issue is particularly evident in regions such as the Niger Delta and Jos Plateau, where large-scale mining operations have significantly altered the landscape (Agunbiade, 2019).

Water Pollution: Mining activities, particularly in gold and coal mining, often involve the use of toxic chemicals such as cyanide, mercury, and arsenic. These chemicals are frequently released into nearby water bodies during mining processes, causing severe water pollution (Ogunleye & Oyelola, 2018). Rivers and lakes become contaminated, making the water unsafe for human consumption, agricultural use, and aquatic life. A study by Ayodele *et al*. (2019) revealed that mining operations in the Zamfara State of Nigeria have led to the contamination of water sources with high levels of mercury, significantly impacting the health of local communities.

Air Pollution and Health Risks: Mining activities in Nigeria contribute to air pollution through the release of dust, particulate matter, and fumes from machinery and blasting activities (Ajayi & Akinmoladun, 2017). These airborne pollutants pose serious health risks to nearby populations, including respiratory diseases, asthma,

and other chronic conditions. Additionally, the release of toxic gases such as sulfur dioxide and carbon monoxide from coal mining further aggravates air quality. A report by the Environmental Rights Action (ERA, 2020) noted that residents living near mining areas suffer from frequent respiratory illnesses due to high dust concentrations in the air.

Loss of Biodiversity: Mining operations in Nigeria have led to significant loss of biodiversity, particularly in areas where forest ecosystems are cleared for mining purposes. The destruction of habitats due to mining leads to the displacement of wildlife and reduces the availability of biodiversity, making ecosystems vulnerable to collapse (Akinluyi *et al*., 2018). For example, the loss of forests in the Niger Delta region has led to a decline in local wildlife populations, affecting both plant and animal species that depend on these ecosystems for survival (Obasi, 2017).

Inadequate Regulation and Enforcement of Environmental Laws: Despite the existence of environmental regulations in Nigeria, enforcement remains weak. The mining sector is largely unregulated, with illegal mining activities (commonly referred to as "Artisanal and Small-scale Mining," or ASM) contributing significantly to environmental degradation (Ike *et al*., 2018). Illegal miners often lack proper training and equipment to minimize environmental damage, and mining companies frequently violate environmental laws by failing to restore mined areas or mitigate pollution. The Nigerian government’s inability to effectively enforce mining regulations has compounded environmental challenges, allowing mining pollution to proliferate unchecked (Oloruntoba & Oladipo, 2020).

Social and Economic Impacts on Communities: Mining pollution does not only affect the environment but also poses significant social and economic challenges to surrounding communities. Polluted water sources and degraded land limit agricultural productivity, which is often the primary livelihood of local populations. In mining areas such as the Niger Delta, the contamination of water and soil has led

to poor agricultural yields, affecting food security and the economic well-being of local farmers (Ogunbiyi *et al*., 2019). Furthermore, pollution has led to conflicts between mining companies and local communities over the rights to land and resources, leading to social unrest and, at times, violent clashes.

Prospect of Education Miners on Mining Pollution on the Environment in Nigeria

The prospects of mining pollution on the environment in Nigeria involve several potential future scenarios, some of which could lead to significant improvement or exacerbation of environmental issues. While mining activities play a crucial role in Nigeria's economic development, they also pose serious risks to the environment. These risks include soil degradation, water pollution, and air contamination, all of which have long-term implications for public health, biodiversity, and sustainable development.

1. Environmental Education Awareness on Rehabilitation and Restoration: One prospect for mitigating the effects of mining pollution is the growing emphasis on environmental rehabilitation and restoration. Over the past decade, there have been increasing efforts to reclaim and restore areas that have been degraded by mining activities. The Nigerian government, in collaboration with international organizations and environmental NGOs, has introduced several initiatives aimed at cleaning up mining sites and restoring ecological balance (Ademiluyi & Adeyemi, 2020). For example, efforts to reclaim abandoned mining pits and rehabilitate forests could help prevent further environmental degradation. This process, however, remains slow due to inadequate funding, weak enforcement of environmental regulations, and lack of technical expertise in mine rehabilitation.

2. Introduction of Cleaner Mining Technologies: Another prospect is the adoption of cleaner, more environmentally friendly mining technologies. Some companies have already started to embrace modern technologies that minimize the

environmental impact of mining activities. These technologies include the use of low-impact mining methods, advanced water treatment techniques to reduce water contamination, and the recycling of waste materials from mining operations. The use of such technologies can significantly reduce the pollution burden in mining areas (Ogundele *et al*., 2021). Moreover, the Nigerian government has been working towards promoting sustainable mining practices by encouraging the implementation of the Environmental Impact Assessment (EIA) as a prerequisite for mining operations (Eze *et al*., 2019).

3. Government Policies and International Collaboration: The Nigerian government, through agencies like the Federal Ministry of Environment and the National Environmental Standards and Regulations Enforcement Agency (NESREA), has been developing policies to regulate mining activities. Efforts are underway to improve enforcement of environmental laws and encourage mining companies to adopt cleaner practices. Furthermore, Nigeria's participation in international environmental agreements, such as the Paris Climate Agreement, could bring additional pressure on local mining operations to align with global environmental standards (Ajayi *et al*., 2022). International cooperation, through foreign investments and collaborations with international environmental organizations, holds great promise for improving environmental management in the mining sector.

4. Economic Diversification and Sustainable Development: Mining pollution has often been linked to the underdevelopment of rural areas, with mining communities suffering from environmental degradation without receiving significant economic benefits. One future prospect lies in the potential for economic diversification within mining communities. The government, in partnership with the private sector, could focus on integrating sustainable livelihoods for communities affected by mining activities, promoting eco-tourism, and developing other forms of sustainable

agriculture (Fayemi *et al*., 2021). This shift could help reduce reliance on traditional, highly polluting forms of mining, thereby mitigating long-term environmental risks.

5. Awareness and Advocacy: Increased public awareness of the negative effects of mining pollution on the environment and public health can lead to more community-driven initiatives for environmental protection. The role of civil society organizations, environmental NGOs, and local communities is crucial in pushing for cleaner mining practices and holding both the government and mining companies accountable (Oluwaseun *et al*., 2020). The prospect of more informed and proactive communities can lead to significant strides in reducing mining pollution.

Conclusion

In conclusion, mining pollution in Nigeria presents a complex and multifaceted challenge, with significant environmental education and socio-economic implications. The issues stemming from mining activities, including water contamination, soil degradation, and air pollution, have led to widespread environmental degradation, affecting local communities and biodiversity. While there are prospects for mitigating these environmental impacts through environmental education rehabilitation, the adoption of cleaner mining technologies, and stronger regulatory frameworks, these efforts face several challenges, including inadequate enforcement of environmental laws, lack of technical expertise, and insufficient funding. However, the potential for positive change exists through government policies, international collaboration, and increased community awareness of environmental education and advocacy. To ensure sustainable mining practices, Nigeria must balance economic development with environmental conservation, fostering a more resilient and eco-friendly mining industry. Ultimately, achieving this balance will require a concerted effort from all stakeholders, including government agencies, mining companies, and local communities.

Recommendations

Based on the findings of the study, it is recommended that;

1. The Nigerian government should strengthen the enforcement of environmental education awareness, laws and regulations, ensuring that mining companies adhere to sustainable education practices. This includes regular monitoring of mining activities and imposing severe penalties for non-compliance.
2. Mining companies should invest in environmentally friendly mining technologies that minimize pollution and reduce the environmental footprint of mining activities. They should explore innovations like water treatment systems and low-impact mining techniques.
3. Local communities should be actively involved in the monitoring and management of mining activities. The government and mining companies should collaborate with local stakeholders to raise awareness about the impacts of mining pollution and empower them to advocate for environmental protection.
4. The government should offer financial and technical incentives to mining companies that engage in environmental rehabilitation, such as reclaiming abandoned mining sites and reforesting areas affected by mining activities.
5. There should be increased public environmental education awareness campaigns about the adverse effects of mining pollution on health and the environment. These campaigns should target both local communities and the general public to foster a culture of environmental responsibility.
6. Nigeria should collaborate with international organizations, such as the United Nations Environment Programme (UNEP) and World Bank, to secure funding and expertise for the development of cleaner mining technologies and environmental restoration projects.

7. The government should integrate sustainable mining practices into the curriculum of Nigerian universities and technical institutions, offering programs that train future mining professionals in environmental management and sustainability.
8. Regulatory bodies such as NESREA and the Federal Ministry of Environment should be better equipped with the resources, training, and manpower to monitor and manage mining pollution effectively.

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