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Exploitation of Mineral Resources

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ABSTRACT

The exploitation of mineral resources is the process of exploring, extracting, processing, and utilizing naturally occurring minerals for economic, industrial, and national development. Some of the natural mineral resources include crude oil, natural gas, gold, coal, limestone, iron ore, and bitumen which are critical to the growth of any economy as they serve as raw materials for industries, government sources of revenue, and employment opportunities. As much as Nigeria has vast endowment of mineral resources, the sector still remains highly underdeveloped and faced with challenges such as poor funding, inadequate technology, environmental degradation, illegal mining, corruption, and poor infrastructure. This paper looks at the challenges, problems, prospects, and the overall benefits of the exploitation of mineral resources to national development and humanity.

KEYWORDS: *Mineral resources, exploitation, mining, sustainable development, Nigeria, environmental degradation, conflict mineral economy, conflict minerals, illegal mining, sustainable exploitation, environmental laws, cleaner technology, Public-Private Partnership (PPP), Foreign Direct Investment (FDI), Infrastructure development, policy reforms, good governance/accountability, corruption, conflict resolution, Corporate Social Responsibility (CSR).*

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INTRODUCTION

Mineral resources are naturally occurring inorganic substances that have definite chemical composition and physical properties found in the earth's crust [1], as shown in Figure 1. They are non-renewable resources that form the backbone of industrial and economic development of a nation [2]. The exploitation of mineral resources is the processes involved in the exploration, extraction, processing, and utilization of these minerals for economic and societal benefits [3], as shown in Figure 2. From earliest civilizations, humans have depended on minerals for survival and development. The Stone Age tools, Bronze Age weapons, and the Industrial Revolution were all driven by the availability and exploitation of minerals like coal, iron, copper, and petroleum [4]. In the modern economy, minerals serve as the raw materials for construction, manufacturing, energy generation, electronics, and technology [5]. Nigeria is richly endowed with diverse mineral resources in all of the 36 states and the Federal Capital Territory, Abuja [6].

Nigeria has energy minerals like crude oil, natural gas, coal, and bitumen; metallic minerals like iron ore, gold, lead-zinc, and tin: in addition are industrial minerals like limestone, gypsum, kaolin, and clay [7]. The contribution of the solid minerals sector despite the vast abundance to Nigeria's GDP is below 1%, but while crude oil and gas account for over 90% of foreign exchange earnings [7, 8]. The overdependence on petroleum and the neglect of other mineral resources in Nigeria accounts for the above imbalance. These mineral resources are important for the generation of revenue, industrialization, employment generation or creation, infrastructural development and foreign direct investment [2, 9]. A lot of challenges are faced in Nigeria as well as other developing countries in the mining sector such as inadequate funding, poor technology, environmental degradation, illegal mining, corruption, and the lack of value addition, which has resulted into environmental and social problems in mining communities [9-11]. All of these

notwithstanding, the Nigerian government of recent has made efforts to diversify the economy via the Nigerian Minerals and Mining Act 2007 and initiatives by the FMMSD [6, 12].

HISTORY

Mineral exploitation dates back to prehistoric times when man first discovered the use of stones and metals to improve his survival. This has passed through different ages which evolved with technology, politics, and economic needs [1, 13].

1. Prehistoric and Ancient Period

It was in the Stone Age that the earliest exploitation began with the use of flint, obsidian, and quart for tools and weapons [13]. Humans discovered how to extract and smelt copper and tin to produce bronze during the Bronze Age ~3000 BC. The Iron Age ~1200 BC was the beginning of a major shift as iron ore exploitation led to stronger tools for agriculture and war [4]. Ancient civilizations like Egypt, Mesopotamia, and Rome engaged in large-scale mining of gold, copper, salt, and limestone for construction and trade [2].

2. Medieval and Colonial Period

During the medieval period, mining expanded in Europe and Asia with the development of underground shafts for coal, silver, and iron [3]. Africa, Asia, and Latin American during the colonial era were the major sources of minerals for European industries [5]. It was in the early 1900s that colonial exploitation began in Nigeria. Tin and columbite were mined in Jos – Plateau, coal in Enugu, and limestone in Nkalagu, which were exported raw to Britain with little local processing [6, 7], as shown in Figure 3.

3. Post-Independence and Oil Boom Era: 1960s-1980s

After Nigeria's independence in 1960, the government focused on solid minerals. The Nigerian Mining Corporation was established in 1972 to manage mineral exploration [6]. The discovery of crude oil in Oloibiri in 1956, as shown in Figure 4, and the oil boom of the 1970s shifted attention away from solid minerals to petroleum [14], as shown in Figure 5. Oil quickly became the mainstay of the economy, contributing over 90% of export earnings [8]. During this period, iron ore at Itakpe and steel plants at Ajaokuta were initiated to drive industrialization [6].

4. Modern Era: 1990s-Present

The Nigerian government as a result of oil price volatility and the need for diversification enacted the Nigerian Minerals and Mining Act 2007 so as to encourage private and foreign investment in solid minerals, and while NEITI 2004 was created to ensure and promote accountability [7, 12]. Exploitation today is due largely to both large-scale companies and artisanal miners. However, challenges such as illegal mining, poor infrastructure, and environmental damage persist [2, 9]. Globally, the 21st century has seen increased demand for minerals like lithium, cobalt, and rare earths for renewable energy and electronics [1, 5].

5. Global Trends

Globally, mineral exploitation has progressed from manual methods to mechanized and technology-driven mining [3]. It is well known now that countries such as Australia, Canada, and China dominate mineral production due to investment in technology and policy reforms [2]. Furthermore is the global push for a "green economy" which has also increased the exploitation of energy transition minerals [15].

TYPES OF MINERAL RESOURCES

There are four major types of mineral resources which are classified based on their chemical composition, physical properties, and uses as follows:

1. Energy minerals/fuel minerals

These are minerals used primarily for energy generation and as fuel. They are the highest revenue earners globally [2] e. g. crude oil (in Niger Delta, Rivers, Delta, Bayelsa & Akwa Ibom States), natural gas (in Niger Delta, Anambra Basin), coal, bitumen (in Ondo, Ogun, Lagos & Edo States), and uranium (in Cross River & Taraba States).

2. Metallic minerals

These contain metals and are used for making tools, machines, and construction materials, which are often found in igneous and metamorphic rocks [3], such as: iron ore (located in Itakpe-Kogi, Enugu & Niger), gold (in Zamfara, Niger, Osun & Kaduna States), tin (in Jos-Plateau, Bauchi & Kano States), columbite (in Jos-Plateau & Nasarawa States), lead-zinc (in Ebonyi, Benue & Plateau States), copper (in Bauchi, Kano & Zamfara States).

3. Industrial/Non-metallic minerals

These do not contain metals but are very important for industries and construction [4], such minerals are: limestone (found in Ogun, Sokoto, Cross River & Benue States), gypsum (in Sokoto, Borno & Adamawa States), kaolin (in Bauchi, Plateau & Katsina States), clay (found nationwide) [16], barite (in Benue, Nassarawa & Taraba States), salt (in Benue & Nassarawa States).

4. Precious stones/Gemstones

These are rare minerals valued for beauty, durability, and use in jewelry and industry [5]. Such minerals are: sapphire (in Kaduna, Bauchi & Plateau States), tourmaline (in Bauchi & Kaduna States), aquamarine

(in Plateau & Nassarawa States), diamond (not yet in commercial quantity).

Even though Nigeria has the 4 types of mineral resources, exploitation is till concentrated on energy minerals, especially crude oil [7], while the solid minerals sector remains largely untapped and contributes less than 1% to GDP [2], as shown in Figure 6.

CHALLENGES FACING EXPLOITATION OF MINERAL RESOURCES

Many developing countries, including Nigeria, face several challenges despite the abundance of mineral resources which hinder and limit the contributions of the sector to national development. These factors include [2, 6]:

1. Environmental degradation

Mining activities most often lead to deforestation, soil erosion, land degradation, water pollution, and air pollution [9]. For instance:

- Oil spillage and gas flaring have destroyed aquatic life and farmlands in the Niger Delta [11].
- Artisanal mining leads to open pits and toxic waste that affect human health [17].
- UNEP 2011 reported the severe contamination of soil and groundwater in Ogoniland due to oil exploitation [9].

2. Poor funding and inadequate technology

The mining sector is capital intensive requiring huge amount of money for exploration, extraction, and processing [2].

- Nigeria depends on foreign companies due to lack of funds and modern equipment [6].
- Crude and manual methods are still used by miners instead of mechanized mining [16].
- In addition is the lack of geological data which makes exploration risky and expensive [7].

3. Poor infrastructure

The cost of transporting minerals is increased due to bad roads, lack of rail lines, and epileptic or erratic power supply [2].

- Most of the mineral deposits are in rural areas with no access roads [6].
- Thereby making the evacuation of heavy minerals such as iron ore and limestone difficult and costly.

4. Illegal mining and smuggling

Artisanal and illegal mining is widespread, especially for gold in Zamfara, Niger, and Osun states [7].

- This form of activities often leads to loss of government revenue, insecurity, and banditry [5].
- Smuggled minerals are sold outside Nigeria without paying royalties or taxes [10].

5. Corruption and poor governance

The lack of transparency in licensing, revenue collection, and contract awards reduces government earnings [10].

- The diversion of mineral revenue and weak enforcement of mining laws are common problems [2].
- This leads to discouraging genuine investors.

6. Conflicts and community crises

The exploitation of minerals often leads to disputes over land ownership, compensation, and resource control [11].

- Examples are Niger Delta militancy and pipeline vandalism [9].
- Host communities protest against environmental damage and lack of benefits [2].

7. Over-dependence on crude oil

The focus of the government on oil has led to the neglect of solid minerals [7, 8].

- Solid minerals only contribute less than 1% to GDP while oil contributes over 90% of export earnings [8].
- This makes the economy vulnerable to oil price shocks.

8. Lack of value addition

Most minerals are exported in the raw form without processing [4].

- As a result of this, Nigeria loses jobs and foreign exchange that could have accrued to the country from local processing [6].
- An example is iron ore mined but steel plants like Ajaokuta are not yet fully operational.

In order for mineral exploitation to contribute meaningfully to national development, Nigeria must address the afore-mentioned challenges via better funding, infrastructure, environmental laws, transparency, and ensure local processing [2, 15].

Conflict minerals

Conflict minerals are natural minerals mined in a conflict zone and which are sold to finance armed conflict, human rights abuses, and forced labor. This is as obtained in the Democratic Republic of Congo (DRC) and other surrounding countries. However, the 4 main conflict minerals (3TG) are:

1. Tin (Cassiterite) – used in electronics solder, and tin cans
2. Tantalum (Coltan) – used in capacitors for phones, laptops, and jet engines
3. Tungsten (Wolframite) – used in light bulbs and drills
4. Gold – used in jewelry, electronics, and central banks.

Sometimes **cobalt and diamond** are now added to the list because of child labor and militia funding in DRC. In other words, conflict minerals are minerals that are used to fund war.

Nigeria is said to have all the 4 of the classic conflict minerals i.e., tin, tantalum, tungsten, gold (3TG) + lithium now. Even though as at now, Nigeria is not officially listed like Congo under the US Dodd-Frank law, but experts and security reports say it now has a conflict mineral economy, especially in the North-West. Nigeria therefore has conflict minerals, but unlike DRC's rebel groups, here it's banditry plus illegal mining fueling each other: violence creates ungoverned space for extraction, while extraction generates cash for more violence [18, 19], as shown in Figure 7.

SOLUTIONS

However, the exploitation of mineral resources can cause environmental degradation, pollution, land destruction, displacement of communities, corruption, and the depletion of non-renewable resources when poorly managed. The solution is not to stop all mineral exploitation, but to ensure that resources are extracted responsibly, sustainably, and for the benefit of present and future generations.

For developing countries including Nigeria to maximize benefits from its mineral resources, the above identified challenges must be properly addressed via policy reforms, investment, and sustainable practices as suggested below [2, 6]:

1. Environmental management and regulation

This should be through strict enforcement of environmental laws and the adoption of sustainable mining practices, e. g.

- Environmental Impact Assessment (EIA) Act 1992: It requires EIA before any mining project to assess and mitigate damage [20]. An EIA identifies possible environmental and social consequences, including:
  - Deforestation and erosion
  - Water contamination
  - Air pollution
  - Loss of wildlife habitats
  - Displacement of local communities
  - Health and safety risks

The assessment should lead to an environmental management plan, including measures to prevent, reduce, and monitor damage [21].

- Land reclamation and mine closure plans should be made compulsory [9]. Mining companies should provide financial guarantees for rehabilitation so that the government and communities are not left with abandoned mine sites [22, 23].
- The use of cleaner technology to reduce gas flaring and oil spillage. The Niger Delta Clean-up by UNEP 2011 is a model [9].
- The need for regular monitoring by NESREA and community involvement in environmental audits [17].

2. Increased funding and technology transfer

This will necessitate government and private sector investment with foreign partnership.

- Need to establish a Solid Minerals Development Fund to help finance exploration and SMEs [6].
- To encourage Public-Private Partnership (PPP) and Foreign Direct Investment (FDI) [2].
- The adoption of mechanized mining and geological mapping using modern technology such as GIS and remote sensing [1].
- Training of local engineers and geologists through universities and technical colleges [3].

3. Infrastructural development

This is through the provision of roads, rail, and power to mining areas. This shall be enhanced by:

- The completion of the Itakpe-Ajaokuta-Warri rail line for iron ore evacuation [6].
- Rural electrification and gas pipelines to power the processing plants [8].
- Government should prioritize infrastructure in mineral-rich areas to reduce cost [2].

4. Curbing of illegal mining and smuggling

There would be the need for the formalization and regulation of artisanal mining by:

- Registration of artisanal miners into cooperatives under SMEDAN [16].
- The deployment of Mines Surveillance Task Force so as to monitor illegal sites [6, 24].
- The establishment of mineral buying centers to ensure that royalties are paid [7].
- Establishment of community policing and awareness to discourage smuggling [10].

5. Transparency, good governance and policy reform

This is to assist to strengthen institutions and laws. This can be achieved via:

- The full implementation of Nigerian Minerals and Mining Act 2007 with tax incentives [12].
- Strengthening NEITI to publish annual audit reports on revenue [7, 25].
- E-licensing and open data portal to reduce corruption in license issuance [2].
- Community Development Agreement (CDA) to ensure that the host communities benefit [6].

6. Diversification and reducing oil dependence

This will entail deliberate policy to grow solid minerals.

- Federal Government's Economic Recovery and Growth Plan ERGP targets 10% GDP from solid minerals [6].
- Need for incentives for investors in non-oil minerals such as gold, limestone, and iron ore [8].
- Export promotion for processed minerals instead of raw export [4].
- Governments should invest in: agriculture, manufacturing, renewable energy, technology and innovation, tourism, small and medium-sized enterprises, education and skills development [26].

7. Value addition and local processing

Need to encourage beneficiation before export. This will involve:

- The revival of Ajaokuta Steel Company and Itakpe Iron Ore for local steel [6].
- Establishment of cement plants, ceramic factories, and jewelry processing centers [4].
- The ban or tax on export of raw minerals to force local processing [2].

8. Community participation and conflict resolution

This would involve host communities in planning and benefits via:

- The payment of compensation and royalties directly to communities [10].
- Corporate Social Responsibility (CSR) by the mining companies in the provision of amenities like schools, hospitals, water [15].
- The setup of dialogue and peace committees to resolve resource control disputes [5, 24].

9. Promoting sustainable mining practices

This involves extracting minerals while minimizing environmental damage and conserving resources for future generations [23]. Therefore, mining companies should adopt:

- Efficient extraction methods
- Water-saving technologies
- Energy-efficient machinery
- Cleaner production techniques
- Waste-reduction systems
- Responsible management of mining chemicals

10. Promoting mineral recycling and circular economy

Recycling reduces the need to extract new minerals and can help conserve natural resources. The World Bank's Climate-Smart Mining framework includes circular economy practices and recycling as part of responsible mineral supply chains [23].

The proper implementation of these solutions can help transform Nigeria's mineral sector into a major driver of economic growth, job creator, and sustainable development and while the environment is well protected [2, 15].

CONCLUSION

Despite the challenges, mineral resources can be exploited and this should be done responsibly and sustainably. Effective environmental regulations, responsible mining practices, technological innovation, transparency in the management of mineral revenues, as well as the active participation of local communities are essential for reducing the negative consequences of mineral exploitation. When properly managed, mineral resources can serve as a powerful foundation for national development. Governments, mining companies, communities, and international organizations must work together to ensure that mineral wealth benefits both present and future generations. Sustainable mineral exploitation should promote economic progress while also protecting the environment, respecting human rights, and ensuring equitable distribution of the benefits of natural resources. More information can be obtained in the books in [27-44] and the following related journals:

International Journal of Mining Science and Technology

Resources Policy

Journal of Cleaner Production

Resources, Conservation and Recycling

The Extractive Industries and Society

Minerals Engineering

Mineral Economics

Ore Geology Reviews

Nature Sustainability

Mining, Metallurgy & Exploration

Environmental Impact Assessment Review

Interdisciplinary Environmental Review

Sustainable Development Law and Policy

Journal of African Law

International Journal of Engineering and Modern Technology

Review of Development Economics

Journal of Environmental Science and Technology

Chemistry Central Journal

European Economic Review

Africa Development

Natural Resources Forum

REFERENCES

[1] United States Geological Survey (2023), *Mineral commodity summaries 2023.* USGS.

[2] World Bank (2020), *The changing wealth of nations 2018.* World Bank.

[3] International Labor Organization (2019), *Safety and health in mines convention*. ILO.

[4] United Nations Industrial Development Organization (2019), *Industrial development report.* UNIDO.

[5] United Nations (2021), *World economic situation and prospects.* UN.

[6] Federal Ministry of Mines and Steel Development (2022), *Roadmap for the growth and development of the Nigerian mining industry.* FMMSD.

[7] Nigerian Extractive Industries Transparency Initiative (2023), *2021 oil, gas and solid minerals industry report.* NEITI.

[8] Central Bank of Nigeria (2022), *Annual statistical bulletin.* CBN.

[9] United Nations Environment Programme (2011), *Environmental assessment of Ogoniland.* UNEP.

[10] Transparency International (2022), *Corruption perception index*. TI.

[11] Amnesty International (2018), *A criminal enterprise? Shell's involvement in the spills in the Niger Delta.* Amnesty International Publications.

[12] Federal Republic of Nigeria (2007), *Nigerian minerals and mining act*. Government Press.

[13] United Nations Educational, Scientific and Cultural Organization (2018), *The history of human society and mining.* UNESCO.

[14] Nigerian National Petroleum Corporation (2022), *NNPC annual report and financial statements*. NNPC.

[15] United Nations Development Programme (2020), *Human development report*. UNDP.

[16] Small and Medium Enterprises Development Agency of Nigeria (2020), *Artisanal and small-scale mining in Nigeria*. SMEDAN.

[17] World Health Organization (2019), *Health and environment*: *Managing the process of mining*. WHO.

[18] M. Otalike (April 9, 2026), "The deadly nexus: Banditry and illegal minerals as self-reinforcing criminal enterprise: A searchlight follow-up analysis – Part 3," https//www.thesearchlightcomblog.wordpress.com

[19] Nigerian NewsDirect (2 July 2026), "Illegal mining fuelling insecurity in parts of Nigeria – Experts warn," https//www.nigeriannewsdirect.com

[20] Federal Environmental Protection Agency (1992), *Environmental impact assessment decree No. 86.* FEPA.

[21] International Finance Corporation (2012), *Performance standards on environmental and social sustainability.*

[22] International Council on Mining and Metals (ICMM), *Mining principles.* ICMM Mining Principles.

[23] United Nations Environment Programme (UNEP), *Mineral resource governance and sustainable development.*

[24] World Bank (May 26, 2019), *Climate-smart mining: Minerals for climate action.* World Bank Group. Climate-Smart Mining.

[25] United Nations Environment Programme (UNEP), *Mineral resource governance in the 21st century: Gearing extractive industries towards sustainable development. Nairobi: UNEP. Official report.*

[26] World Bank (2017), *Oil, gas, and mining: A sourcebook for understanding the extractive industries,* Washington, DC: World Bank Group. World Bank.

[27] United Nations Environment Programme & International Resource Panel (2024), *Global resources outlook 2024: Bend the trend-pathways to a liveable planet as resource use spikes.* Nairobi: UNEP.

[28] World Bank (1998), *Environmental assessment of mining projects.* Environmental Department, Update No. 22. Washington, DC: World Bank.

[29] K. Hund et al. (2020), *Minerals for climate action: The mineral intensity of the clean energy transition*. Washington, DC: World Bank Group.

[30] United Nations Environment Programme & International Resource Panel (2019), *Global resources outlook 2019: Natural resources for the future we want.* Nairobi: UNEP.

[31] N. G. Obaje (2009), *Geology and mineral resources of Nigeria*. Springer.

[32] H. L. Hartman & J. M. Mutmansky (2002), *Introductory mining engineering* (2nd ed.). John Wiley & Sons.

[33] P. Crowson (2012), *Mining unearthed: The definitive book on how economic and political forces shape the mining industry*. Aspermont.

[34] R. M. Auty (1993), *Sustaining development in mineral economies: The resource curse thesis*. Routledge.

[35] B. G. Lottermoser (2010), *Mine wastes: Characterization, treatment and environmental impacts* (3rd ed.). Springer.

[36] S. A. Khan (1994), *Nigeria: The political economy of oil*. Oxford University Press.

[37] R. Lukman (2013), *Nigerian minerals and mining law: Principles and practice*. Malthouse Press.

[38] S. H. Ali (2003), *Mining, the environment, and indigenous development conflicts*. University of Arizona Press.

[39] B. A. Wills & J. A. Finch (2015), *Will's mineral processing technology: An introduction to the practical aspects of ore treatment and mineral recovery* (8th ed.). Butterworth-Heinemann.

[40] J. L. Hammond (2011), *The resource curse and the extractive industries in Africa*. Palgrave Macmillan.

[41] J. G. Frynas (2000), *Oil in Nigeria: Conflict and litigation between oil companies and village communities*. LIT Verlag.

[42] B. Campbell (2009), *Mining in Africa: Regulation and development*. Pluto Press.

[43] M. P. Todaro & S. C. Smith (2020), *Economic development* (13th ed.). Pearson.

[44] C. O. Okonkwo (2015), *Environmental law and oil pollution in Nigeria*. University of Lagos Press.



Figure 1. Types of natural resources



Figure 2. Exploitation of natural resources
Source:
https://en.wikipedia.org/wiki/Exploitation_of_natural_resources



Figure 3. The history of Nigerian mining industry



Figure 4. Oloibiri oil well No. 1 (1956)
Source: https://en.wikipedia.org/wiki/Oloibiri

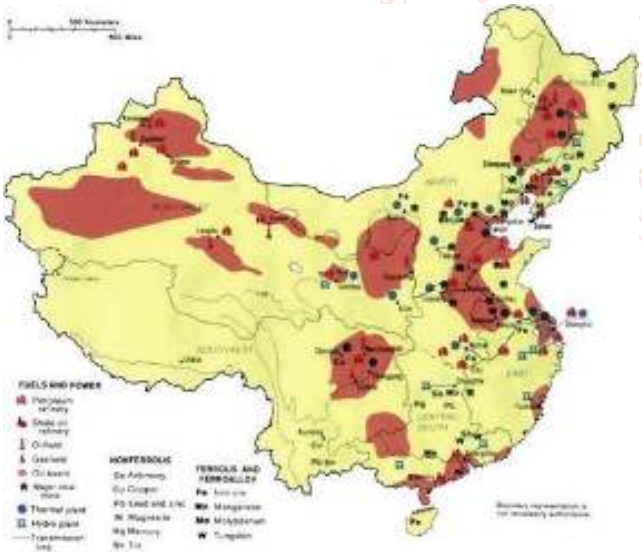


Figure 5. Mineral-resource



Figure 6. Mining
Source: https://en.wikipedia.org/wiki/Mining



Figure 7. Conflict-minerals.