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SUSTAINABLE MANAGEMENT OF SOLID MINERAL EXTRACTION IN OKE-OGUN, SOUTHWESTERN NIGERIA: ENVIRONMENTAL, LIVELIHOOD, AND GOVERNANCE PERSPECTIVES

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Abstract
The Oke-Ogun region in southwestern Nigeria has experienced significant growth in solid mineral extraction activities. Nonetheless, the sector is predominantly characterized by informal and inadequately regulated operations. This research investigates the spatial patterns, extent, and consequences of ongoing mining operations in the area, evaluating their environmental, socioeconomic, and governance ramifications using a mixed-methods design that combines field mapping of 187 mining sites, interviews with stakeholders, and secondary data from geological surveys and policy documents. Drawing on the Sustainable Livelihoods Framework, Stakeholder Theory, and the Resource Curse hypothesis, this analysis synthesizes environmental, socioeconomic, and institutional factors into a comprehensive framework for sustainable mineral governance. Key findings indicate that artisanal and small-scale mining constitutes over 90% of activities, underscoring the sector's informality and regulatory shortcomings. Gemstone mining predominates with 89 sites, followed by granite quarrying at 62 sites. Local communities report substantial natural capital degradation, with 88% noting adverse environmental effects, contrasted by 75% acknowledging benefits to financial capital, which highlights an unsustainable exchange of immediate economic gains for enduring ecological stability. Moreover, inadequate implementation of the Minerals and Mining Act, constrained institutional capabilities, and jurisdictional overlaps intensify governance failures and conflicts among stakeholders. The study reveals that Oke-Ogun's mining economy exemplifies the duality of localized advantages amid systemic fragilities, a paradox that the proposed holistic model addresses by integrating multidimensional perspectives. As a novel contribution, this framework advances beyond fragmented analyses, offering actionable pathways for transformation. Recommendations include the prompt formalization of artisanal mining cooperatives, enhanced community involvement in governance, dedicated funding for environmental restoration, and livelihood diversification strategies to reposition the region's extractive industry as a catalyst for equitable and sustainable regional development.

Keywords: *Artisanal and Small-Scale Mining (ASM), Sustainable Livelihoods Framework (SLF), environmental degradation, resource governance, Oke-Ogun Region-Nigeria, stakeholder dynamics, Resource-Curse Thesis.*

Introduction

Nigeria's longstanding quest for economic diversification has placed the solid mineral sector in the national spotlight as a critical alternative to hydrocarbon dependency. The country is endowed with significant mineral resources, and policy frameworks have emphasized mining as a catalyst for industrial growth, generate substantial employment, and foster sustainable development across the nation (Anzolin & Pietrobelli, 2025; Chukwuma et al., 2020; Eniowo et al., 2025). This renewed emphasis has invigorated the exploration and development of metalliferous deposits and gemstones, moving beyond the historical focus on crude oil which, despite its economic dominance, is

a non-renewable resource (Adebayo & Obasaju, 2021).

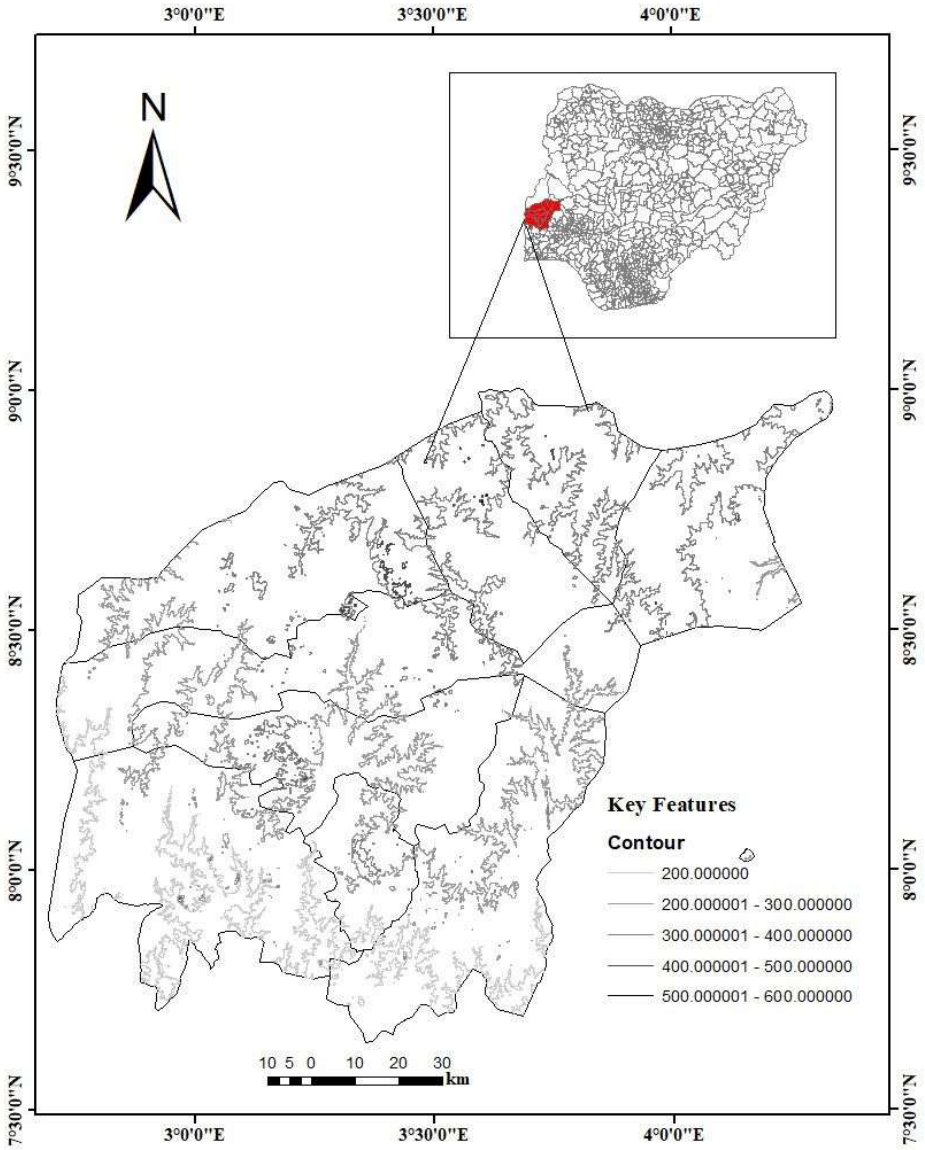


Figure 1. A topomap of the study area (the Oke-Ogun region) with insert of the map of Nigeria

This potential is particularly salient in the Oke-Ogun region of Oyo State, the largest geographical and agricultural zone in the state (Figure 1). Beneath its vast arable land lies a wealth of valuable solid minerals, including high-grade talc, marble, limestone, gemstones, and granite (Adekoya et al., 2003; Omotunde, 2020). This endowment positions Oke-Ogun as a future hub for mineral-based industrialization, capable of driving regional economic transformation, reducing the poverty levels of the locals, and providing crucial revenue for both the state and local governments (Azubuike et al., 2022; Ofulume et al., 2017). However, the reality on ground is in stark contrast to this enormous potential. The extraction of these resources is currently dominated by informal, unregulated, and predominantly artisanal mining activities. These practices are fundamentally unsustainable and are characterized by environmentally destructive techniques that eventually lead to severe land degradation, deforestation, and pollution of critical water sources (Bansah et al., 2024; Meaza, 2025; Nyakuwanika & Panicker, 2025). The socioeconomic landscape is marred by issues such as conflicts between miners and indigenous agrarian communities, loss of

livelihoods, and minimal local beneficiation of the resources extracted. Consequently, the region is trapped in a paradox in which immense mineral wealth translates into environmental degradation, social tension, and squandered economic opportunities, ultimately undermining the goals of sustainable development (Brunet & Longboat, 2023; Opongo, 2021; Sarfo & Tweneboah, 2024).

While the challenges of artisanal and small-scale mining (ASM) in Nigeria have been documented in broader studies, a critical gap still remains in the context-specific, multi-stakeholder analysis of the Oke-Ogun region. Previous investigations have frequently concentrated on particular minerals or environmental consequences in a fragmented manner, failing to offer a cohesive framework for sustainable management that is specifically adapted to the distinctive socio-ecological context of the region (Olajide-Kayode et al., 2020; Olujimi et al., 2015; Omanayin & Ogunbajo, 2016). Consequently, this study addresses this gap by providing a comprehensive, multi-dimensional analysis of mining in Oke-Ogun. Firstly, it provides a comprehensive geospatial inventory of mining activities in the region. Secondly, it integrates environmental, socio-economic, and governance data within a unified analytical framework. Also, it applies established theoretical frameworks in a localized context to explain mining-related trade-offs. And finally, it proposes a context-specific governance model for sustainable mineral resource management.

Regional geological setting

The Oke-Ogun region, like much of Southwestern Nigeria, is underlain by Precambrian Basement Complex rocks (Figure 2). These are ancient igneous and metamorphic rocks that form the stable continental crust of the West African Craton. The geology of the area is characterized by three major rock types (Ogunyele et al., 2019; Oladejo et al., 2020; Olisa et al., 2018).

- Migmatite–gneiss Complex, which are the oldest rocks in the region, primarily consisting of banded gneisses and migmatites. These form the "basement" into which younger rocks are emplaced (Akingboye et al., 2018; ODIGI, 2002).
- Schist Belts (supracrustals), which are the narrow, NNE-SSW trending belts of metasedimentary and metavolcanic rocks (quartzites, schists, and amphibolites) that are folded within the Migmatite-Gneiss Complex. Noteworthy is that, the Iseyin Schist Belt is a prominent example of a belt running through the region (Abdus-Salam, 2020; Adepoju, 2022).
- Older Granites (Pan-African Granitoids), which are the intrusive igneous bodies that were emplaced during the Pan-African Orogeny (ca. 600 million years ago). These include a variety of granites, granodiorites, and syenites that often form spectacular inselbergs and hills across the Oke-Ogun landscape (Akinola et al., 2021; Goodenough et al., 2014).

The Geology of Oke-Ogun region and the mineralization implication

This region, situated within the Nigerian Precambrian basement complex, is characterized by a diverse lithology comprising migmatite-gneiss complexes, meta-sedimentary and meta-volcanic rocks, Pan-African granitoids, and unmetamorphosed dykes (Adekiya et al., 2024; Falebita et al., 2020). The migmatites and gneisses of the region cover extensive areas and are composed of alternating felsic and mafic mineral bands. They serve as hosts for various minerals formed through metamorphic processes and subsequent weathering (Fakolade et al., 2024; Mafimisebi & Abdulrahman, 2022; Oyebamiji et al., 2018). The Schist Belts comprise largely (a) quartzites, which are a primary source of silica and are sometimes mined for dimension stones and aggregates, (b) amphibolites and talc schists, which are the primary host for talc deposits, and (c) pegmatites that cut across the schist belts and other basement rocks. These are exceptionally important because they are the host of rare minerals, such as gemstones, tantalite-columbite, and cassiterite. The Older Granites are the plutonic rocks that randomly host the Biomic granites that are often mined as limestone for cement production and agricultural lime, and coarse-grained granites that are quarried extensively either as dimension stones (building blocks, paving stones) or crushed as aggregates for the construction industry.

Literature review and theoretical framework

Existing research across sub-Saharan Africa shows that while mining contributes to rural incomes, it also creates significant ecological and social externalities (Haroon & Hayyat, 2025); Ofosu et al., 2020). Globally, mining is associated with deforestation, landscape scarring, erosion, and contamination of soil and water resources (Kumi et al., 2023; Wassie, 2020). Studies in Nigeria (Folorunso & Folorunso, (2022); Balogun et al., 2024) confirm similar outcomes, linking widespread degradation to poor environmental governance. Specifically, in regions like Zamfara, Ogun, Niger,

Ebonyi, and Kogi, inadequate regulatory enforcement and the prevalence of unauthorized mining operations exacerbate the emission of airborne particulates, the poisoning of surface and groundwater, and extensive vegetation loss (Mu'azu et al., 2025). These environmental repercussions disproportionately affect local communities, often leading to conflicts over natural resources and land rights (Leonard, 2024).

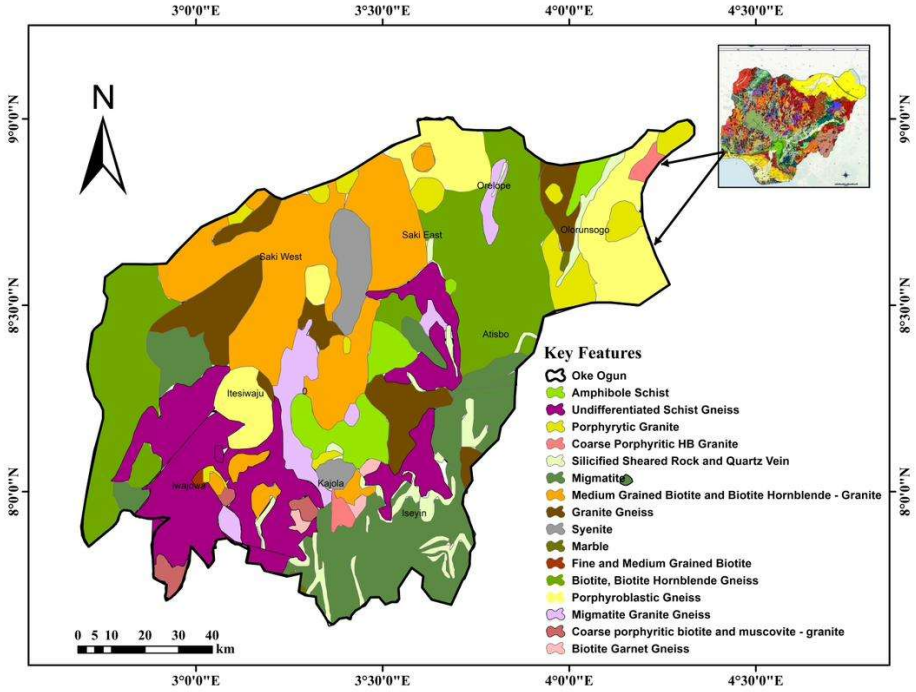


Figure 2: A geologic map of study area (modified from regional map of Oyo state – NGSA 2006)

Using Stakeholder Theory (Mahajan et al., 2023), it has been shown that unequal influence and weak accountability structures often result in governance gaps and legitimacy crises (Jongen & Scholte, (2022)). This often marginalizes host communities, limiting their participation in decision-making processes and undermining their long-term well-being (Naibbi & Chindo, 2020). This marginalization is particularly evident in artisanal and small-scale mining communities, where poverty-stricken miners often operate under precarious conditions with minimal mechanization, contributing to both ecological damage and social instability (Hwyere-Yashim, 2025). The Resource-Curse Thesis (Gritsenko & Efimova, 2020; Reisinezhad, 2021) posits that resource-rich economies often experience slower development, institutional decay, and social tension. Nigeria exemplifies this paradox such that, despite its abundant mineral wealth, weak governance and rent-seeking have constrained sustainable outcomes (Fagbemi & Omowumi Adeoye, 2020). Although artisanal and small-scale mining (ASM) provides critical income and employment where alternative livelihoods are scarce, the benefits are often temporary and unevenly distributed (Hilson & Maconachie, 2020). Research in Ghana, Tanzania, and Burkina Faso shows declining agricultural productivity, unstable earnings, and worsening inequality (Bekoe, 2022). This often leads to a complex dynamic where the immediate economic relief provided by mining is overshadowed by long-term environmental degradation and the erosion of traditional livelihood systems, such as agriculture (Ofosu et al., 2020). Despite the availability of Laws, Acts, and regulations in Nigeria to promote sustainable mining through licensing, community development agreements (CDAs), and environmental management plans, enforcement remains limited (Onuoha et al., 2024). Institutional overlap between federal and state authorities, inadequate technical capacity, and corruption undermine the effectiveness of regulations. For instance, studies on tin mining in Plateau State highlight that despite historical significance, the industry has contributed minimally to social development, economic empowerment, and has led to widespread ecological impacts due to inadequate infrastructure and poor enforcement (Kalu and Uzoamaka., 2020; Ephraim, 2025). These

governance deficiencies frequently translate into severe public health risks, environmental degradation, and livelihood displacement for host communities, exacerbated by weak legislation and insufficient oversight from regulatory bodies (Fayomi et al., 2024; Sam et al., 2024).

International experience demonstrates that formalization is pivotal if ASM must be transformed into a sustainable livelihood activity. The World Bank (2019) and UNEP (2018) advocate stepwise strategies, which include simplified licensing system, functional cooperative structures, access to much needed finance, and technical training. Environmental safeguards, such as reclamation bonds, progressive rehabilitation, and the "polluter-pays" principle, are integral to best practices (Aragão, 2022). Community participation frameworks, particularly Free, Prior, and Informed Consent (FPIC), can strengthen accountability and social acceptance (Klein, 2024).

Research Methodology

Research Design

This study adopted a convergent parallel mixed-methods design, in which quantitative and qualitative data were collected concurrently, analyzed separately, and then integrated during interpretation. This design was selected to enable triangulation of findings and to provide both breadth (through survey data) and depth (through qualitative insights) in examining the socio-economic and environmental impacts of mining activities in Oke-Ogun.

Study Area and Sampling Procedure

The study was conducted in ten Local Government Areas (LGAs) within the Oke-Ogun region of Oyo State, Nigeria, an area characterized by intensive artisanal and small-scale mining activities.

A multi-stage stratified sampling technique was employed. In the first stage, communities were stratified into two categories based on proximity to mining activities:

1. Mining communities (located within 5 km of active mining sites)
2. Non-mining communities (located more than 5 km away from mining sites)

In the second stage, communities were randomly selected from each stratum using a simple random sampling method. In the third stage, households within selected communities were systematically sampled using household listings obtained from local administrative records.

A total of 400 household heads were surveyed, comprising 200 respondents from mining communities and 200 from non-mining communities. Respondents were eligible if they were aged 18 years or older and had resided in the community for at least two years prior to the study.

For the qualitative component, 25 key informants were purposively selected based on their institutional roles and knowledge of mining activities. These included officials from the State Ministry of Environment and Natural Resources, the Mines Inspectorate, leaders of mining associations, and community leaders. Additionally, 8 Focus Group Discussions (FGDs) were conducted, with participants grouped by occupation and social category (miners, farmers, women, and youth), ensuring diversity of perspectives.

Fieldwork was conducted between October 2024 and April 2025.

Data Collection Methods

Quantitative Data

Quantitative data were collected using structured questionnaires administered to household heads. The questionnaire captured information on demographic characteristics, income sources, livelihood changes, health conditions, and perceived environmental impacts of mining. The instrument was pre-tested in a similar community outside the study area, and necessary adjustments were made to improve clarity and reliability.

Qualitative Data

Qualitative data were collected through:

- Semi-Structured Interviews (SSIs) which was conducted with the 25 key informants to explore institutional perspectives, regulatory challenges, and governance issues.
- Focus Group Discussions (FGDs) where eight FGDs were held, each consisting of 6–10 participants, to capture community-level experiences, perceptions of mining impacts, and sources of conflict.
- And lasty, by direct Observation: Field observations of mining sites were systematically documented, including land degradation, water pollution, and mining practices. Geo-tagged photographs were taken to support environmental assessments.

Secondary Data

Secondary data were obtained from official publications and reports from the Nigeria Mining Cadastre Office (MCO), the Ministry of Mines and Steel Development, environmental impact assessment reports, and relevant academic literature.

Data Analysis

Quantitative data were coded and analyzed using excel statistical software. Descriptive statistics (frequencies, means, and percentages) were used to

summarize household characteristics and key variables. Inferential statistical tests, including independent sample t-tests and chi-square tests, were conducted to examine differences between mining and non-mining communities. Where appropriate, multiple regression analysis was employed to assess the relationship between mining exposure and socio-economic outcomes.

Qualitative data from interviews and FGDs were audio-recorded, transcribed verbatim, and analyzed using thematic analysis. An inductive coding approach was applied to identify recurring themes related to environmental impacts, livelihood changes, governance, and conflict dynamics. Data from observations were integrated to corroborate findings from both quantitative and qualitative sources.

Integration of quantitative and qualitative findings was carried out at the interpretation stage to ensure complementarity and triangulation.

Ethical Considerations

Ethical approval for the study was obtained from the Solid Minerals Agency of Oyo State - Nigeria. Informed consent was obtained from all participants prior to data collection. Participants were assured of anonymity and confidentiality, and all data were used strictly for academic purposes.

Results

The geospatial inventory confirmed 187 active mining sites across Oke-Ogun (Figure 3). The distribution is highly clustered and directly correlates with the underlying geology.

Analysis revealed (Table 1) that 92% of all sites are classified as Artisanal or Small-Scale (Figure 4). Furthermore, only 18 sites (9.6%) possessed any form of formal mining title from the MCO, confirming the extensive informality of the sector.

Environmental impacts assessment

Environmental degradation is severe and widespread, affecting all three core environmental media of land, water, and air (Figures 5, 6, and 7).

Land Degradation

Field-based environmental assessments were conducted across 187 active and abandoned mining sites distributed within the study area. Observations were guided by a structured checklist adapted from standard environmental impact assessment protocols, focusing on indicators such as vegetation loss, open pits, topsoil removal, waste rock accumulation, and visible erosion features.

The results indicate that all surveyed sites (100%) exhibited clear signs of land degradation. The most common features included abandoned excavation pits, exposed subsoil, and extensive waste dumps. Notably, 91% of the sites showed no evidence of land reclamation or rehabilitation efforts.

Erosion risk was further evaluated using a three-tier classification system (low, moderate, high/severe) based on observable geomorphological features. Findings revealed that 65% of the sites fell within the high or severe erosion risk category, characterized by deep gullies, active soil displacement, and unstable terrain. These patterns suggest that mining activities have significantly altered the physical landscape, increasing susceptibility to long-term environmental degradation.

Water pollution - Water quality assessment was carried out using 65 surface water samples collected from streams located within a 1 km radius of active mining sites, particularly around the Iseyin gemstone mining axis (Table 2). Sampling points were strategically selected to include both upstream (control) and downstream (impact) locations relative to mining operations. Laboratory analysis of samples was conducted using the gravimetric method for Total Suspended Solids (TSS) in line with World Health Organization (WHO) drinking water quality guidelines. The results showed that mean TSS concentrations in affected streams were approximately 15 times higher than the WHO-recommended limit of 10 mg/L for potable water.

All values remain substantially above the World Health Organization recommended limit of 10 mg/L for potable water, indicating an approximate 15-fold exceedance across the sampled streams.

These findings are consistent with household survey responses. Among respondents in mining-adjacent communities (n = 200), 82% (164 respondents) reported a significant decline in water quality, citing increased turbidity, unpleasant taste, and discoloration. The convergence of empirical measurements and community perceptions strengthens the evidence for mining-induced water contamination in the study area.

Air and noise pollution - Data on health impacts were derived from household surveys focusing on residents living in close proximity to mining operations. Among respondents residing within 500 meters of granite crushing sites (n = 146), 74% (108 respondents) reported frequent respiratory symptoms, including persistent coughing, catarrh, and asthma-like conditions. These outcomes are likely associated with prolonged exposure to airborne particulate matter generated during crushing and hauling processes.

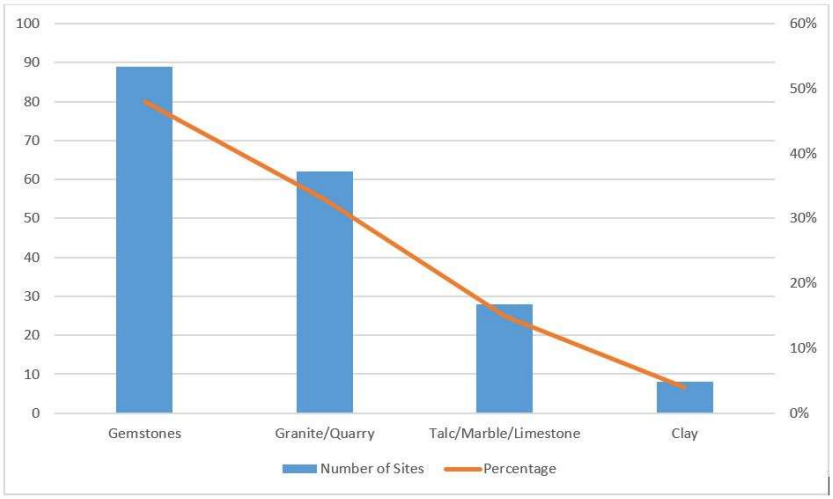


Figure 3: Histogram showing the distribution of active solid mineral extraction sites by mineral type in Oke-Ogun, Oyo State.

Table 1: Classification of active mining sites by mineral and scale

Mineral Type	**No. of Sites**	**Predominant Scale**	**Key Locations (LGAs)**
Talc/Marble/Limestone	28	Small-Scale	Olorunsogo (Igbetti)
Gemstones (Beryl, Tourmaline)	89	Artisanal	Iseyin, Irepo (Igboho), Kajola
Granite/Quarry	62	Artisanal & Small-Scale	Widespread (Saki West, Saki East, Iseyin)
Clay	8	Artisanal	Atisbo, Itesiwaju
TOTAL	187		

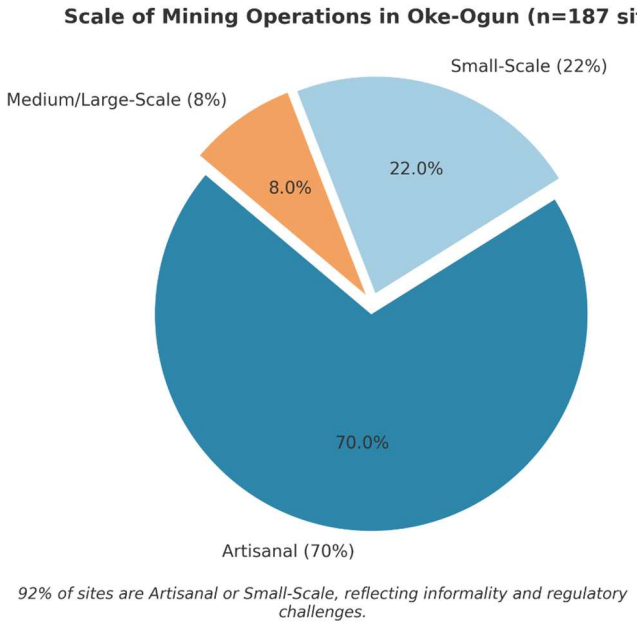


Figure 4: Scale of mining operations in Oke-Ogun (n=187 sites)

Table 2: Gravimetric TSS Results Summary (n = 65)

Parameter	Value (mg/L)
Mean	152
Standard Deviation (SD)	18
Minimum (Min)	135
Maximum (Max)	172
Range	37

Figure 5: showing massive land degradation in the study area as a result of open pit mines

Figure 6: showing land degradation and loss of habitat in study area as result of trees felling, dredging and excavation

Figure 7: showing air pollution in study area resulting from pollution from heavy duty trucks in mine sites

Noise pollution was assessed through direct measurement at 10 active granite crushing sites using a calibrated digital sound level meter. Measurements were taken at distances of approximately 10–20 meters from the primary crushing units during peak operational periods. Recorded noise levels ranged from 88 dB to 102 dB, consistently exceeding the 85 dB safety threshold recommended by international occupational health standards. Prolonged exposure to such noise levels poses significant risks, including hearing impairment and increased stress levels among both workers and nearby residents.

Socio-economic impacts from a livelihood perspective

Applying the Sustainable Livelihoods Framework (SLF), the impacts on the five capital assets were significant.

The data, as shown in Table 3 and Figure 8, reveal a critical trade-off: while mining provides crucial short-term financial capital, it systematically degrades the natural capital (land and water) upon which the region's long-term, sustainable agrarian economy is built. Focus Group Discussions (FGDs) with farmers revealed deep anxiety, with one participant stating that, "The money from the stones is sweet, but it cannot be eaten. When the land is gone, what will we leave for our children?"

Stakeholder analysis – their roles, interests, and perceptions

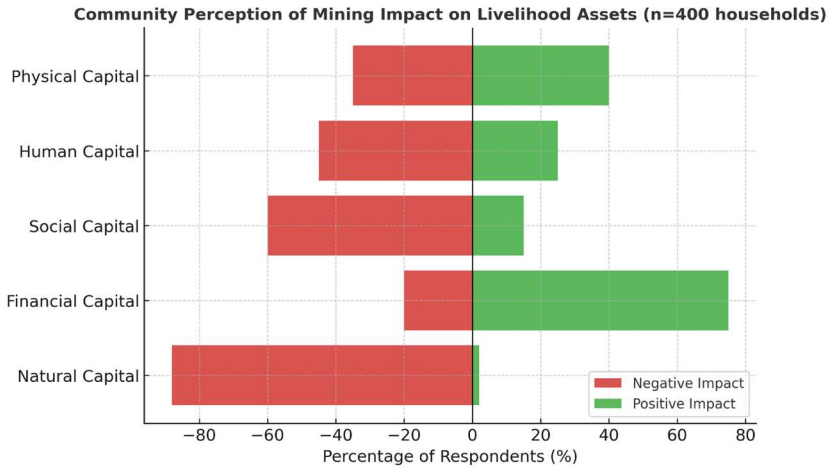
The application of Stakeholder Theory uncovered clear conflicts and alignments.

Artisanal Miners' primary interest is immediate income (95% cited it as their main motivation). They perceive government agencies as hostile, who only come to oppress and to extort them, they view the environmental rules as a threat to their livelihood.

The host communities (farmers/residents) exhibit profound ambivalence. While 78% acknowledged the new source of income for youth, 85% were worried about the destruction of farmland and pollution caused by the industry. A significant 72% of the respondents felt completely excluded from decision-making processes regarding mining on their land.

Table 3: Perceived impact of mining on community livelihood assets (n=400 households)

Livelihood Asset	% Reporting Negative Impact	% Reporting Positive Impact	Key Manifestations
Natural Capital	88%	2%	Loss of farmland, polluted water sources
Human Capital	45%	25%	Health issues vs. new mining skills
Social Capital	60%	15%	Conflicts vs. new social networks (cooperatives)
Physical Capital	35%	40%	Damaged roads/farms vs. new motorcycles/phones
Financial Capital	20%	75%	Loss of farm income vs. direct cash from mining



Natural Capital shows the most negative impact (88%), while Financial Capital reflects mostly positive outcomes (75%).

Figure 8: Community perception of mining impact on livelihood assets (n=400 households)

Traditional rulers, functioning as intermediaries, articulate a dual commitment to preserving social harmony and fostering community development. Interviews, however, uncovered their frustration, as one respondent observed that the Federal Government grants the license without consulting those who own the land, and that suffering community members turn to the palace for redress.
Government agencies: A critical issue identified was jurisdictional confusion and overlap. Federal officials attributed their limited oversight of Oke-Ogun to insufficient personnel resources, while state officials contended that they lacked jurisdiction over mineral resources, viewing such matters as outside their purview. This misalignment of responsibilities has fostered a substantial enforcement gap, which perpetuates unregulated extraction activities and hampers coordinated governance for sustainable mineral management.

Policy and regulatory enforcement deficit

The data confirm a near-total collapse of governance. Of the 187 active sites; 19 (about 10%) had publicly available or implemented Community Development Agreements (CDA); less than 31% (57 companies) had a visible and operational Environmental Management Plan (EMP); while no state or federal official could provide verifiable evidence of an environmental inspection in the preceding 12 months. All stakeholder groups identified this regulatory failure as the primary enabler of current unsustainable practices.

Discussion

Environmental impacts and interpretations

The findings demonstrate that mining activities in the Oke-Ogun region significantly degrade the physical environment of the area. Land disturbance through excavation, vegetation clearing, and artisanal pits mirrors patterns reported in other sub-Saharan African ASM regions (Mhlongo & Akintola, 2021; Jeevanandam, 2025). Soils are stripped of their top horizons, rendering them infertile and unsuitable for agriculture, which traditionally sustains most households. Water quality analysis indicates contamination from suspended sediments and possible heavy metals from mineral processing, echoing concerns raised in the global literature regarding mercury, lead, and arsenic pollution in small-scale mining belts (Mulenga et al., 2024). Dust and particulate emissions from quarrying contribute to air quality deterioration, leading to respiratory problems.

These outcomes from this study further confirms and extend existing research. They confirm global observations that artisanal and small-scale mining creates ecological "hotspots" of degradation but extend knowledge by identifying the peculiarities of the Oke-Ogun regio, where semi-arid climatic conditions exacerbate soil erosion and water scarcity. Unlike wetter tropical mining zones, the fragility of the Oke-Ogun ecosystems means that recovery trajectories are slower, suggesting a heightened vulnerability to long-term environmental collapse. From a theoretical perspective, the Sustainable Livelihoods Framework (SLF) helps interpret these findings: natural capital is being depleted without adequate replenishment, undermining other livelihood assets (e.g., reduced soil fertility lowers agricultural income, thereby constraining financial and human capital investments such as education).

Socio-economic dimensions

Socioeconomically, mining in the Oke-Ogun region generates contradictory outcomes. Mining provides employment opportunities, particularly for youth and migrants, offering immediate financial returns in contexts of limited formal employment. It also stimulates ancillary economic activities, such as petty trading, transport, and food services, similar to observations in Tanzanian and Ghanaian ASM communities (Huggins, (2021). However, these benefits are greatly undermined by negative social externalities such as health challenges, including respiratory illnesses and injuries from unsafe pits, mirror findings in Ghana and Burkina Faso (Stewart, 2020; Leuenberger et al., 2021). Livelihood displacement occurs when farmlands are converted into minefields, threatening food security. Security issues ranging from land disputes to clashes between miners and farmers, reflect what Niu et al. (2023) describe as "resource conflicts" arising from competing land-use priorities. This tension can be interpreted through the resource curse thesis, which predicts that resource dependent communities often experience social dislocations rather than prosperity when governance mechanisms are weak. The Oke-Ogun case illustrates this paradox of rather than delivering broad-based development, mining deepens inequalities, marginalizes vulnerable groups (women and smallholder farmers), and also fosters social insecurity.

However, the findings also add nuance. While the Resource Curse has often been studied in oil- and gas-producing states, this research demonstrates that similar dynamics apply to solid minerals at a local scale, expanding the theory's applicability beyond hydrocarbons.

Governance and stakeholder conflicts

Governance is the most critical dimension shaping sustainability outcomes. Policies and regulations for the Nigerian solid mineral sector exist on paper through frameworks such as the Nigerian Minerals

and Mining Act (2007) and subsequent guidelines, but enforcement in Oke-Ogun remains weak. This confirms prior studies that highlight the gap between centralized policy design and localized enforcement in Nigeria (Amakiri & Arugu, 2025).

Stakeholder analysis revealed conflicting perceptions and interests among various stakeholders. Government agencies prioritize revenue collection and investment attraction while mining companies and artisanal operators often perceive regulation as a burden to them to adhere to. The local communities emphasize environmental and livelihood security but the NGOs and traditional rulers demand socially and culturally sensitive governance. These divergent views reflect Stakeholder Theory, which emphasizes that differences in power, legitimacy, and urgency influence how actors prioritize issues. These findings suggest that the state's top-down governance model has failed to adequately engage grassroots stakeholders, thereby reducing the legitimacy of policies. This is consistent with the global critiques of "extractive governance" (Nygren et al., 2022). A lack of institutional trust fuels contestation and undermines cooperative approaches. Moreover, elite capture and corruption are hallmarks of the Resource-Curse Thesis that further erode policy effectiveness, leading to informal and sometimes illegal mining practices flourishing in governance vacuums. Importantly, the Oke-Ogun case contributes to scholarship by illustrating that culturally embedded institutions, such as traditional rulers and community-based associations, play a central role in mediating conflicts and should not be excluded from governance arrangements. This highlights the necessity of hybrid governance approaches that integrate formal state regulations with local cultural structures.

Implications for sustainability

This study's findings imply that sustainability in Oke-Ogun's mining sector will remain elusive without deliberate and systemic reforms. Environmental sustainability requires adequate rehabilitation frameworks, stricter monitoring of ASM practices, and investment in alternative livelihoods that reduce dependency on resource extraction. Socio-economic sustainability requires balancing short-term income benefits with the long-term preservation of human and natural capital. While governance sustainability demands stronger enforcement of available regulations, transparent revenue management, and an all-inclusive decision-making mechanism that would bridge the gap between the state, community, and private actors.

By applying the SLF, Stakeholder Theory, and Resource-Curse Thesis in an integrated framework, this study shows that sustainability is not only a technical or environmental challenge but fundamentally a question of governance and social relations. Unless institutions are reformed to manage divergent stakeholder interests, mining will continue to reinforce cycles of degradation, conflict and poverty in Oke-Ogun.

Conclusion

This study investigated the environmental, socioeconomic, and governance dynamics of solid mineral extraction in Nigeria's Oke-Ogun region. The central problem addressed was the paradox of resource exploitation, that is, while mining presents opportunities for economic engagement, it simultaneously generates significant environmental degradation, social conflict, and governance challenges that undermine sustainability in the region. The findings from this study revealed that mining activities have caused widespread environmental damage, including land degradation, water pollution, and air pollution. Socioeconomically, mining provides short-term employment and income but at the cost of health risks, livelihood displacement, and increased insecurity. Governance analysis showed that although Nigeria has a solid mineral regulatory framework, weak enforcement and institutional capture have created a governance gap. Conflicting interests among all stakeholders such as government agencies, the mining companies, artisanal miners, local communities, NGOs, and traditional rulers, further complicate sustainable resource management efforts. By integrating the Sustainable Livelihoods Framework, Stakeholder Theory, and the Resource-Curse Thesis, this study demonstrated that the sustainability of mining in Oke-Ogun cannot be reduced to technical interventions. Instead, sustainability hinges on strengthening governance, addressing stakeholder conflicts, and diversifying livelihoods to reduce the dependency on mining.

In summary, this study confirms that unless deliberate reforms are pursued, solid mineral extraction in Oke-Ogun will continue to exacerbate poverty, insecurity, and ecological decline rather than contribute to sustainable development.

Recommendations

For Government (Federal and State)

- There is the need to strengthen enforcement of regulations by establishing well-resourced monitoring units in Oke - Ogun region so as to ensure compliance with environmental and safety standards.

- There should be decentralized governance that engages traditional rulers and community associations formally in mineral governance structures to enhance legitimacy.
- There must be transparent revenue management to ensure that mineral revenues are transparently reported and reinvested in local development (schools, clinics, and roads).
- Government can float a dedicated environmental restoration fund financed by levies on mining companies and ASM operators.

For Mining Companies and Artisanal/Small-Scale Mining (ASM) Cooperatives

- They should provide training and access to safer, environmentally friendly mining technologies especially for dust suppression and proper tailings management.
- They must establish agreements with host communities that guarantee local hiring, compensation for land loss, and social investment projects.
- Encourage cooperatives to register legally, which would improve access to credit, technology, and government support programs.

For Communities and Civil Society

- They can form local resource monitoring committees to report abuse and ensure that community interests are considered in decision-making.
- They should encourage and promote skill development such as agro-processing, renewable energy, and small-scale manufacturing, to reduce dependence on mining.
- Collaborate with NGOs to provide education on mining-related health risks and environmental protection.

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