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Community-Based Survey on the Effects of Mineral Exploration and Geophysical Mapping in Rural Areas

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Abstract
This study investigates the perceived socio-environmental and health impacts of geophysical surveys conducted in local communities, using a sample of 200 respondents. The research adopted a descriptive survey design, and data were collected through structured questionnaires. Findings revealed significant environmental concerns, with 80% of respondents identifying deforestation and 75% citing soil degradation as major impacts. Water pollution (72%) and loss of farmland (65%) were also commonly reported. Socio-economically, 65% noted reduced farm output, while 52% expressed dissatisfaction due to lack of compensation for land loss. Health-related issues included respiratory problems (51%) and skin irritation (36%). Additionally, 72% of respondents reported not being consulted before the survey began, while 75% felt excluded from all decisions, indicating poor community engagement and transparency. The study highlights the need for inclusive stakeholder participation, adequate compensation, and enforcement of environmental safety measures during geophysical activities. These findings align with previous research that underscores the importance of community-based natural resource management. To ensure sustainable development, it is recommended that government agencies and private companies adopt participatory approaches in decision-making and prioritize environmental and health safeguards. This study provides empirical insights into the lived experiences of affected populations and contributes to the discourse on responsible resource exploration practices in Nigeria and beyond.

Keywords: *Geophysical survey, Environmental impact, Community perception, Health risks, Resource management*

1. Introduction

Mineral exploration and geophysical mapping are critical components in the identification and extraction of valuable natural resources such as gold, oil, and gas. These activities are typically conducted in rural and remote areas due to the natural endowment of such regions with mineral-rich deposits. While these practices are economically significant, they have generated increasing concern about their social, environmental, and health implications on local communities (Adebayo et al., 2020). A community-based survey provides a relevant framework to capture the lived experiences, perceptions, and adaptive responses of rural dwellers to the impacts of such industrial activities.

In developing countries, particularly in Africa, mineral exploration has been linked to both development opportunities and environmental degradation. For instance, in Nigeria's Niger Delta, oil exploration has contributed to community displacement, water pollution, deforestation, and

loss of livelihoods, especially among farmers and fishermen (Ajayi et al., 2019). Geophysical mapping, which involves techniques such as seismic surveys, electromagnetic sensing, and ground-penetrating radar, can also result in land degradation, noise pollution, and disruption of ecological systems (Obi & Okafor, 2021). These impacts often go underreported or are inadequately documented in national environmental assessments due to weak regulatory oversight or lack of community involvement in decision-making.

The absence of inclusive policies to manage the social and ecological consequences of mineral exploration has led to rising tensions between host communities, government agencies, and mining companies (Eze & Nwankwo, 2020). Rural populations, often characterized by low literacy rates and limited access to information, remain the most vulnerable to exploitation and environmental injustice. A community-based survey thus becomes essential in identifying specific concerns such as land use changes, health risks, compensation mechanisms, and perceptions of environmental safety among residents.

Furthermore, the long-term sustainability of mineral exploration efforts depends on the integration of environmental and social safeguards that reflect community priorities. Without community buy-in, mineral development projects risk being undermined by resistance, protests, or outright conflict (Olaleye & Adegbite, 2018). Therefore, this study seeks to explore, through a community-based survey approach, the multi-dimensional effects of mineral exploration and geophysical mapping on the well-being, environment, and socio-economic activities of rural inhabitants. The findings aim to inform policy reforms and encourage participatory frameworks that balance resource extraction with rural sustainability.

Statement of the Problem

Despite the economic benefits associated with mineral exploration and geophysical mapping in rural areas, these activities often result in significant environmental degradation, displacement of communities, loss of livelihoods, and long-term health implications for local residents. Many rural communities lack the capacity, awareness, or institutional support to effectively respond to the adverse impacts of these operations, leading to feelings of marginalization and neglect. Moreover, there is often a disconnect between government policies, corporate practices, and community needs, resulting in inadequate compensation, weak environmental regulation, and limited community participation in decision-making processes. This gap underscores the need for a community-based approach to assess and document the real experiences and concerns of rural populations affected by mineral exploration and geophysical mapping, in order to inform more inclusive and sustainable development practices.

Aim of the Study

The aim of this study is to assess the effects of mineral exploration and geophysical mapping on rural communities using a community-based survey approach.

Objectives of the Study

1. To examine the environmental and health impacts of mineral exploration and geophysical mapping in rural areas.
2. To assess the socio-economic consequences of mineral exploration activities on the livelihoods of rural residents.
3. To evaluate the level of community participation and awareness in decision-making processes related to mineral exploration and mapping projects.

2. Reviews

Mineral Exploration

Mineral exploration refers to the process of locating concentrations of minerals of economic interest within the earth's crust. It involves several stages including preliminary surveys, geophysical mapping, drilling, sampling, and feasibility studies (Kumar & Singh, 2017). In rural areas, mineral exploration often targets untapped natural resources, but it also comes with disruptions to the local environment, such as deforestation, soil erosion, water pollution, and land displacement. These consequences affect not only the physical landscape but also the socio-cultural fabric of the host communities.

Geophysical Mapping

Geophysical mapping is a scientific process used in mineral exploration to detect subsurface anomalies by measuring variations in the earth's physical properties such as magnetism, gravity, or electrical conductivity. Techniques such as seismic surveys, electromagnetic profiling, and ground-penetrating radar are commonly used (Obi & Okafor, 2021). While these techniques are non-invasive in theory, their execution—especially through heavy equipment, noise, and access roads—may cause significant disturbance to the environment and local communities. In rural settings where the population depends heavily on land for farming and cultural practices, such activities can be deeply disruptive.

Community-Based Approach

A community-based approach emphasizes the participation and engagement of local residents in identifying, analyzing, and responding to issues that affect their environment and well-being. In research, this approach allows for the inclusion of community voices, indigenous knowledge, and lived experiences, leading to more accurate and context-specific data (Chambers, 1994). For studies on environmental impacts, a community-based survey ensures that the concerns of marginalized groups are not overlooked and that any proposed mitigation strategies are rooted in local realities.

Environmental and Health Impacts

The environmental and health impacts of mineral exploration can be far-reaching. Common issues include contamination of water sources with heavy metals, exposure to toxic dust or chemicals, respiratory illnesses, and noise pollution (Adebayo et al., 2020). These issues are exacerbated in rural areas where access to healthcare is limited, and the monitoring of industrial activity is weak or absent. Understanding these impacts is crucial for implementing effective environmental management systems and health interventions.

Socio-Economic Effects

Mineral exploration can alter the economic activities of rural communities. While it may offer temporary jobs or infrastructure improvements, it can also lead to the displacement of farming activities, loss of ancestral lands, and widening inequality between beneficiaries and marginalized groups (Eze & Nwankwo, 2020). This duality makes it essential to assess the broader socio-economic implications, especially from the perspective of those directly affected.

Empirical Review

watuk (2005) critically examines the limitations and outcomes of Community-Based Natural Resource Management (CBNRM) programs in Botswana, arguing that their disappointing results are not simply due to local incapacity or lack of will, as often portrayed in mainstream development narratives. Instead, the paper employs a political ecology perspective to analyze how unequal power relations and global governance structures shape the implementation and outcomes of CBNRM initiatives. In Southern Africa, CBNRM is largely centered on wildlife conservation efforts near national parks, targeting impoverished rural communities with the aim of co-managing natural resources to improve livelihoods and environmental sustainability. However, Swatuk argues that these programs often become contested spaces of competing interests, shaped by both local struggles over land access and the influence of international norms such as good governance and biodiversity preservation. Drawing on theoretical insights from Homer-Dixon's notions of resource capture and ecological marginalization, as well as Acharya's concept of localizing global norms, the study finds that CBNRM functions more as a site of negotiation between actors with unequal power and knowledge than as a coherent development strategy. In Botswana, these dynamics have led to outcomes that deviate significantly from the intentions of CBNRM's global advocates, highlighting the tension between local realities and external expectations in natural resource governance.

Fabricius and Koch (2004) explore the evolving nature of community-based natural resource management (CBNRM) in Southern Africa, highlighting the shift from externally driven conservation projects to participatory, community-led initiatives. The authors emphasize that while CBNRM is rooted in ideals of empowerment and sustainability, its implementation often falls short due to limited devolution of authority to local communities and persistent bureaucratic control. Through case studies, they illustrate how genuine community participation is frequently undermined by top-down approaches that prioritize conservation outcomes over local socio-economic development. The paper calls for stronger local institutional capacity, equitable benefit-sharing mechanisms, and policy frameworks that respect indigenous knowledge and governance structures. This study is particularly relevant for understanding the institutional dynamics at play in rural areas affected by mineral exploration and geophysical mapping, where similar tensions between external actors and local communities arise.

Blaikie (2006) critiques the theoretical underpinnings of community-based approaches in natural resource management, arguing that many programs fail due to a simplistic view of "community" as a homogeneous, harmonious entity. Instead, he stresses that communities are complex and often divided by class, gender, age, and power relations. Using examples from Africa and Asia, Blaikie demonstrates how external interventions frequently overlook internal conflicts and inequalities, thereby reinforcing elite capture and marginalizing vulnerable groups. His analysis of power dynamics within communities provides critical insight into the social challenges of implementing CBNRM and highlights the need for careful stakeholder analysis in environmental governance. This is especially pertinent in rural settings undergoing mineral development, where external investments can exacerbate local inequalities and spark contestation over resource use and access.

Agrawal and Gibson (1999) provide a foundational critique of the assumptions behind community-based conservation, proposing that successful CBNRM depends on understanding the multiple actors and institutions within and beyond the community. They argue that effective management must consider how institutions mediate access to resources, how incentives align with conservation goals, and how political context shapes outcomes. The paper urges a move away from idealized conceptions of community toward a more nuanced analysis that incorporates local heterogeneity

and cross-scale interactions. Their work is instrumental in explaining why some rural communities benefit from resource governance while others experience negative outcomes such as exclusion or conflict—dynamics often present in mineral exploration contexts.

Ribot and Peluso (2003) introduce the "theory of access" to explain how different actors gain, maintain, or lose control over natural resources. Unlike traditional property rights theories, their framework distinguishes between legal access and the actual ability to benefit from resources. This perspective is particularly useful for analyzing CBNRM and mineral exploration projects, where formal rights may not reflect real-world outcomes. The authors emphasize that access is determined by a range of mechanisms including technology, capital, labor, markets, knowledge, and authority. Their theory helps unpack the structural inequalities that often limit community empowerment in resource governance, particularly in rural areas facing large-scale geophysical surveys and extractive operations.

3. Methodology

Research Design

This study employed a descriptive community-based survey design to assess the effects of mineral exploration and geophysical mapping in rural areas of Taraba State, Nigeria. This design was appropriate as it facilitated the collection of both quantitative and qualitative data from residents directly impacted by such activities. The community-based approach ensured that the voices of those most affected were central to the analysis.

Study Area

The research was conducted in selected rural communities within Taraba State, located in the northeastern region of Nigeria. The state is known for its mineral resources, including barite, gypsum, limestone, and clay, making it a hotspot for exploration activities. Rural communities such as Gashaka, Bali, and Sardauna Local Government Areas were selected due to the presence of ongoing or recent mineral exploration and geophysical mapping efforts. These areas are primarily agrarian and are characterized by limited infrastructure, dependency on natural resources, and environmental sensitivity.

Population and Sampling Technique

The population of the study included adult residents of rural communities in the selected local government areas of Taraba State. A multi-stage sampling technique was adopted. First, purposive sampling was used to identify local government areas with significant exploration activities. Secondly, stratified sampling was applied to categorize the population by age, gender, and occupation. Finally, simple random sampling was used to select individuals from each stratum. A total of 150 respondents were selected across the chosen communities to ensure broad representation and reliability of responses.

Data Collection Instruments

Data were collected through structured questionnaires, key informant interviews (KIIs), and focus group discussions (FGDs). The questionnaire consisted of both closed and open-ended questions covering themes such as environmental impact, livelihood disruptions, health risks, displacement, and community involvement in resource governance. KIIs were conducted with community leaders, representatives of local government environmental units, and mining company staff.

FGDs were organized with groups of residents to deepen insights and cross-check individual responses.

Validity and Reliability

To ensure the validity of the instruments, the questionnaire and interview guides were reviewed by experts from the Department of Geography and Environmental Management, Taraba State University. A pilot test was conducted in a rural community in Zing LGA, which was not included in the main study. Revisions were made based on feedback received. Cronbach's alpha was calculated for internal consistency of the questionnaire and yielded a reliability score of 0.82, indicating strong reliability.

Method of Data Analysis

Quantitative data obtained from the questionnaires were analyzed using descriptive statistics such as frequencies, percentages, and mean scores, and presented using tables and charts. Qualitative data from KIIs and FGDs were analyzed thematically to identify recurring issues and perspectives. This mixed-method approach enabled a comprehensive analysis of the complex impacts of mineral exploration and geophysical mapping on the socio-economic and environmental realities of rural communities in Taraba State.

4. Results and Data Analysis

Table 4.1: Socio-Demographic Characteristics of Respondents (N = 200)

Variable	Category	Frequency	Percentage (%)
Gender	Male	124	62%
	Female	76	38%
Age	Below 30	44	22%
	31–50	108	54%
	Above 50	48	24%
Occupation	Farming	140	70%
	Trading	30	15%
	Artisan/Unemployed	30	15%
Education Level	No Formal Education	70	35%
	Primary and Above	130	65%

Table 4.1 shows the socio-demographic characteristics of the 200 respondents involved in the community-based survey on the effects of mineral exploration and geophysical mapping in rural areas of Taraba State. The data reveal that 62% of the participants were male, while 38% were

female. In terms of age, the majority (54%) were between 31 and 50 years, 24% were above 50, and 22% were below 30. Farming was the dominant occupation, accounting for 70% of respondents, while trading and artisan/unemployed groups each represented 15%. Educationally, 65% had attained primary education or higher, whereas 35% had no formal education. These results suggest that the study population was largely male, within the working-age group, primarily engaged in farming, and possessed a basic level of education—factors that influence their awareness and response to the impacts of mineral exploration in their communities.

Table 4.2: Environmental Impacts Reported by Respondents

Impact Type	Frequency	Percentage (%)
Deforestation	160	80%
Soil degradation	150	75%
Water pollution	144	72%
Loss of farmland	130	65%

Table 4.2 shows the reported environmental impacts of mineral exploration and geophysical mapping as experienced by respondents in rural communities of Taraba State. The most commonly reported impact was deforestation, noted by 80% (160) of the participants, followed closely by soil degradation at 75% (150 respondents). Water pollution was identified by 72% (144 respondents), while loss of farmland due to exploration activities affected 65% (130 respondents). These findings indicate that the environmental consequences of mineral exploration are widespread and significantly affect the natural resources and livelihoods of the local population, particularly through the destruction of forest cover, soil fertility loss, contaminated water sources, and reduced agricultural land.

Table 4.3: Socio-Economic Effects of Mineral Exploration

Socio-Economic Impact	Frequency	Percentage (%)
Reduced farm output	130	65%
Rise in food/basic commodity prices	44	22%
Temporary employment	26	13%
Lack of compensation for land loss	104	52%

Table 4.3 presents the socio-economic impacts of mineral exploration and geophysical mapping in the rural communities of Taraba State as reported by respondents. A significant 65% (130 respondents) indicated that mineral exploration led to reduced farm output, highlighting a direct threat to agricultural productivity and food security. Additionally, lack of compensation for land loss was reported by 52% (104 respondents), reflecting grievances over land rights and economic displacement. Only 22% (44 respondents) reported a rise in the prices of food and basic commodities, while a smaller portion—13% (26 respondents)—benefited from temporary employment created by the exploration activities. These findings suggest that while exploration brings some short-term job opportunities, the negative socio-economic impacts—especially on farming and land ownership—are more prominent and require urgent policy attention.

Table 4.4: Health Issues Reported by Community Members

Health Concern	Frequency	Percentage (%)
Respiratory problems	102	51%
Skin irritation	72	36%
Hearing issues (noise)	24	12%
No noticeable health impact	32	16%

Table 4.4 illustrates the health concerns reported by residents in communities affected by mineral exploration and geophysical mapping in Taraba State. A majority of respondents, 51% (102), reported experiencing **respiratory problems**, likely due to dust and air pollutants generated during exploration activities. **Skin irritation** was the second most common issue, affecting 36% (72) of the participants, while 12% (24) reported **hearing issues**, possibly from prolonged exposure to heavy machinery and blasting noise. Interestingly, 16% (32) of the respondents indicated that they observed **no noticeable health impact**. These results suggest that mineral exploration has

considerable health implications for rural dwellers, particularly concerning air quality and skin exposure.

Table 4.5: Community Participation in Exploration Activities

Community Involvement Indicator	Frequency	Percentage (%)
Were consulted before exploration	56	28%
Not consulted / unaware until it started	144	72%
Felt informed and involved	50	25%
Felt excluded from all decisions	150	75%

Table 4.5 **shows** the level of community involvement in decision-making related to mineral exploration and geophysical mapping in rural areas of Taraba State. Only 28% (56 respondents) reported that they **were consulted** prior to the commencement of exploration activities, while a significant majority of 72% (144 respondents) indicated they **were not consulted or were unaware** until the operations had already started. Furthermore, just 25% (50 respondents) felt **informed and involved** in the process, whereas 75% (150 respondents) felt **completely excluded from all decisions**. These findings highlight a major gap in participatory engagement, suggesting that most rural communities experience mineral exploration as a top-down process with minimal consultation or inclusion, which could contribute to resistance, mistrust, and socio-environmental conflict.

Discussion of Findings

The findings of this study reveal a multifaceted impact of mineral exploration and geophysical mapping on rural communities in Taraba State, Nigeria. Consistent with previous research, the environmental consequences observed—such as deforestation (80%), soil degradation (75%), water pollution (72%), and loss of farmland (65%)—demonstrate that mineral-related activities pose a significant threat to rural ecosystems and agricultural livelihoods (Adebayo et al., 2020; Ajayi et al., 2019). These environmental degradations not only affect the sustainability of the natural environment but also the socio-economic well-being of the communities that rely heavily on farming and natural resources.

The socio-economic impacts identified in the study include reduced farm output (65%), lack of compensation for land loss (52%), and only minimal short-term benefits such as temporary employment (13%). This aligns with Swatuk (2005), who argued that while community-based natural resource management (CBNRM) initiatives aim to empower rural dwellers, the reality is often marked by marginalization, elite capture, and lack of meaningful benefits for the local population. In the context of Taraba State, the lack of compensatory mechanisms and economic alternatives has further deepened community vulnerability and poverty.

Health-related issues were also notable among the study population. A majority of participants reported respiratory problems (51%) and skin irritations (36%) as likely consequences of dust, chemical exposure, and proximity to exploration sites. This finding supports the views of Nwankwo and Ogundele (2021), who found that communities near mineral exploration zones in

Nigeria often suffer significant health challenges due to lack of protective measures and inadequate monitoring of environmental standards.

Furthermore, the findings on community involvement underscore a major governance gap. About 72% of respondents reported that they were not consulted before exploration activities began, and 75% felt excluded from decision-making processes. This pattern mirrors previous observations by Swatuk (2005) and the United Nations Development Programme (UNDP, 2020), who noted that many extractive projects across Africa proceed with limited community engagement, leading to mistrust, protest, and in some cases, violent conflict. Effective natural resource governance, therefore, requires not only technical assessments but also inclusive planning that involves local stakeholders from the onset.

In sum, the study's findings illustrate that while mineral exploration has potential economic benefits, the current practice in Taraba State tends to marginalize host communities, degrade their environment, and undermine their social and health conditions. Without addressing issues of community participation, environmental sustainability, and equitable economic gains, mineral exploration risks perpetuating rural underdevelopment rather than alleviating it.

Conclusion

This study examined the perceived impacts of geophysical mapping and mineral exploration on rural communities in Taraba State. The findings revealed that such activities have led to significant environmental degradation, including deforestation, soil damage, water pollution, and the loss of farmland. These environmental issues, in turn, have triggered socio-economic challenges such as reduced farm output, lack of compensation for land use, and only limited employment benefits. Furthermore, health concerns like respiratory and skin problems were reported, while the majority of respondents felt excluded from key decision-making processes regarding exploration in their communities. These findings highlight the urgent need for inclusive governance, environmental protection, and equitable benefit-sharing to ensure that mineral development projects do not worsen poverty or marginalization in rural areas.

Recommendations

Government and exploration companies should adopt transparent and inclusive consultation processes before, during, and after mineral exploration activities. This includes obtaining free, prior, and informed consent (FPIC) from host communities.

Regulatory agencies must enforce strict environmental guidelines and monitor compliance to minimize degradation and protect public health. Exploration firms should also be mandated to provide adequate compensation and social services to affected communities.

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