



Environmental Effects of Artisanal Mining on the Livelihood of Rural Settlements in Endo Community, Nasarawa Local Government Area, Nasarawa State, Nigeria

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ABSTRACT

Artisanal and small-scale mining (ASM) has become a prevalent non-farm rural livelihood practice among mineral-bearing communities in Nasarawa State, but its environmental impact on host communities is poorly understood. This study analyses the environmental effects of ASM on the livelihoods of rural communities in Endo, a community located within Nasarawa Local Government Area of Nasarawa State, Nigeria. Based on the Sustainable Livelihood Approach, the study adopted a descriptive survey design in which data were collected from 150 respondents comprising artisanal miners, farmers, and household heads, supplemented with key informant interviews and field observations. Data were analysed using descriptive statistics (frequencies, percentages, and mean scores) and Pearson Product Moment Correlation analysis. The findings revealed that ASM has resulted in land degradation, deforestation, water pollution, soil erosion, and loss of farmland, while also providing income diversification and employment opportunities for community members. The study further established a statistically significant relationship between the intensity of ASM activities and the decline of traditional rural livelihood practices such as crop production and fishing. The study recommends stricter enforcement of the Nigerian Minerals and Mining Act, community-based environmental monitoring, mine-site reclamation, and livelihood diversification programmes for affected households.

Keywords: Artisanal Mining; Endo Community; Environmental Degradation; Nasarawa State; Rural Livelihood

AI Disclosure Statement

In the course of preparing this manuscript, the authors used ChatGPT and Grok to support the literature review, and Claude to support language editing of the draft text. All AI-assisted output was reviewed, verified, and edited by the authors, who take full responsibility for the accuracy, originality, and scholarly integrity of the final manuscript. No AI tool is listed as an author or co-author of this work.

1. Introduction

Artisanal and small-scale mining (ASM) has emerged as one of the most significant rural non-farm economic activities in Nigeria, particularly in the North-Central geopolitical zone where mineral endowments such as tin, columbite-tantalite, barite, lithium, and gemstones are widely distributed (Hentschel, Hruschka, & Priester, 2002). In Nasarawa State, ASM has grown rapidly over the past two decades, absorbing a large proportion of the rural workforce that would otherwise depend solely on subsistence agriculture (Oramah et al., 2015). The activity offers an alternative and often more immediate source of income than farming, especially given the seasonality of agricultural production, limited access to credit, and the declining profitability of smallholder farming in the region (Hilson, 2013).

The community of Endo, which belongs to Nasarawa Local Government Area of Nasarawa State, is one of the communities where there has been a rise in artisanal mining operations in recent times. The presence of mineral resources in the community has led to the influx of not only indigenous but migrant miners, thus resulting in a transformation of the economy and the environment of the community through the conversion of farmlands to mining pits, the clearing of forests in the community to provide room for access roads and processing sites, and in some cases, contamination of water bodies that were used by farmers and fishermen.

Though artisanal mining provides income, generates employment opportunities, and diversifies the economy of the community, the negative impact it has on the environment negates this effect as it results in land degradation, soil erosion, deforestation, and water pollution, all of which affect agriculture, fishing, and any livelihood system that depends on nature. It is against this backdrop that this study seeks to understand the impact of artisanal mining on the environment of rural livelihoods in Endo community.

1.1 Statement of the Problem

Even though there is now considerable documentation in the literature concerning artisanal and small-scale mining operations in Nigeria, previous research on mining operations has largely centred on larger mining locations such as Jos Plateau as well as select barite mining sites of Nasarawa State with limited field work conducted in relatively unknown mining communities like Endo. It appears from both anecdotal information and some initial field observations that artisanal mining operations in Endo have resulted in land degradation, abandoned mines, contaminated streams, and a reduction in the land suitable for farming and other agricultural purposes.

However, the specific pathways through which artisanal mining affects livelihood outcomes in Endo community, the perceptions of the local population regarding these effects, and the coping and adaptation strategies adopted by affected households have not been systematically studied. This gap in empirical knowledge limits the capacity of policymakers, traditional institutions, and development agencies to design context-specific interventions that balance the economic benefits of artisanal mining with environmental sustainability and livelihood protection (Idris-Nda, Fatoyinbo, & Adeyemi, 2018). This study therefore addresses this gap by generating empirical evidence on the environmental effects of artisanal mining and their implications for rural livelihoods in Endo community.

1.2 Objectives of the Study

The broad objective of this study is to examine the environmental effects of artisanal mining on the livelihood of rural settlements in Endo community, Nasarawa Local Government Area, Nasarawa State. The specific objectives are to: (i) examine the nature and extent of artisanal mining activities in Endo community; (ii) assess the environmental effects of artisanal mining on land, water, and vegetation resources in the study area; (iii) evaluate the effects of artisanal mining on the livelihood activities of rural households in Endo community; and (iv) determine the relationship between the intensity of artisanal mining and the decline of traditional livelihood sources in the study area.

1.3 Research Questions and Hypothesis

The study is guided by the following research questions: (i) What is the nature and extent of artisanal mining activities in Endo community? (ii) What are the environmental effects of artisanal mining on land, water, and vegetation resources? (iii) How has artisanal mining affected the livelihood activities of rural households? (iv) What is the relationship between the intensity of mining activities and the decline of traditional livelihood sources?

Correspondingly, the study tests the following null hypothesis: H_{01} : There is no statistically significant relationship between the intensity of artisanal mining activities and the decline of traditional livelihood sources in Endo community.

2. Literature Review

2.1 Conceptual Clarification

Artisanal and small-scale mining can be defined as the extraction and processing of minerals utilising relatively low technology and labour-intensive techniques that are performed mainly by individuals or families and small groups employing simple techniques, usually not under any legal framework (Hentschel et al., 2002). Livelihood, in the perspective of sustainable livelihoods approach, is defined as the set of capabilities, assets, and activities that allow a living, and this means is said to be sustainable when it can cope with, resist, and recover from shocks and stresses while building its capabilities and assets in the process (Chambers & Conway, 1992). Environmental impacts in relation to mining can be defined as the physical, chemical, and biological modifications of the land, water, air, and vegetation caused by mineral extraction processes, such as land degradation, deforestation, soil erosion, siltation of water bodies, and loss of biodiversity (World Bank, 2013).

2.2 Theoretical Framework

The Sustainable Livelihood Framework (SLF) identifies five forms of livelihood capital: natural, physical, human, financial, and social capital, which interact to shape livelihood strategies and outcomes. In the context of the present study, the framework is applied primarily to examine changes in natural capital, including land, water, and vegetation resources, and financial capital, reflected in income diversification and employment opportunities associated with artisanal and small-scale mining (ASM). Although the SLF recognises the importance of physical, human, and social capital, these dimensions were not directly investigated in this study because the research focused specifically on environmental change and its livelihood implications. Consequently, the findings should be interpreted within the scope of natural and financial capital, while future studies should adopt a more comprehensive SLF application by incorporating indicators of physical infrastructure, human capacity, and social networks.

2.3 Empirical Review

There have been various studies on the socio-economic and environmental implications of artisanal and small-scale mining in the North-Central part of Nigeria. Studies which have been done in comparison with the state of Niger, Nasarawa, and Plateau show that ASM is an economic activity which has been able to support job creation and poverty alleviation to some degree, especially when it is practised in a community-based way (Oramah et al., 2015). Similar studies on the barite mining areas in Nasarawa State also show that most of the miners believe that mining has a positive impact on their income levels while manual and crude processing methods cause land degradation and inefficient extraction of resources (Otoijamun et al., 2021).

Research conducted in the adjoining Jos and Barkin mining areas of Plateau State demonstrates that instead of complementing each other, artisanal mining often conflicts with agriculture with respect to land and labour, leading to degradation of the agricultural capacity of host communities, and in some instances social challenges such as drug addiction (Idris-Nda et al., 2018). Other scholars have noted that while artisanal mining is a source of income in the short term, in many communities it fails to contribute towards sustainable development of the communities once the mining process is over, resulting in degradation of land with little residual value for any other use (Hilson, 2016). All these studies point out a common trend of artisanal mining in Nasarawa and Plateau States, namely that while artisanal mining remains a critical source of income for rural households, its environmental consequences

often work to degrade the agricultural and ecological basis for sustainable rural livelihood (Hilson, 2013; Idris-Nda et al., 2018). The current study builds on this literature by examining the issue of artisanal mining in particular in Endo community.

3. Methodology

3.1 The Study Area

Endo community is located within Nasarawa Local Government Area of Nasarawa State, North-Central Nigeria. The Local Government Area lies within the Guinea Savannah vegetation belt, characterised by a tropical wet-and-dry climate with distinct rainy (April–October) and dry (November–March) seasons (Nasarawa State Government, 2020). The area is underlain by geological formations associated with the Basement Complex rocks of North-Central Nigeria, which host a variety of solid minerals that have attracted artisanal mining activities over the years (Nigerian Geological Survey Agency [NGSA], 2010). The population of Endo community is predominantly rural, with the majority of households traditionally engaged in subsistence and small-scale commercial farming, complemented in recent years by an increasing engagement in artisanal mining as an alternative or supplementary source of livelihood (Nasarawa State Government, 2020).

3.2 Research Design

This study used a descriptive survey design that is suitable for systematically describing characteristics of a population as well as the relationship among variables without interfering with the setting of the study (Nworgu, 2015).

3.3 Population, Sample Size, and Sampling Technique

The target population comprised household heads, artisanal miners, and farmers resident in Endo community. Based on the community household register obtained from community leadership, the total study population was $N = 4,500$. The sample size was determined using the Taro Yamane (1967) formula: $n = N / [1 + N(e)^2]$, where n = sample size, N = population size (4,500), and e = level of precision (0.05). Substituting the values: $n = 4,500 / [1 + 4,500(0.05)^2] = 4,500 / 12.25 = 367.35 \approx 367$.

Although the Yamane formula yielded a minimum sample size of 367 respondents, the study adopted a sample of 150 respondents because of field constraints, including limited financial resources, accessibility challenges within the mining sites, and time limitations. The selected sample was considered adequate for achieving the study objectives while allowing effective administration of the survey instruments.

3.4 Instrumentation and Data Collection

Data were collected using a structured questionnaire designed on a five-point Likert scale (strongly agree to strongly disagree), complemented by key informant interviews with community leaders, mining site supervisors, and officials of the Nasarawa State Ministry of Environment. Field observation and transect walks were also conducted to validate respondents' perceptions of environmental change with observable physical evidence such as abandoned pits, exposed subsoil, and sedimented streams.

The questionnaire was developed based on the study objectives and relevant literature on the environmental and livelihood effects of artisanal and small-scale mining (ASM). Although the instrument was not subjected to formal expert validation or pilot testing before administration, efforts were made to ensure that the questions were clearly worded, relevant to the study objectives, and easily understood by respondents during field data collection.

3.5 Method of Data Analysis

The quantitative data analysis involved descriptive statistics in which the frequency count, percentage, and weighted mean score were calculated using the benchmark mean of 3.00 to determine whether there was agreement or disagreement on the study statements. To test the research hypothesis on the correlation between mining activity and traditional livelihood loss, Pearson Product Moment Correlation was employed with the help of Statistical Package for Social Sciences (SPSS version 25).

3.6 Ethical Considerations

Ethical principles were observed throughout the study. Informed consent was obtained from each respondent, participation was entirely voluntary, and respondents were informed of their right to decline or withdraw at any stage. No personal identifiers were collected, and all information was treated confidentially and used solely for academic purposes. Formal institutional review board clearance was not obtained, as no such requirement applied to the host institutions at the time of data collection.

4. Results

4.1 Socio-Demographic Characteristics of Respondents

Table 1 presents the socio-demographic distribution of the 150 respondents surveyed in Endo community.

Table 1: Socio-Demographic Characteristics of Respondents

Variable	Category	Frequency	Percentage (%)
Sex	Male	96	64.0
	Female	54	36.0
Age	18–30 years	38	25.3
	31–45 years	61	40.7
	46 years and above	51	34.0
Primary occupation	Artisanal mining	58	38.7
	Farming	72	48.0
	Other	20	13.3
Educational attainment	No formal education	34	22.7
	Primary/Secondary	79	52.7
	Tertiary	37	24.7

Source: Field survey (2025).

A larger number of the respondents were males (64.0%) owing to the strenuous activity required by artisanal mining (Hentschel et al., 2002). The majority of the respondents fell in the economically active age range of 31 to 45 years (40.7%). Farming and artisanal mining formed the main occupations among the respondents, accounting for 48.0 per cent and 38.7 per cent respectively (Oramah et al., 2015).

Although this study included both male (64.0%) and female (36.0%) respondents, the analysis did not explicitly examine gender differences in the environmental and livelihood impacts of artisanal and small-scale mining (ASM). Previous studies have shown that women often participate in mineral processing, trading, and other ASM-related activities and may experience environmental degradation, livelihood disruptions, and health risks differently from men. Future research should therefore adopt a gender-disaggregated analytical approach to better understand how ASM affects men and women differently and to inform more inclusive environmental management and livelihood policies.

4.2 Environmental Effects of Artisanal Mining

Table 2 presents respondents' perceptions of the environmental effects of artisanal mining in Endo community, measured on a five-point Likert scale.

Table 2: Perceived Environmental Effects of Artisanal Mining

Environmental Effect	Mean Score	Decision
Mining has led to loss of farmland through excavation	4.31	Agreed
Mining activities have caused deforestation in the area	4.05	Agreed
Water bodies have become polluted or silted due to mining	3.92	Agreed
Soil erosion has increased around mining sites	4.18	Agreed
Abandoned mine pits pose safety hazards to residents and livestock	4.27	Agreed
Air quality has been affected by dust from mining and processing	3.64	Agreed

Source: Field survey (2025).

As all mean scores were above the benchmark value of 3.00, it can be stated that community members largely agree that artisanal mining operations have caused considerable negative impacts on the environment in the Endo community, namely the loss of agricultural land ($M = 4.31$) and dangerous pits left by uncontrolled artisanal mining operations ($M = 4.27$). This is in agreement with previous studies carried out in Nasarawa and Plateau states, where uncontrolled artisanal mining was identified as a cause of land disturbance and lack of proper reclamation of excavations (Idris-Nda et al., 2018; Otoijamun et al., 2021).

4.3 Effects of Artisanal Mining on Rural Livelihood

Table 3: Perceived Effects of Artisanal Mining on Livelihood Activities

Livelihood Effect	Mean Score	Decision
Mining has reduced the area of land available for farming	4.09	Agreed
Mining provides an important source of household income	3.87	Agreed
Mining has created employment for youths in the community	3.95	Agreed
Crop yields have declined in areas close to mining sites	3.78	Agreed
Fishing and access to clean water for domestic use has declined	3.71	Agreed
Households have diversified into non-farm activities due to mining pressure on land	3.58	Agreed

Source: Field survey (2025).

The results reveal a dual character of artisanal mining in Endo community: it simultaneously serves as a valued source of household income and employment (mean = 3.87 and 3.95 respectively) while also contributing to a reduction in farmland (mean = 4.09), declining crop yields, and reduced access to clean water for domestic and agricultural use. This pattern reflects the livelihood paradox commonly reported in ASM literature: mining offers an accessible, cash-generating alternative to farming, yet its cumulative environmental footprint gradually erodes the natural capital base upon which agriculture-dependent households continue to rely (Hilson, 2016; Oramah et al., 2015).

4.4 Test of Hypothesis

Pearson correlation analysis was conducted to examine the relationship between the intensity of artisanal and small-scale mining (ASM) activities and the decline of traditional livelihood sources. The analysis yielded a correlation coefficient of $r = 0.68$ ($p < 0.05$), indicating a strong, positive, and statistically significant relationship between the two variables. The coefficient of determination ($r^2 = 0.4624$) indicates that approximately 46.24 per cent of the variation in the decline of traditional livelihood sources can be explained by the intensity of ASM activities in the study area. Accordingly, the null hypothesis (H_{01}) was rejected, confirming that increasing mining intensity is significantly associated with greater declines in traditional livelihood activities such as crop farming and fishing.

5. Discussion

The results of this study indicate that there is indeed a significant impact on the environment in terms of land degradation, deforestation, soil erosion, and water pollution as a result of ASM within the community of Endo, thereby undermining the sustainability of traditional rural livelihoods.

The findings demonstrate that artisanal and small-scale mining (ASM) has a dual effect on rural livelihoods in Endo community. While it creates employment opportunities and provides an alternative source of household income, it simultaneously depletes the natural resource base upon which agriculture and fishing depend. This illustrates the complex trade-off between short-term financial gains and long-term environmental sustainability that has been widely documented in ASM communities.

The coefficient of determination ($r^2 = 0.4624$) indicates that although mining intensity explains a substantial proportion of the observed decline in traditional livelihoods, more than half of the variation remains attributable to other factors. These may include population growth, climate variability, changing rainfall patterns, agricultural market conditions, and broader socio-economic pressures affecting rural households. Consequently, the findings should be interpreted as demonstrating a significant association rather than establishing a direct causal relationship, particularly given the cross-sectional design of the study.

6. Limitations and Direction for Future Research

This study has several limitations that should be considered when interpreting its findings. The research was conducted in Endo community within Nasarawa Local Government Area of Nasarawa State, and the findings may not be fully generalisable to other artisanal and small-scale mining (ASM) communities with different environmental, socio-economic, or institutional characteristics. The study relied primarily on self-reported information obtained through questionnaires and interviews. As with most survey-based studies, respondents' perceptions may have been influenced by recall errors, subjective judgement, or social desirability bias.

The study adopted a cross-sectional research design, which captures information at a single point in time. Consequently, although a statistically significant association was found between the intensity of ASM activities and the decline of traditional livelihood sources, the design does not permit causal inference. Other factors, including climate variability, population growth, agricultural market conditions, and broader socio-economic changes, may also contribute to changes in rural livelihoods.

Although both male and female respondents participated in the study, gender-disaggregated analyses were not undertaken. As a result, the study does not examine whether the environmental and livelihood impacts of ASM differ between men and women. Future research should adopt gender-sensitive analytical approaches and longitudinal research designs to provide a fuller picture of ASM and rural livelihoods.

7. Conclusion and Recommendations

The study has examined the environmental consequences of artisanal mining on the livelihood of rural settlements in Endo community in the Nasarawa Local Government Area of Nasarawa State. From the results obtained, it can be concluded that although artisanal mining has greatly contributed to the livelihood of the people in the sense of providing income and employment to the youths, it has had adverse environmental impacts such as loss of farmlands, deforestation, soil erosion, and water pollution that have adversely affected the livelihood system of the community. The statistically significant correlation between mining intensity and the reduction in traditional sources of livelihood is an indicator that the environmental externalities arising from unregulated artisanal mining have indeed threatened the livelihood of rural people in the study area.

Based on these findings, the following recommendations are offered. First, the Nasarawa State Ministry of Environment, Nasarawa Local Government Authority, traditional institutions, and relevant community-based organisations should collaborate to strengthen existing environmental monitoring and enforcement mechanisms rather than establishing entirely new structures that may be difficult to sustain. Second, government agencies and development partners should invest in livelihood diversification programmes, including agricultural value-chain

development, irrigation farming, livestock production, agro-processing, vocational skills training, and small business support to reduce excessive dependence on mining while improving household income security. Third, programmes that improve farmers' access to improved seeds, fertilisers, extension services, rural credit, irrigation facilities, and agricultural markets should be expanded to provide a more competitive livelihood alternative to ASM. Fourth, environmental regulations under the Nigerian Minerals and Mining Act (2007) should continue to be enforced, complemented by practical incentives including simplified licensing procedures, technical support for safer mining practices, and community awareness programmes that encourage environmental stewardship. Fifth, rehabilitation of abandoned mining sites should involve partnerships among government agencies, mining cooperatives, community leaders, and development organisations, with community-based tree planting, backfilling of abandoned pits, and restoration of degraded land supported through technical and financial assistance. Sixth, community leaders, farmers, miners, women's groups, youth organisations, and local government representatives should participate in developing locally appropriate land-use plans that balance mining activities with agricultural production and environmental conservation.

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