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Socio-Economic Effects of Quarry and Heavy Metal Mining in Abia State, Nigeria

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ABSTRACT

This study investigates the socio-economic impacts of quarry and heavy metal mining in Abia State, Nigeria, within the broader context of extractive sector expansion across sub-Saharan Africa. While mining contributes to raw material supply and local employment, it also introduces complex socio-cultural transformations in host communities. Employing a convergent mixed-methods design, the study integrates quantitative survey data from 100 community members with qualitative interviews involving 12 officials from mining firms. Seven thematic domains guided the analysis: marriage and family life, youth deviance, community conflict, income and employment patterns, infrastructure development, agricultural impacts, and mitigation strategies. Quantitative data were analyzed using descriptive statistics and Analysis of Variance (ANOVA), while qualitative data were examined thematically. Findings reveal that although quarry operations provide employment and spur infrastructure growth, they simultaneously drive early marriage, family instability, youth substance abuse, land disputes, and declining agricultural productivity. CSR interventions, while present, were found to be fragmented and insufficiently participatory. Grounded in Stakeholder Theory and Contingency Theory, the study concludes that mining-induced development in Abia State is context-dependent and unevenly distributed. It calls for inclusive CSR frameworks, youth engagement, and stronger institutional oversight. The findings contribute to extractive-sector literature by emphasizing socio-economic dimensions often overlooked in environmental assessments and offer policy guidance for sustainable community-centered mining governance.

Keywords: *Abia state, heavy metal, mining, socio-economic, quarry*

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INTRODUCTION

Globally, mining and quarrying have long played a pivotal role in industrial development, economic growth, and infrastructure expansion. According to the World Bank (2019), extractive industries account for over 10% of GDP in more than 50 countries, many of which are in the Global South. These industries are not only critical sources of raw materials such as limestone, granite, and metallic ores but also contribute significantly to employment, foreign direct investment, and public revenues. However, this economic relevance is increasingly accompanied by critical scrutiny

of their social and environmental implications. The International Council on Mining and Metals (ICMM, 2020) emphasizes that while extractive activities can foster development, they often do so at the cost of community cohesion, ecological balance, and equitable resource distribution.

In sub-Saharan Africa, mining and quarrying form the backbone of many national economies. Countries like Ghana, Zambia, South Africa, and Nigeria have intensified mineral exploration to diversify their economic base amid fluctuating oil prices and global demand for construction materials and metals (Hilson & Osei-Kufuor, 2022). Yet, this economic drive has had complex consequences for host communities. The continent continues to experience widespread concerns over environmental degradation, displacement, youth restiveness, and changes in social structure, a phenomena often underrepresented in conventional economic appraisals (Aubynn, 2017; Ovadia, 2020).

In Nigeria, the Federal Government has identified solid minerals as a key driver in its post-oil economic diversification strategy. The Nigerian Mining and Minerals Act (Federal Republic of Nigeria, 2007) and subsequent policy reforms have promoted private sector participation and foreign investment in quarrying and metal extraction. Recent studies reveal that mining now contributes to employment and rural development, especially in states like Ebonyi, Kwara, and Ogun (Oladimeji et al., 2018). However, empirical evidence also indicates that the sector remains poorly regulated in terms of its socio-economic footprint. Communities hosting quarry operations often face disrupted livelihoods, family instability, loss of farmland, and rising youth delinquency (Melodi & Ogunyemi, 2019; Chukwu, 2018).

Abia State, located in southeastern Nigeria, has witnessed increased quarry and heavy metal mining activities over the past decade. This trend stems from the region's rich deposits of industrial rocks and its strategic importance in supplying raw materials to construction companies across Nigeria. While these developments have generated employment opportunities and led to selective infrastructure projects, they have simultaneously engendered new forms of socio-economic dislocation. Fieldwork for this study, supported by both survey data and in-depth interviews, indicates that local communities are undergoing profound transformations in marriage patterns, youth behavior, land use, and conflict dynamics. Quarrying in Abia State has not only affected the natural landscape but has also begun to reshape the very social fabric of affected communities. For instance, respondents in this study reported rising cases of early marriage, transactional relationships, youth substance abuse, and a noticeable shift away from traditional agricultural livelihoods. These social changes are compounded by weak institutional oversight, fragmented Corporate Social Responsibility (CSR) programs, and inadequate community consultation, which are conditions that echo broader patterns in African extractive contexts (Sheriff, Gogra & Koroma, 2018; Essaghah et al., 2013). This study therefore sought to fill a critical gap in existing literature by focusing specifically on the socio-economic effects, rather than just environmental impacts of quarry and heavy metal mining in Abia State.

Across Nigeria and much of sub-Saharan Africa, quarrying and heavy metal mining have become prominent extractive activities, especially in areas rich in natural resources and geological deposits. These industries play a central role in providing raw materials for infrastructure, urbanization, and economic diversification. However, the expansion of these operations is often accompanied by significant socio-economic challenges for host communities. In many cases, the emphasis of scholarly and policy attention has focused almost exclusively on environmental effects such as land degradation, deforestation, and water contamination, while the **social** and economic dimensions of impact remain understudied and poorly integrated into planning frameworks (Melodi & Ogunyemi, 2019; Sheriff, Gogra & Koroma, 2018).

Quarrying and mining, by their very nature, transform the landscape, not only physically, but also socially. The introduction of capital-intensive enterprises into relatively traditional and agrarian communities tends to generate ripple effects in areas such as family life, social norms, youth behavior, conflict dynamics, and local livelihoods. For example, anecdotal and observational evidence from mining regions in southeastern Nigeria suggests that early marriage, family instability, youth idleness, and deviant behavior may be increasing in response to shifting economic incentives and cultural exposure. Similarly, land conversion for quarrying often disrupts agricultural activities, contributing to food insecurity and displacement of traditional labor roles.

Moreover, conflicts over land ownership, employment exclusion, and benefit-sharing arrangements have emerged in various communities where quarrying activities are ongoing. These social tensions are often aggravated by the absence of inclusive governance, limited community consultation, and the inadequacy or unsustainability of Corporate Social Responsibility (CSR) interventions. Yet, current legal and institutional frameworks do not sufficiently mandate comprehensive socio-economic impact assessments (SEIAs) as part of the licensing and operational processes for mining firms. In the case of Abia State, a region experiencing growing quarry and mining operations, there is a clear gap in empirical research that investigates these socio-economic transformations from the perspective of **local** communities**.** Without such insight, it becomes difficult to formulate policies, interventions, or engagement strategies that promote inclusive development. This study is thus designed to explore, describe, and assess the **socio-**economic effects of quarry and heavy metal mining on host communities in Abia State.

Objectives of the Study

The overarching aim of this study is to investigate the

socio-economic effects of quarry and heavy metal mining activities on host communities in Abia State, Nigeria**.** In doing so, the study seeks to explore how these extractive operations reshape local livelihoods, social behavior, and community dynamics, while assessing the extent to which mitigation efforts address emerging challenges.

Specific Objectives

1. To assess the influence of quarrying and mining activities on marriage patterns and family stability.
2. To examine the effects of extractive operations on youth behavior and social deviance.
3. To investigate the emergence and patterns of intra- and inter-community conflict.
4. To evaluate the impact of quarry and mining activities on income levels and livelihood diversification.
5. To explore the role of mining companies in the provision or development of local infrastructure.
6. To assess how quarrying affects agricultural practices and food security.
7. To identify and critically analyze the mitigation strategies adopted by companies, communities, and government institutions.

LITERATURE REVIEW

Global Overview of Extractive Industries and Socio-Economic Change

Mining and quarrying have long been central to the economic development of resource-rich nations, contributing significantly to gross domestic product, foreign exchange earnings, and employment opportunities. Globally, the extractive sector accounts for more than 10% of GDP in at least 30 low- and middle-income countries (World Bank, 2020). Historically, these industries have been studied primarily through the lenses of macroeconomic growth **and** environmental degradation**.** However, there is an increasing scholarly and policy-oriented shift toward understanding **their** localized, socio-economic consequences**,** particularly in host communities where the costs and benefits of extraction are unevenly distributed.

The International Council on Mining and Metals (ICMM, 2020) has emphasized that modern mining must transcend profit-making to embrace inclusive development, participatory governance, and social impact mitigation. Yet, empirical studies across multiple regions such as Latin America (Peru, Colombia), Southeast Asia (Indonesia, Philippines), and sub-Saharan Africa (Ghana, Sierra Leone, South Africa), demonstrate that the economic promise of mining often comes at the expense of social stability and cohesion**.** In many cases, extractive activities stimulate infrastructure development, short-term employment, and regional GDP growth, but also intensify income inequality, cultural erosion , land disputes**,** and social fragmentation (Bebbington et al., 2018; Ovadia, 2020). These tensions are particularly evident in rural and agrarian communities**,** where the sudden influx of capital, labor, and outsiders disrupts long-established social structures and economic rhythms. Population surges linked to mining booms often strain local infrastructure, introduce urban-oriented lifestyles, and marginalize traditional authority systems. Studies by Hilson (2017) and Lahiri-Dutt (2021) show **t**hat extractive modernization tends to reconfigure household roles, shift youth aspirations away from agriculture, and increase exposure to urban social behaviors**,** including commercial sex work, gambling, and substance abuse.

Moreover, the introduction of market-oriented labor and gender relations often leads **to** household tension**,** intergenerational conflict**,** and fragmentation of indigenous livelihoods**.** In many mining regions, the lack of formal grievance mechanisms or benefit-sharing agreements further alienates local residents, giving rise to social resistance, protest movements, and distrust toward both companies and the state (Campbell, 2012; Tschakert, 2016).

Therefore, while mining and quarrying continue to be essential to national development strategies, especially in resource-dependent economies, the **need to embed** socio-economic equity and cultural sensitivity into extractive governance frameworks has never been more urgent. Global best practices now advocate for integrated impact assessments that include environmental, economic, and social dimensions, particularly those that capture family life, youth behavior, land use, and community identity, often the domains most deeply affected but least institutionally protected.

Mining, Livelihoods, and Rural Transformation

A consistent theme in African mining literature is the transformation of local economies**.** Extractive industries, particularly in West and Southern Africa, have been shown to shift labor away from subsistence farming and traditional crafts toward wage employment and service roles surrounding mining operations (Hilson & Osei-Kufuor, 2022). While this transition may increase cash income, it often creates economic dependency**,** income inequality**,** and the erosion of food security due to reduced farming activity and land displacement (Aubynn, 2017).

In Nigeria, quarrying has been linked to both improved earnings among local traders and artisans and livelihood **loss** for farmers due to land conversion and dust pollution (Melodi & Ogunyemi, 2019). Felix and Yomi (2013) emphasized that quarrying in southern Nigeria supports local economies through employment and business growth but warned that these gains are often limited to those with access to company-linked contracts or proximity to extraction zones.

Studies by Oladimeji et al. (2018) also report that while extractive activities create employment, these jobs are frequently casual, low-paying, and lack social protections,

exposing workers to **economic precarity** despite increased cash flow. Furthermore, agricultural decline, whether through labor diversion or environmental contamination, remains a persistent issue in many host communities (Chukwu, 2018).

Family, Youth, and the Social Effects of Extraction

Beyond economics, extractive industries also drive **social** and cultural transformation**,** particularly in the realms of family life and youth behavior**.** Musokotwane (2016) observed that in rural Zambian mining towns, economic influx often leads **to** early marriage, rising polygamy, and family instability**,** particularly among households where income is uneven or migration separates family members. Similar findings are echoed by researchers in Sierra Leone and Ghana, who link quarrying to changes in marital customs and intra-household dynamics, often fueled by materialism and exposure to urban norms (Sheriff et al., 2018; Hilson, 2017).

Of growing concern is the influence of quarry economies on youth deviance and social disorientation**.** Studies have documented increases in substance abuse, gambling, and sexual exploitation in areas with significant mining activities (Melodi, 2017; Orogun, 2014). The availability of disposable income among young people, coupled with weak social control, often results in cultural disruption and identity crisis**,** especially in communities where traditional authority is eroded by new power structures associated with mining companies.

The gendered dimensions of these behaviors are also noteworthy. Immoral behaviors and social vices are more frequently reported among males, whereas females are often exposed to early marriage or transactional relationships tied to perceived economic security (Oladimeji et al., 2018).

Conflict, Displacement, and Community Disruption

Mining operations have long been associated with conflict and contestation**,** especially where land ownership is ambiguous or benefit distribution is perceived as unfair. In Nigeria, conflicts between communities and companies over employment opportunities, compensation, and environmental damage have become increasingly common (Essaghah et al., 2013). Research in Ebonyi and Plateau states shows that inter-generational and inter-community conflicts often arise from exclusionary employment practices, unfulfilled corporate promises, and unequal compensation for land use (Chukwu, 2018).

Conflict may also occur within communities**,** particularly between youth and elders or among family units over royalty payments and employment slots. These findings reflect broader theories of resource-induced grievance where the inflow of extractive revenues, if not managed transparently undermines social cohesion (Ovadia, 2020).

Infrastructure Development and CSR Limitations

While mining companies are often lauded for constructing clinics, roads, schools, and boreholes as part of their Corporate Social Responsibility (CSR), these efforts frequently suffer from inadequate coverage, poor maintenance, or lack of local participation**.** Ite et al. (2011) warned that CSR in Nigeria's extractive sector often functions as a public relations tool rather than a structured development strategy. Ben-Caleb (2015) similarly noted that infrastructure built by extractive firms rarely aligns with community development plans, and in many cases, expectations exceed delivery. Recent studies stress the importance of inclusive, participatory CSR planning that engages community representatives not only in consultation but also in monitoring and evaluation. However, this remains the exception rather than the norm. In Abia State and other parts of southeastern Nigeria, anecdotal reports suggest that while mining companies provide infrastructure, questions of sustainability, equity, and ownership remain unresolved (Melodi & Ogunyemi, 2019).

THEORETICAL FRAMEWORK

This study is underpinned by two interrelated theoretical perspectives, the Stakeholder Theory and Contingency Theory, which offer explanatory lenses for interpreting the complex socio-economic impacts of quarry and heavy metal mining activities on host communities. These theories provide both normative and analytical foundations for assessing the role of mining firms, community responses, and the variability of development outcomes across different local contexts.

Stakeholder Theory

Stakeholder Theory, originally formulated by Freeman (1984), argues that the success and legitimacy of an organization are intrinsically tied to its ability to recognize, engage, and balance the interests of all its stakeholders, not merely shareholders. Stakeholders, in this context, include individuals, groups, or institutions that are affected by or can affect the operations of a business enterprise (Freeman, 1984; Mitchell, Agle, & Wood, 1997). The theory emphasizes ethical decision-making, participatory governance, and equitable distribution of value, arguing that businesses must go beyond profit maximization to incorporate social responsibility and stakeholder inclusion into their operational models.

In the context of mining and quarrying in Abia State, Stakeholder Theory serves to explain the dynamics between mining companies and local communities, particularly with respect to issues of benefit-sharing, employment, land compensation, and Corporate Social Responsibility (CSR). When host communities are excluded from decision-making or experience only limited and non-consultative CSR interventions, socio-economic

tensions, distrust, and resistance are likely to emerge. Prior research by Ite et al. (2011) and Campbell (2012) affirms that stakeholder neglect in extractive industries often leads to social dislocation, grievance escalation, and weakened legitimacy of corporate actions. This study, therefore, employs Stakeholder Theory to underscore the necessity of inclusive, transparent, and accountable stakeholder engagement as a mechanism for mitigating the adverse socio-economic consequences of resource extraction.

Contingency Theory

Contingency Theory, as developed by Fiedler (1964) and expanded in subsequent organizational studies, posits that there is no universally optimal way to organize or manage an institution. Instead, the effectiveness of any strategy or intervention is contingent upon the specific internal and external factors surrounding the organization, including environmental variability, institutional capacity, and socio-cultural dynamics (Fiedler, 1967; Donaldson, 2001). This theory promotes the idea of contextual fit that successful outcomes depend on the alignment between organizational strategies and the situational conditions in which they are applied. Applied to this study, Contingency Theory offers a framework for understanding why similar quarry and mining operations may yield divergent outcomes across different communities in Abia State. Factors such as youth unemployment, traditional governance systems, gender norms, and institutional oversight shape how communities experience and respond to extractive activities. For instance, weak regulatory enforcement, fragmented community leadership, or poor communication channels can amplify negative social effects such as early marriage, youth delinquency, and land conflicts (Melodi & Ogunyemi, 2019; Sheriff, Gogra, & Koroma, 2018). Conversely, communities with stronger institutional arrangements or more active civil society participation may experience more balanced or mitigated outcomes. Thus, Contingency Theory enables this study to highlight the critical role of local context in shaping the socio-economic trajectories of mining-induced transformations. Together, these theories provide a comprehensive analytical lens. While Stakeholder

Theory foregrounds the ethical and participatory imperatives in corporate-community relations, Contingency Theory accounts for the variability in impact based on local conditions and governance arrangements. By integrating both perspectives, this study is able to critically assess not just the outcomes of quarry and mining activities, but also the processes and contextual factors that mediate those outcomes. This dual-theoretical orientation enhances the study's explanatory power and supports the formulation of nuanced, context-sensitive policy recommendations.

METHODOLOGY

This study adopted a convergent mixed-methods design**,** integrating quantitative and qualitative approaches to investigate the socio-economic effects of quarry and heavy metal mining in Abia State, Nigeria. This design enabled triangulation between statistical trends and community narratives for a more context-rich understanding. The quantitative component utilized a cross-sectional survey of local residents, while the qualitative component consisted of in-depth interviews with key personnel from mining firms. The research was conducted in selected communities across Abia State where quarrying and mining activities are most intense. These locations were purposively chosen based on observed socio-economic transformations and accessibility. Abia's industrial mineral wealth and its expanding role in construction supply chains made it a suitable case for study.

Two key populations were targeted: adult residents living near quarry operations and company officials with roles in community engagement, CSR, and operations. Community respondents (n = 100) were selected using purposive and availability sampling, based on their residency of at least five years. This ensured adequate exposure to mining-related changes. Additionally, 12 key informants were purposively selected from five major mining firms for the qualitative strand. A structured questionnaire with Likert-type items aligned to study objectives and a semi-structured in-depth interview (IDI) guide were employed as the two data collection instruments. Instruments were pre-tested in a demographically similar non-sample community, and revisions ensured clarity and contextual fit.

Quantitative data were analyzed using SPSS (Version 27.0), employing descriptive statistics and Analysis of Variance (ANOVA) to explore perceptual differences across demographics. Qualitative data were analyzed thematically using Braun and Clarke (2006) experiential approach, allowing codes and categories to emerge from the data and align with quantitative findings. Ethical approval was obtained from an institutional review board. All participants provided informed consent, with assurances of confidentiality and voluntary participation. Sensitive disclosures were handled with discretion, and data were securely stored in password-protected systems.

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents (n = 100)

Majority (55%) fall within the 18–37 years range, indicative of a young, economically active population. Only 20% are above 52, suggesting a smaller presence of older dependents. Slight male dominance (53% vs 47%) aligns with likely gender roles in quarry labor, men being more involved in direct site work (Table 1).

Table 1: Demographic Characteristics of Respondents (n = 100).

Variable	Category	Frequency	Percentage
Age	18 – 22	16	16.0%
	23 – 27	12	12.0%
	28 – 32	8	8.0%
	33 – 37	19	19.0%
	38 – 42	6	6.0%
	43 – 47	4	4.0%
	48 – 52	10	10.0%
	53 – 57	9	9.0%
	58 – 62	6	6.0%
	63 and above	10	10.0%
Sex	Male	53	53.0%
	Female	47	47.0%
Occupation	Civil Service	24	24.0%
	Trading	24	24.0%
	Artisanship	9	9.0%
	Schooling	28	28.0%
	Unemployed	6	6.0%
	Farming	10	10.0%
Education Level	No Schooling	7	7.0%
	Primary	18	18.0%
	Secondary	57	57.0%
	Tertiary	19	19.0%
Marital Status	Single	52	52.0%
	Married	25	25.0%
	Separated	6	6.0%
	Divorced	6	6.0%
	Cohabiting	2	2.0%
	Widowed	9	9.0%
Religion	Christianity	80	80.0%
	Islam	5	5.0%
	African Traditional Religion (ATR)	15	15.0%

Source: Field Survey, 2025

The leading occupational groups are: Schooling (28%), Trading (24%), Civil service (24%). Farming and artisanship are marginal (10% and 9%), suggesting economic diversification and possible displacement of traditional occupations by quarry activities. The community is well-educated**,** with 57% attaining secondary education and 19% tertiary. Only 7% reported no schooling. This literacy level enhances the population's awareness of socio-economic and environmental impacts**.** A majority (52%) are single**,** with only 25% married. 14% are divorced/separated, and 2% cohabiting, signs of emerging non-traditional marital patterns that may be linked to quarry-induced social change. Christianity is dominant (80%)**,** but a notable 15% adhere to traditional religion**.** The presence of ATR may indicate enduring local customs **and** traditional governance structures **in** decision-making.

Effects of Quarry on Marriage and Family Life

The data reveals that quarry and heavy metal mining activities are perceived to have a moderate to strong impact on certain aspects of marriage and family life, particularly: Early marriage (especially for girls), Polygamy, and Delayed marriage (notably for males).

However, other aspects such as divorce, broken homes, and family separation scored relatively low, indicating that while new family patterns are emerging, they have not yet culminated in widespread family disintegration. The perception of stable family life also scored high (Mean = 2.93), suggesting that not all changes are negative, some families may even be stabilizing or benefiting economically. Therefore, it could be said that the objective is met, as the analysis provides quantitative evidence that quarry and mining activities influence key aspects of marriage and family life in the host communities, particularly through: Encouraging early and cross-boundary marriages; Promoting polygamous unions; and Delaying traditional marriage patterns. While there is no strong evidence of widespread family collapse, subtle structural shifts are evident (Table 2).

Effects of Quarry on Deviance in the Study Area

Immorality among males (Mean = 2.94) was the most affirmed deviance indicator, followed by immorality among females (2.73) and alcohol abuse (2.72), suggesting a visible social shift in gendered moral behavior and substance use. Drug abuse (2.65) is also widely perceived, likely linked to increased cash flow or idleness. Indecent dressing (2.58) was moderately acknowledged, reflecting changing youth culture (Table 3). Increased stealing (2.34) and diabolism (2.32) were least affirmed, possibly due to normalization or lower visibility. Variability in responses was highest for drug (SD = 1.12) and alcohol

Table 2: Effects of quarry

Item	SA (%)	A (%)	D (%)	SD (%)	Mean	Std Dev
Polygamy has increased	48	15	13	24	2.87	1.25
Early marriage for girls	45	23	19	13	3.00	1.08
Early marriage for boys	29	29	20	22	2.65	1.12
Marriages between locals and strangers	25	36	24	15	2.71	1.00
Increase in failed marriages	24	23	24	29	2.42	1.14
Separation between couples	20	27	29	24	2.43	1.06
Increase in late marriages (males)	37	26	27	10	2.90	1.01
Increase in late marriages (females)	25	27	28	20	2.57	1.07
Increased bride price	32	15	18	37	2.46	1.28
Increase in divorce	8	40	30	22	2.34	0.91
Rise in broken homes	18	17	37	28	2.25	1.05
Improved/stable family life	42	25	17	16	2.93	1.11

Source: Field Survey, 2025

Table 3: Deviance Indicators' Quantitative Results (N = 100).

Item	SA (%)	A (%)	D (%)	SD (%)	Mean	Std Dev
Increased stealing	16	29	28	27	2.34	1.04
Immorality among females	22	39	29	10	2.73	0.91
Immorality among males	37	26	31	6	2.94	0.96
Alcohol abuse (drunkenness)	32	26	24	18	2.72	1.10
Drug abuse	30	26	23	21	2.65	1.12
Indecent dressing	20	34	30	16	2.58	0.98
Diabolism (poisoning others)	21	17	35	27	2.32	1.09

Source: Field Survey, 2025

Table 4: Effects of Quarrying and Mining on Income (N = 100).

Item	SA (%)	A (%)	D (%)	SD (%)	Mean	Std Dev
Senior workers in the company have increased income	45	18	17	19	2.90	1.14
Middle workers (foremen) have increased income	13	60	22	5	2.81	0.85
Lower workers (drivers, security men) have increased income	21	32	30	17	2.57	1.06
Artisans involved with company have increased income	28	24	34	14	2.66	1.05
Petty traders (food vendors, etc.) have increased income	38	32	17	13	2.95	1.03
Others indirectly involved have increased income	23	29	30	18	2.57	1.02
Contractors supplying equipment/services have increased income	25	39	23	13	2.76	0.97
Community middlemen involved in quarry work have increased income	30	36	14	20	2.76	1.03

Source: Field Survey, 2025

abuse (1.10), while immorality among females (0.91) showed consistent perception. Thus, the second objective, examining deviance, was achieved. Results show moderate to strong agreement that quarry and mining activities contribute to increased immoral behavior, substance abuse, and evolving social norms. Although severe deviance like stealing and diabolism showed lower agreement, the overall pattern confirms that quarry-induced socio-economic changes are fueling deviant behaviors in the host communities (Table 3).

Effects of Quarrying and Mining on Income Level

Petty traders recorded the highest perceived income increase (Mean = 2.95), reflecting strong commercial gains from direct interaction with quarry staff and rising micro-enterprises. Senior (2.90) and middle-level workers (2.81) also reported significant benefits, indicating upward income mobility within the company's structure. Artisans and contractors (2.66–2.76) showed moderate agreement, likely due to fluctuating or contract-based earnings (Table 4). Lower-level workers and indirect beneficiaries (both 2.57) reported the least perceived income gains, revealing disparities in how economic benefits are distributed. Standard deviations (e.g., 1.14 for senior workers, 1.03 for middlemen) suggest that income experiences are uneven even within groups. Thus, the third objective, assessing quarrying's effect on income was achieved. The data confirm a positive but unequal income impact: direct participants enjoy clearer financial gains, while lower-tier and peripheral actors benefit less predictably. The presence of the quarry has stimulated entrepreneurship and local commerce, but with noticeable disparity in benefit distribution across community roles.

Effects of Quarrying and Mining on Infrastructure

Healthcare infrastructure received the strongest affirmation, with clinic construction (2.90) and upgrades (2.92) highly rated. Drug supply (2.79) and medical equipment (2.35) scored lower, likely due to inconsistency. Education support was mixed: school buildings (2.66)

Table 5: Infrastructure Development Impact in the Area (N = 100).

Item	SA (%)	A (%)	D (%)	SD (%)	Mean	Std Dev
Good roads constructed by the company	27	28	15	30	2.52	1.20
Schools built in the area	30	25	26	19	2.66	1.12
Books donated to schools	20	22	34	24	2.38	1.12
Computers/instructional materials donated	15	32	22	31	2.31	1.14
Repair of school structures	27	28	29	16	2.66	1.09
Clinics/hospitals built	46	18	16	20	2.90	1.14
Structures added to health centers	38	30	18	14	2.92	1.01
Medical equipment supplied	25	22	16	37	2.35	1.21
Free drug supply to clinics	41	18	20	21	2.79	1.15
Boreholes provided	23	29	20	21	2.61	1.08
Maintenance of existing boreholes	13	60	20	7	2.79	0.88
Maintenance of company-installed boreholes	15	30	20	35	2.25	1.14
Electricity provision	20	30	21	29	2.41	1.15
Transformers provided	35	21	23	21	2.70	1.17
Electric poles and accessories provided	31	36	21	12	2.86	1.01

Source: Field Survey, 2025

Table 6: Perceived Effects of Quarrying on Agriculture (N = 100).

Item	SA (%)	A (%)	D (%)	SD (%)	Mean	Std Dev
Farming attention diverted due to company	15	30	32	23	2.37	1.05
Land use for quarrying affected agriculture	20	25	22	33	2.32	1.13
Company activities destroyed farmlands	12	31	17	40	2.15	1.09
Youths stopped farming due to company jobs	14	41	15	30	2.39	1.03
Crop yield reduced from company's activities	41	30	21	8	3.04	0.98
Other negative agricultural impacts observed	31	21	18	30	2.53	1.19

Source: Field Survey, 2025

rated well, but materials like books (2.38) and computers (2.31) lagged. Borehole maintenance (2.79) scored high, but provision (2.61) and long-term upkeep (2.25) varied. Electricity infrastructure transformers (2.70), poles (2.86), was well-rated; general electricity (2.41) and roads (2.52) showed mixed views. Objective 4 is thus achieved: mining spurred infrastructure gains, though gaps in educational content, water, and roads highlight CSR areas for improvement (Table 5).

Effects of Quarrying and Mining on Agricultural Activities

Crop yield reduction (Mean = 3.04) emerged as the most significant agricultural impact, attributed to environmental pollution, land degradation, and altered rainfall patterns. General negative effects (2.53) suggest indirect disruptions like dust and noise also influence farming (Table 6). Youth labor diversion (2.39) and reduced interest in farming (2.37) highlight economic shifts driven by quarrying, especially among younger residents. Land displacement (2.32) and direct farm destruction (2.15) were least affirmed, indicating such occurrences are less frequent or visible.

Objective 5 is achieved: quarrying contributes to declining agricultural productivity, mainly through labor shifts and ecological damage. While direct land loss is limited, long-term sustainability is threatened, necessitating policies for corporate-backed agricultural revitalization and environmental mitigation (Table 6).

Ameliorative Strategies Implemented by the Company and Community

The strongest perceived impact is on community income improvement strategies (Mean = 3.01), indicating clear recognition of economic support through job creation, entrepreneurship, or subcontracting. Programs addressing deviance (Mean = 2.85) also rank highly, reflecting effective outreach and youth engagement (Table 7). Moderate strategies include conflict resolution (2.72), government interventions (2.71), and community-driven efforts (2.71), suggesting fair recognition of town halls, development committees, or authority collaboration. Lower-rated strategies include agriculture (2.61) and family life improvement (2.34), viewed as less visible or impactful. Most concerning is the low score for worker income strategies (2.22), implying perceived internal inequality. Overall, Objective 6 is achieved: efforts from both company and community to address socio-economic impacts of quarrying are evident, with economic empowerment and deviance control most effective, while family welfare, agriculture, and worker income require greater attention (Table 7).

Summary Comparison and Discussion of the Socio-Economic Effects of Quarry and Heavy Metal Mining

Table 8 presents areas of convergence, divergence, and novel insight across the literature, survey findings, and qualitative interviews regarding the socio-economic effects

Table 7: Perception of Amelioration Strategies (N = 100).

Item	SA (%)	A (%)	D (%)	SD (%)	Mean	Std Dev
Company has strategies to improve family life	18	30	20	32	2.34	1.16
Company programs to curb deviance	41	20	22	17	2.85	1.13
Company strategies to manage conflicts	31	31	17	21	2.72	1.12
Company strategies to improve workers' income	20	23	16	41	2.22	1.22
Company strategies to improve community income	35	41	14	10	3.01	0.97
Company strategies to improve infrastructure	21	31	23	25	2.48	1.11
Company strategies to improve agriculture	30	21	23	23	2.61	1.13
Government policies to reduce mining impacts	40	14	23	23	2.71	1.20
Community efforts to reduce negative impacts	41	18	12	29	2.71	1.26

Source: Field Survey, 2025

Table 8: Comparison

Key Theme	Literature Review Insights	Survey Findings	In-depth Interviews
1. Marriage & Family Life	Literature (Musokotwane, 2016) identifies early marriage, disruption of traditional structures, and unstable family patterns due to extractive activities.	Survey confirms early marriages (mean = 3.00), polygamy (2.87), delayed marriages (2.90), and inter-community unions (2.71). Divorce and family instability less reported.	Interviews revealed increase in polygamy, economic-motivated marriages, separation due to relocation, and transactional unions, supporting and deepening survey results.
2. Deviance	Quarrying linked to rise in immoral behaviors, social disorganization, and substance abuse (Melodi, 2017; Sheriff et al., 2018).	Strongest agreement on immorality among males (2.94), alcohol abuse (2.72), and drug abuse (2.65). Stealing and diabolism had lower scores.	Interviewees confirmed increased substance abuse, peer pressure, and decline in moral behavior—especially among males—driven by sudden income and urban influence.
3. Conflict	Studies (Essaghah et al., 2013) highlight community-company disputes, land struggles, and youth exclusion as conflict drivers.	Survey shows conflicts mostly intra-family (2.81), youth-elder (2.75), and inter-village (2.69).	Interviews offered details of land compensation conflicts, youth exclusion from employment, and intergenerational tensions over benefit sharing.
4. Income	Literature acknowledges income gains and employment (Melodi & Ogunyemi, 2019) but also warns of casualization and inequality.	Petty traders (2.95), senior workers (2.90), and middle workers (2.81) reported highest gains. Lower-level workers and indirect beneficiaries scored lower (2.57).	Interviews support the duality: economic uplift for some (vendors, contractors) and vulnerability for others (casuals, artisans). Seasonal employment, wage disparity noted.
5. Infrastructure	Quarrying has historically led to road, school, clinic projects (Felix & Yomi, 2013), though with uneven distribution.	Clinics (2.90), health centers (2.92), and electric poles (2.86) were top-rated. Road (2.52) and education support (2.31–2.66) moderately affirmed.	Interviews validated infrastructure delivery but highlighted issues of coverage, irregular maintenance, and high community expectations.
6. Agriculture	Literature (Chukwu, 2018) links mining to yield decline, land loss, and reduced farm labor.	Crop yield reduction (3.04) was highest. Farmland loss and diversion of youth from farming scored moderately (2.15–2.39).	Interviews confirmed shift of youth labor to quarrying, land degradation. Many still saw benefits outweighing costs.
7. Amelioration Strategies	Literature is sparse but emphasizes CSR and stakeholder engagement as critical (Melodi, 2017).	Strategies for income (3.01), deviance control (2.85), and conflict management (2.72) received moderate affirmation. Workers' income support (2.22) and family-focused interventions (2.34) rated low.	Interviews described CSR efforts like training, scholarships, conflict committees. However, noted were budget constraints, implementation delays, and insufficient scale.
8. Divergences and Novel Insights	Studies often generalize impacts. Literature rarely disaggregates based on education, occupation, or marital status.	ANOVA shows deviance perception rises with education; no significant difference in income or marriage perception by occupation/marital status.	Interviews confirmed that perception is often shaped by exposure, awareness, and community-wide narratives—not individual status—adding nuance to the survey data.

of quarry and heavy metal mining in Abia State. The triangulation between the existing literature, quantitative findings and findings from qualitative data, as synthesized in the (Table 8) is discussed as follows: The study revealed complex socio-economic consequences of quarry and heavy metal mining in Abia State. Marriage patterns have shifted, with increases in early marriage (45%) and polygamy (48%), reflecting trends noted by Musokotwane (2016) and confirmed by Chukwu (2018) and Essaghah et al. (2013). Youth deviance particularly substance abuse and moral decline was more prevalent among males (Sheriff et al., 2018; Melodi, 2017), aligning with Anifowose's (2009) findings on youth alienation. Conflict manifested primarily within communities, especially across generational lines, rather than between communities and companies, diverging from Felix and Yomi's (2013).

Table 9: Perceived impact of quarry and heavy metal mining on marriage and family life.

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.370	5	0.074	1.175	0.327
Within Groups	11.238	94	0.120		
Total	11.608	99			

Source: SPSS 27

Table 10: Perceived economic benefits of quarrying and mining activities if differ from other occupation.

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.236	5	0.047	1.404	0.230
Within Groups	3.260	95	0.034		
Total	3.496	100			

Source: SPSS 27

external conflict model. Income effects were bifurcated: traders and senior workers reported gains (Melodi & Ogunyemi, 2019), while artisans faced wage precarity, echoing Ogbonna (2021). Infrastructure provision (e.g., clinics, boreholes) was acknowledged but deemed inadequate, supporting Ite et al. (2011) and Ben-Caleb (2015) on CSR tokenism. Agriculture declined due to yield reduction, labor diversion, and dust, confirming Chukwu (2018) and Orogun (2014), though overt displacement was minimal. CSR interventions such as vocational training and grievance committees had moderate approval but were seen as superficial and non-transformative (Melodi, 2017; Otuu, 2020). Collectively, these findings emphasize uneven development, internal tensions, and the need for more inclusive, participatory governance in extractive contexts.

Perception of Marriage and Family Life Effects by Marital Status

This section uses ANOVA to test whether the perceived impact of quarry and heavy metal mining on marriage and family life varies significantly across different marital status groups such as Single, Married, Separated, Divorced, Cohabiting, and Widowed (Table 9). The ANOVA result shows no statistically significant difference in how different marital status groups perceive the impact of quarry activities on marriage and family life ($F(5, 94) = 1.175$, $p = 0.327$). This means that although respondents may hold different marital experiences (e.g., single vs. divorced), these do not significantly alter how they perceive changes in family structure, early/late marriage trends, divorce, polygamy, etc., due to quarry operations. Uniform perception may imply that community members, regardless of marital experience, observe similar social changes such as more polygamy, as well as delayed marriage. Collective lived experience such as shared community observations, may dominate over personal marital status when evaluating the social effects of industrial activity (Table 9).

Perception of Income Impact by Occupation

The result reveals no statistically significant difference in perceived income effects across different occupational groups *($F(5, 95) = 1.404$, $p = 0.230$)*. Although one might expect petty traders, artisans, or company-affiliated workers to report higher benefits, the analysis shows that perceived economic impacts are not strongly stratified by occupation. The community may experience either generalized benefits or shared economic disillusionment, both resulting in similar perception scores. It challenges the assumption that proximity to quarry operations (through occupation) always conditions positive perceptions of income change. Disparity in actual gains may exist, but perception remains homogeneous, possibly due to expectations not being met across the board (Table 10).

Perception of Deviance by Education Level

The result shows a statistically significant difference in deviance perception scores across the four educational categories: $F(3, 97) = 9.183$, $p < 0.001$. This implies that at least one educational group differs significantly **from** the others in how they perceive deviant behaviors associated with quarrying activities (Table 11).

The results reveal a progressive increase in perceived deviance as education level rises**.** Respondents with tertiary education exhibited the highest deviance perception (Mean = 2.92). This could stem from increased awareness, critical reasoning, and a stronger alignment with formal social norms. Educated individuals are more likely to identify behaviors such as drug abuse or immorality as deviant due to their social conditioning and exposure to legalistic or health-related consequences of such actions. Respondents with little or no formal education perceived deviance less strongly (Means = 2.47–2.56). This could be explained by lower awareness of what constitutes deviance in a formalized sense; and greater tolerance or normalization of behaviors that are disruptive but socially embedded in less formally educated settings. In the context of quarrying communities in Abia State, this pattern suggests that perception of social problems related to mining activities is stratified by educational attainment**.** More educated community members might interpret social transformations such as youth idleness, increased access to money, erosion of

Table 11: Perception of deviance by education level

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.013	3	0.671	9.183	0.000
Within Groups	7.087	97	0.073		
Total	9.099	100			

Source: SPSS 27

traditional values, as clear indicators of moral decay, whereas less educated members may not regard them with the same level of concern (Table 11).

Qualitative Analysis of In-Depth Interviews

Focusing on participants' interpretations of how quarry and heavy metal mining operations affect host communities, this analysis adopts an experiential approach to qualitative inquiry (Braun & Clarke, 2006; Byrne, 2021). It seeks to understand the insider perspectives of key personnel across departments, providing rich narrative insight into the socio-economic impacts, in alignment with the study's seven core objectives. The qualitative data is triangulated with quantitative findings and is thematically presented under the following headings:

Quarrying and Family/Marriage Life

Respondents consistently acknowledged that the company's presence has impacted family dynamics and marriage systems within host communities.

"Many of our younger workers from outside the community end up marrying locals. There's a visible increase in intermarriages, and some of these unions are transactional in nature." (Community Relations Officer, Age 41)

"I actually have observed that local girls are getting married younger now, sometimes they marry to workers who earn just enough to entice families. The money they flaunt have introduced some kind of pressure on the girls, especially where families are struggling." (Human Resource Manager, Age 46)

One manager reported a rise **in** polygamy and late marriages**,** saying that a number of local men are taking second wives because of increased income. Similarly, it was observed from most of the responses that some young men now delay marriage, saying they want to 'make it big' before settling down. Other respondents noted the emergence of broken homes, partially due to frequent relocations or work-induced separations.

"*There are cases where employees are posted temporarily, and family structures suffer. Some even take on relationships in other sites." (Administrative Officer, Age 35)*

These accounts support quantitative trends showing increased polygamy, early marriages, and delayed marriages, especially among males, suggesting that industrial presence disrupts traditional marriage timelines and values.

Quarrying and Deviance in the Community

Nearly all interviewees expressed concern about the moral consequences of mining-induced rapid social change. The prevailing argument is that increase in income, especially when it comes steady without much effort, leads people into temptations.

*"With cash comes temptation. There's been a noticeable rise in alcohol and drug use among both workers and some locals**."** (Logistics Officer, Age 42)*

"Our cultural patterns, beliefs and values, are changing as some of the new businesses and strangers that come into town have introduced indecent dressing, nightlife, and other vices. It's slowly changing the cultural fabric." (Security Chief, Age 40).

On immorality and youth behavior**,** others added:

"Young men now flaunt money and attract attention, which leads to immorality. We've had to caution some of our own staff." (Finance Officer, Age 36)

"There are complaints from locals about thefts. And, yes, rumors of poisoning and suspicion among workers exist, likely due to competition and distrust." (Safety Manager, Age 38)

The narrative validates survey results that highlight deviance as a significant issue especially in forms like immorality, alcohol and drug abuse, and youth delinquency.

Quarrying and Conflict in the Community

Respondents provided layered insights on intra-family, inter-village, and company–community conflicts. They agreed that the major dispute issues is on land compensation which leads to intra-family and inter-family disputes, and sometimes even inter-communal conflicts.

"What I have often heard and seen are disputes between families over land compensation. Most of the time people will always feel cheated when others receive larger

payments. And that have often resulted into serious issues that sometimes even affect our activities" (Land Affairs Officer, Age 44)

"We've experienced resistance from youth groups who feel left out of employment. This kind of situation have often led to protests and sometimes site disruptions." (Community Liaison Officer, Age 39)

"Villages have competing interests. We try to balance benefits across them, but tensions still occur, especially when one area feels sidelined." (Public Relations Executive, Age 45)

Intergenerational conflicts were also cited:

"I have seen situations where the elders prefer long-term development like building schools, road etc, but the youths will say give us the money in cash. Most times, this kind of disagreement causes a lot of discrepancy in how they engage us." (CSR Manager, Age 37)

This complements survey data that showed moderate to high levels of conflict**,** especially between families, villages, and between company and community youth. The interviews add nuance by identifying land disputes and exclusionary employment practices as triggers.

Quarrying and Income Levels

Exploring the perceptions of the respondents over quarrying and income levels, the respondents affirmed that income generation is the most visible benefit of quarry operations. Many believed that because of the quarrying companies, they are able to have food and other basic amenities.

"Our senior staff earn well, but even the low-cadre staff earn better than what they' make as farmers. That's why people flock here." (Accounts Officer, Age 41)

"They have contracts with local food vendors, tailors, and cleaners. Their livelihoods depend on the daily operations of the company. Actually, me I won't ever agree that the companies be allowed to leave our community" (Procurement Head, Age 46)

"…the work here is good, is just that it is not steady for some. For instance, artisans and truck drivers, their work is not consistent, so they take when they see. Work is seasonal for many, and that's a challenge." (Maintenance Supervisor, Age 38)

However, it was also noted by the respondents that there is income inequality and casualization of labor which is making it look like some are doing better than others in the community**:**

"Most community members are casual workers. They do not have job security or health benefits. This limits their growth and economic stability." (HR Assistant, Age 34)

The qualitative narratives corroborate quantitative results, indicating that while income gains are real and widespread, they are also uneven and inconsistent**,** especially among non-permanent and indirect beneficiaries.

Quarrying and Infrastructure Development

The study wanted to know if there is any contribution of the quarrying activities to infrastructural development, and it was observed that the respondents agreed that the company has contributed to health, education, and utility infrastructure, but argued that the impact of the infrastructural development varies by location:

"The companies built a clinic and supported schools with books and some materials. But there's a long way to go, because the clinics still lack a lot of equipment, and sometimes you will go there and there is no doctor to attend to you." (Head of CSR, Age 47)

"My company donated transformers and boreholes, but we are not the power maintenance company, yet when there is power outage, you hear comments that implies we have done nothing. So we often get blamed unfairly." (Facility Engineer, Age 35)

There were also comments and discussions on roads and electrification**,** and some respondents expressed concern:

"Our company repaired some roads, but others are now worse due to truck traffic. The situation is just very complicated." (Transport Manager, Age 39)

"…of course the company is making effort, but sometimes it seems that the effort is not good enough. For instance, our company installed poles for electrification, and the lights were installed, but the power supply itself is erratic." (Electrical Engineer, Age 43)

While physical structures have been provided, expectation gaps and coordination issues persist, especially in areas like water maintenance and power delivery.

Quarrying and Agricultural Impact

Most respondents admitted that mining activities have disrupted agriculture, especially through land loss and youth labor shift. A project manager revealed that the farmland their project occupies was once productive, as individual citizens farmland, which was now taken away by the community and the government. In relation to that, an

operation assistants argued: "Young people prefer quarry jobs to farming, which have led to farms being abandoned." Also, observed is that dust and blasting have affected crops. Some plants don't grow well anymore. Still, a few respondents that there is no much negative effect on agriculture, as they believe that the little effect is compensated by the socio-economic welfare brought by the quarrying activities:

*"…well I can't say the quarrying activities didn't affect agriculture, but is its not that serious. Also, the job, the school, hospitals that have been brought by their activities is a good compensation**."** (Planning Officer, Age 40)*

"The effects on agriculture is majorly on land, which some people have lost some of their farmland to quarrying activities, …well I don't know if there is any effect on crops, but I have seen any effect" (Admin officer, Age 38)

These observations align with survey findings: youth withdrawal from agriculture and yield reduction are widely acknowledged, while direct destruction of farmlands is less consistently perceived.

Amelioration Strategies and Policies

Exploring amelioration strategies, several respondents described current mitigation efforts put up by the companies, though with varied effectiveness:

***"**We offer scholarships, small business grants, and organize vocational training. But the challenge we have always faced is that demand always exceeds supply." (CSR Lead, Age 46)*

"We've set up conflict resolution committees involving community reps, elders, and youth groups along with company staff members. This committee have had some success in their conflict resolution efforts." (Community Liaison Officer, Age 39)

On internal welfare, limitations were acknowledged, as a finance officer revealed that in their company, they have improved top-tier wages, but junior staff still feel excluded. Budget issues affect wage reviews. Also, observed was some synergy and coordination with government and the communities and some challenges inherent**:**

"We align our activities with local government plans, but implementation delays often weaken the synergy." (External Affairs Manager, Age 43)

"Communities sometimes mobilize themselves. For example, one village built a school using part of the royalty fund we gave them." (Accounts Manager, Age 44)

These insights affirm that while amelioration efforts exist, they face challenges of scale, perception, and sustainability. There is a clear need for improved collaboration and participatory development planning. This thematic analysis of 12 in-depth interviews confirms that quarry and mining operations in Abia State are socio-economically transformative but polarizing. Key themes such as marriage structure change, deviance escalation, localized conflicts, economic uplifttment, and agricultural decline were consistently noted. Moreover, amelioration strategies, while active are viewed as insufficient or uneven. The findings support Contingency Theory (contextual adaptation and organizational fit) and Stakeholder Theory (balancing corporate interests with community well-being). They also triangulate strongly with the earlier quantitative data, strengthening the validity and depth of the study's conclusions as seen in the thematic map in (Figure 1).

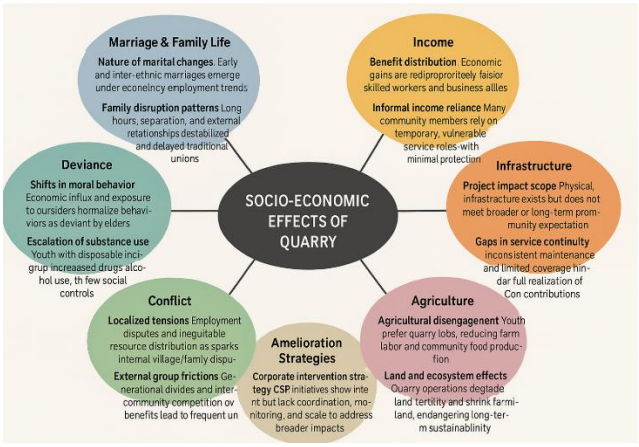

Figure 1: Thematic Map of socio-economic effects of quarry and heavy metal mining

Conclusion

This study examined the socio-economic impacts of quarry and heavy metal mining in Abia State using a mixed-methods design that combined quantitative surveys and qualitative interviews. It assessed seven core domains, offering a comprehensive picture of how extractive activities reshape host communities. Economically, quarrying contributed to employment and improved income for traders and skilled workers, alongside modest infrastructure gains such as boreholes and clinics. However, social disruptions were profound. Shifts in marriage patterns, including early marriages, polygamy, and spousal separation, were linked to income changes and labor migration. Youth deviance, marked by substance abuse and moral decline was widespread, while intra- and inter-community conflicts reflected tensions over land, compensation, and unequal benefit distribution. Agricultural livelihoods suffered from land loss, reduced yields, and youth disengagement. Though some ameliorative efforts existed, CSR initiatives were fragmented, under-consulted, and lacked transparency.

The study validated Contingency Theory by showing that mining impacts vary based on local context, while Stakeholder Theory highlighted the importance of trust, inclusion, and perception in community-company relations. Ultimately, while mining holds economic potential, its destabilizing social effects demand urgent policy attention. Sustainable development in mining zones requires participatory governance, coordinated CSR planning, and long-term investment in community cohesion and resilience.

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