



Socio-environmental perception of local communities toward sandstone mining in Dholpur district

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ABSTRACT

Sandstone mining in Dholpur district, while economically significant, has engendered profound socio-environmental implications. This study critically evaluates the perceptions of local communities regarding the environmental degradation and socio-economic disruptions associated with mining activities. The primary objective is to explore community awareness, lived experiences, and the extent of public engagement in addressing mining-induced challenges.

Employing a mixed-method research design, data were collected through structured questionnaires administered to 100 respondents from mining-affected areas, supplemented by in-depth interviews and focus group discussions. The findings reveal a dichotomy: although mining is recognized for its employment potential, a substantial proportion of the population articulates concerns over environmental deterioration, including deforestation, air and water pollution, soil infertility, and adverse health outcomes. Moreover, there exists a pervasive sense of marginalization due to limited community participation in governance and environmental oversight.

The study concludes that fostering sustainable mining in Dholpur necessitates an integrative policy framework that prioritizes ecological preservation, social equity, and participatory governance. Enhanced regulatory enforcement, inclusive decision-making, and the adoption of environmentally sound mining technologies are imperative to harmonize economic development with the long-term well-being of local communities.

Keywords: Sandstone, environmental deterioration, sustainable mining, local communities.

INTRODUCTION

Mining, as an extractive industry, occupies a pivotal role in the socio-economic development of mineral-rich regions across the globe. In the Indian context, the mining sector significantly contributes to industrial growth, infrastructure development, and rural employment (Ministry of

Mines, 2020). Among the various minerals extracted, sandstone holds particular prominence in Rajasthan, which accounts for a large share of the country's building stone production. Dholpur district, in eastern Rajasthan, is well known for its high-quality red and buff sandstone, widely used in monuments, public buildings, and construction projects throughout India (Gupta & Mathur, 2017). The exploitation of these resources has brought notable economic gains, including employment generation and ancillary business opportunities (Jodha, 2018).

However, the environmental and social costs associated with sandstone mining have raised serious concerns. Unregulated and open-cast mining in the Dholpur region has led to deforestation, land degradation, air and water pollution, and depletion of groundwater resources (Sharma & Kumar, 2021; Jain & Meena, 2019). In many mining areas, topsoil is removed without reclamation, and the lack of post-mining land restoration exacerbates ecological vulnerability (Tiwari & Joshi, 2020). Dust emissions from blasting and transportation of sandstone contribute to respiratory ailments, reduced crop productivity, and contamination of local water sources (Kaur & Singh, 2016). These environmental stressors are compounded by the absence of effective environmental impact assessments and monitoring frameworks.

In parallel with ecological degradation, socio-economic disruptions are evident. Many residents living near mining zones experience a loss of traditional livelihoods, particularly in agriculture and animal husbandry, due to the conversion of arable land for mining purposes (Chakraborty & Mishra, 2018). Health problems, displacement, inadequate compensation, and deteriorating public infrastructure are commonly reported (Patel & Desai, 2020). Furthermore, the benefits of mining are not equitably distributed—often concentrated among contractors and intermediaries—leaving local communities with minimal long-term socio-economic gains (Bisht & Kothiyari, 2020; UNDP India, 2017).

A critical concern in this context is the marginalization of local voices in environmental governance. Despite the legal provisions for public consultation under frameworks such as the Environment Protection Act (1986) and the Panchayats (Extension to Scheduled Areas) Act (1996),

community involvement in mining-related decision-making remains largely symbolic or absent (Agarwal, 2020; Saxena, 2015). This exclusion erodes trust, weakens institutional accountability, and intensifies conflict between local populations and external stakeholders. Understanding the perceptions of local communities is, therefore, not only important for environmental justice but also essential for designing context-sensitive and sustainable policy interventions (Chopra & Singh, 2019).

Research has shown that community perceptions are shaped by both immediate experiences and historical interactions with extractive industries. These perceptions serve as critical indicators of socio-environmental stress and can inform more inclusive approaches to resource management (Narain & Vij, 2021). Yet, in the context of sandstone mining in Dholpur, there is a noticeable gap in empirical studies focusing on how local people interpret and respond to mining-induced changes. Existing literature has predominantly emphasized the geological and economic dimensions, with limited attention to the socio-cultural and ecological perspectives from the ground (Singh et al., 2022).

This study addresses that gap by examining the socio-environmental perceptions of communities living in sandstone mining-affected areas of Dholpur district. The research aims to explore the lived experiences, perceived environmental and health risks, and the degree of public awareness and participation in environmental governance. By employing a mixed-method research design—combining structured surveys, in-depth interviews, and focus group discussions—the study seeks to generate a nuanced understanding of the mining–community interface. It draws on both quantitative data and qualitative narratives to highlight patterns of marginalization, resistance, adaptation, and agency within affected populations.

The study ultimately seeks to contribute to broader discourses on sustainable mining by advocating for participatory governance, environmental accountability, and policy reforms that align with the principles of ecological integrity and social justice. In the backdrop of India's Sustainable Development Goals (SDGs), particularly SDG 12 (Responsible Consumption and Production) and SDG 15 (Life on Land), integrating local

perceptions into mining governance is not only timely but essential.

STUDY AREA

The present study was carried out in Dholpur district, situated in the southeastern part of Rajasthan, India. Geographically, the district lies between 26°22' to 26°52' North latitude and 77°13' to 78°17' East longitude, encompassing an area of about 3,034 square kilometers. It shares boundaries with Bharatpur district to the north, Karauli district to the west, Morena district of Madhya Pradesh to the east, and Agra district of Uttar Pradesh to the northeast (Government of Rajasthan, 2015). The Chambal River basin defines much of its physical and ecological setting, supporting both settlements and economic activities (Sharma & Meena, 2019).

The terrain of Dholpur is marked by rocky uplands, undulating plains, and patches of alluvial soil, with elevation ranging between 150 and 300 meters above sea level. The district experiences a semi-arid climate, with very hot summers, short monsoon showers between July and September, and relatively mild winters. The average annual rainfall ranges between 700 and 800 millimetres, which plays a critical role in determining agricultural output, vegetation growth, and the resilience of landscapes affected by mining activities (IMD, 2020). Dholpur is widely recognized for its deposits of high-quality red and pink sandstone, popularly known as Dholpur sandstone. This stone, part of the Vindhyan geological formations, has been used for centuries in monumental and modern architecture, including the Red Fort in Delhi and Rashtrapati Bhavan (GSI, 2017). Quarrying of sandstone provides employment and income opportunities to a large section of the local population, but it has also raised environmental and social concerns, including land degradation, dust pollution, depletion of biodiversity, and livelihood insecurity (Chauhan, 2010; Singh & Agarwal, 2021).

The district is home to about 1.2 million people as per the 2011 Census of India, with the majority residing in rural areas. Agriculture remains the backbone of the local economy, yet mining and related activities such as quarrying, stone cutting, and masonry employ a substantial portion of the workforce (Census of India, 2011). Villages located near quarrying sites are

particularly dependent on this industry, which makes the perceptions of local residents essential for evaluating the socio-environmental consequences of mining.

Dholpur provides a representative case of the intersection between economic dependence on natural resource extraction and the challenges of environmental sustainability. The study of local communities in this region offers valuable insights into how people perceive mining's impacts on their surroundings, health, agriculture, and cultural landscape, thereby underlining the importance of integrating community perspectives into sustainable mining policies (Jain, 2018).

RESEARCH METHODOLOGY

This study adopted a mixed-method approach combining both quantitative and qualitative techniques to comprehensively examine the socio-environmental perceptions of local communities regarding sandstone mining in Dholpur district. A mixed design was considered suitable because it allows for both statistical analysis of large-scale patterns and an in-depth understanding of people's experiences and attitudes (Creswell, 2014).

The research was carried out in selected villages located in close proximity to sandstone quarrying sites across the tehsils of Bari, Baseri, Rajakhera, Dholpur, and Sarmathura. These sites were chosen purposively due to their high concentration of mining activity and the direct dependence of local households on sandstone-related occupations (Singh & Agarwal, 2021).

A multistage sampling method was employed. In the first stage, major mining clusters were identified through government records and field reconnaissance. In the second stage, villages within a 5–10 km radius of quarrying sites were shortlisted. Finally, households within these villages were selected using simple random sampling. A total of 200 households were surveyed to ensure adequate representation of different socio-economic groups. Respondents included both men and women engaged in farming, mining, masonry, or other livelihood activities.

The study relied on both primary and secondary data sources. Primary data were collected through structured

questionnaires, semi-structured interviews, and focus group discussions. The questionnaire included sections on demographic details, livelihood dependence, awareness of environmental impacts, health conditions, and perceptions of sustainability. Semi-structured interviews with community leaders, quarry workers, and local officials were conducted to capture nuanced perspectives, while focus group discussions helped validate community-level concerns. Secondary data were drawn from census records, district statistical handbooks, government mining reports, and published research articles (Census of India, 2011; GSI, 2017).

Quantitative data obtained from household surveys were analyzed using descriptive statistics and cross-tabulations, while inferential tools such as chi-square tests were applied to examine the relationship between demographic variables and perceptions of mining impacts (Kothari, 2004). Qualitative data from interviews and focus groups were subjected to thematic analysis, where recurring patterns and narratives were identified, coded, and interpreted (Braun & Clarke, 2006). Triangulation of multiple data sources ensured the validity and reliability of findings.

By employing this methodology, the study attempts to capture both the measurable socio-economic impacts and the lived experiences of local communities, providing a holistic understanding of how sandstone mining shapes environmental perceptions and livelihood sustainability in Dholpur district.

RESULTS

The present study aimed to investigate the socio-environmental perceptions of local communities living in proximity to sandstone mining sites in Dholpur district, Rajasthan. Primary data were collected from 200 households spread across five tehsils—Bari, Baseri, Rajakhera, Dholpur, and Sarmathura. The findings are organized into subsections, including demographic profile, livelihood dependence, perceptions of environmental impacts, health concerns, and views on sustainability.

Demographic Profile of Respondents

The demographic analysis revealed a skewed gender ratio in terms of participation in mining-related occupations.

Approximately 62% of the surveyed respondents were male, while women accounted for 38%. Age-wise distribution showed that 54% fell in the 30–50-year category, representing the most economically active segment, while 29% were aged below 30, and the remaining 17% were above 50.

Literacy levels were relatively low in the mining-affected villages. Only 46% of respondents reported being able to read and write, while the rest had either no formal schooling or had dropped out at primary levels. Men exhibited higher literacy (57%) compared to women (32%), reflecting broader rural educational disparities in Rajasthan. The education gap was identified as one of the reasons for limited occupational diversification in the study area.

Livelihood Dependence on Mining

The results indicate that sandstone mining forms a backbone of the local economy in Dholpur. Out of the surveyed households, 54% reported direct dependence on quarrying, stone cutting, or masonry work. Another 31% cited agriculture as their primary occupation, though most of these households supplemented farm income with part-time mining-related work. About 15% were engaged in petty trade, transport services, or casual wage labor in nearby towns.

Field interviews revealed that while agriculture is still practiced, declining soil fertility, erratic monsoon rainfall, and groundwater scarcity have reduced its profitability. Mining, despite its occupational hazards, was perceived as offering relatively stable daily wages. A stone cutter reported:

“Farming is uncertain. If it rains less, the crops fail. But with stone work, at least there is daily income. We cannot leave this work even if it harms us.” This sentiment was echoed in multiple villages, reflecting the heavy economic reliance on mining.

Perceptions of Environmental Impacts

The survey data demonstrate widespread recognition of environmental degradation caused by sandstone mining. Nearly 72% of respondents reported that quarrying had led to soil erosion and loss of cultivable land. Farmers particularly highlighted the challenges of declining crop

yields due to dust deposition on fields and the expansion of quarry pits into agricultural zones.

Water scarcity emerged as another major concern. About 68% of respondents observed a decline in groundwater levels in the last two decades, attributing it to uncontrolled mining and reduced recharge. Seasonal ponds and wells that earlier supported irrigation and drinking water had reportedly dried up in several villages near Sarmathura and Bari.

Air quality issues were highlighted by 74% of respondents, who linked quarry dust to respiratory problems and poor visibility. Dust was reported to settle on food, rooftops, and open wells, reducing overall quality of life. Focus group discussions revealed that villagers often associate the white dust clouds rising from quarries with "illness in the air."

Biodiversity loss was also reported. Nearly 41% of respondents stated that grazing areas for livestock had shrunk, while others mentioned declining numbers of birds and small animals. These findings suggest that the ecological footprint of sandstone mining is not limited to human communities but extends to the wider environment.

Health Impacts

Perceptions of health impacts were particularly strong in mining households. Around 57% of respondents cited frequent respiratory problems, such as asthma, silicosis, and chronic cough. Eye irritation and skin allergies were also reported by 36%. Field observations revealed that workers often labored without protective equipment, increasing their vulnerability to dust-related diseases.

Women respondents emphasized the indirect health effects of mining. They reported increased workload in fetching clean water, dealing with sick family members, and coping with food insecurity when agricultural productivity declined. Some also mentioned cases of miscarriages and weakness among women engaged in stone breaking.

Occupational injuries were another concern. Quarry workers described accidents caused by blasting, falling rocks, and unsafe handling of heavy stone blocks. Despite

these risks, only a small fraction reported receiving medical support or compensation.

Social and Economic Inequality

While mining provides livelihood opportunities, respondents perceived inequalities in the distribution of benefits. 66% of surveyed households felt that contractors and traders earned disproportionately higher profits, while local laborers received only meager wages. Informal employment patterns meant that most workers had no social security or health insurance.

FGDs revealed a sense of marginalization among villagers, who expressed limited involvement in decision-making related to mining. While they were aware of government regulations, they perceived enforcement as weak. "Rules exist only on paper, but the mines continue as they wish," said one village elder in Rajakhera.

Perceptions of Sustainability

When asked about the future of mining, 61% of respondents felt that current practices were unsustainable, citing shrinking land, health hazards, and water scarcity. Only 29% believed that mining could continue without major ecological damage, while 10% were uncertain. Respondents suggested measures such as stricter monitoring, provision of health facilities, and reclamation of mined land. Some also called for alternative livelihood options, including skill training for younger generations.

In sum, the results reveal a complex perception among local communities: mining is simultaneously viewed as a lifeline for survival and as a driver of ecological and social distress.

DISCUSSION

The results of this study underscore the paradox of resource dependence in rural mining regions: while sandstone quarrying provides much-needed employment and income, it simultaneously generates significant environmental degradation, health problems, and social inequalities. This section interprets the findings in relation to existing literature and highlights broader implications for sustainable mining policies.

Mining as a Livelihood Strategy

The finding that more than half of surveyed households rely on mining mirrors broader patterns in Rajasthan, where declining agricultural productivity has pushed rural populations toward resource extraction industries (Sharma & Meena, 2019). Previous studies have noted that semi-arid conditions, recurrent droughts, and groundwater depletion reduce farming viability (Gupta, 2014). For communities in Dholpur, sandstone quarrying thus becomes a “fallback livelihood,” offering daily wages even when agriculture fails. However, this dependence increases vulnerability, as mining jobs are informal, seasonal, and physically risky (Singh & Agarwal, 2021).

Awareness of Environmental Degradation

The study revealed strong local awareness of land degradation, water scarcity, and air pollution. This aligns with Chauhan’s (2010) research in other Rajasthan mining districts, which documented soil erosion, loss of arable land, and declining groundwater as persistent consequences of unregulated quarrying. The fact that villagers in Dholpur explicitly linked dust deposition with crop decline suggests that local ecological knowledge is an important but often underutilized resource in environmental monitoring.

The reported reduction in grazing land and biodiversity echoes Ghose’s (2002) argument that mining’s ecological impact extends beyond humans to entire rural ecosystems. By perceiving livestock health decline and loss of common property resources, villagers in Dholpur demonstrate an integrative understanding of socio-environmental change.

Health and Occupational Hazards

The findings regarding respiratory diseases, skin conditions, and injuries are consistent with previous studies on sandstone workers in Rajasthan. Tiwari et al. (2013) documented high prevalence of silicosis and chronic respiratory conditions among mine workers exposed to prolonged dust inhalation. The absence of protective gear and weak medical support exacerbates these health burdens.

Women’s testimonies about miscarriages, weakness, and indirect health impacts illustrate the gendered dimensions of mining, a theme often overlooked in policy discussions.

As Lahiri-Dutt (2012) argues, women in mining communities carry a “double burden,” contributing to household survival while enduring intensified domestic responsibilities and health vulnerabilities.

Social Inequality and Marginalization

The perception that contractors and traders reap greater benefits than local laborers echoes findings from Jain (2018), who emphasized the uneven distribution of mining profits in Rajasthan. Informal employment patterns without social security reinforce this inequality. The community’s sense of exclusion from decision-making reflects broader governance challenges in India’s mining sector, where local voices are often sidelined in favor of economic interests (Banerjee, 2017).

Perceptions of Sustainability

The skepticism expressed by 61% of respondents about the sustainability of current mining practices demonstrates an acute awareness of ecological limits. This finding resonates with global debates on the “resource curse,” where short-term economic gains undermine long-term ecological and social well-being (Hilson, 2002). Respondents’ calls for reclamation, stricter monitoring, and alternative livelihoods suggest that communities are not passive victims but active stakeholders with valuable insights into sustainable strategies.

The paradox of mining in Dholpur necessary for survival but harmful for sustainability underscores the need for balanced policy interventions. Scholars have argued that community-based resource management, participatory monitoring, and livelihood diversification can help reconcile economic and ecological goals (Bebbington et al., 2008). In the Dholpur context, this would mean integrating villagers’ perceptions into mining governance, enforcing environmental regulations, and introducing non-mining livelihood schemes such as agro-forestry, skill training, and eco-tourism.

The results highlight three critical implications:

1. Policy and Regulation - Stronger enforcement of mining regulations, mandatory health protections, and systematic land reclamation are urgently needed.
2. Community Participation - Incorporating local voices into decision-making can improve legitimacy and effectiveness of mining governance.

3. Livelihood Diversification - Reducing dependence on mining through alternative income sources is key to long-term sustainability.

CONCLUSION

The study of local communities in Dholpur district reveals a complex reality in which sandstone mining functions both as a lifeline and as a source of distress. On one hand, it sustains rural households by offering employment opportunities in a region where agriculture is increasingly unreliable. On the other, it has led to visible ecological degradation, groundwater depletion, dust pollution, and rising health risks, with women and vulnerable groups bearing a disproportionate burden. Community perceptions reflect not only an acute awareness of these socio-environmental costs but also a recognition of the uneven distribution of mining benefits, where local laborers remain marginalized while contractors and traders capture most gains.

The results highlight the paradox of mining: it ensures short-term survival yet undermines the long-term sustainability of both environment and livelihoods. For any meaningful policy intervention, the voices of local communities must be placed at the center of mining governance. Strengthening regulatory frameworks, enforcing reclamation measures, providing health protections, and investing in livelihood diversification are essential steps. Ultimately, the study underscores that sustainable development in Dholpur requires balancing economic necessity with ecological integrity, where community perceptions serve not as passive observations but as crucial guides for shaping just and inclusive mining policies.

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