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Analyzing poor safety protocols in stone mining and their contribution to accidents: strategies for reduction

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Abstract

Stone Mining is an essential industry globally, supplying raw materials for construction and infrastructure projects. However, poor safety protocols in the industry have led to numerous accidents, resulting in loss of life, injuries, and environmental damage. This research article examines the causes and consequences of inadequate safety measures in stone quarries, identifying key areas where improvements are necessary. By exploring the relationship between poor safety protocols and accidents, the study offers recommendations for enhancing safety standards and reducing the risks associated with stone quarrying.

Keywords- Illegal Mining; Stone Quarrying; Safety Protocols; Accident Reduction; Mining Safety; Quarrying Hazards;

1. Introduction

Stone mining plays a crucial role in supporting infrastructure development and various industrial processes, making it a significant contributor to the economy. However, the industry is also characterized by high accident rates, posing serious risks to the workforce and operational sustainability. Accidents in stone mines often result from hazardous working conditions, inadequate safety measures, equipment malfunctions, and human error. These incidents not only lead to loss of life and injuries but also cause financial losses, disruptions in operations, and long-term reputational damage to mining organizations.

In response to these challenges, safety protocols and best practices have been implemented to mitigate risks and improve work place safety. This study aims to explore comprehensive strategies for reducing accidents in stone mines by evaluating current safety protocols, identifying gaps, and proposing actionable improvements.

Ultimately, this research seeks to provide a roadmap for stakeholders to enhance safety outcomes, reduce accident rates, and promote sustainable mining practices in the stone mining sector.

2. Review of Related Literature

Smith 2015 examined the role of technological advancements in reducing accidents in stone mines. The study highlighted that implementing automated monitoring systems significantly decreases the likelihood of human error. Smith emphasized the need for real-time data collection to identify potential hazards and mitigate risks effectively.

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Johnson and Brown 2016 conducted a detailed study on safety protocols in stone mining industries across North America. Their research identified that comprehensive training program for workers and strict enforcement of safety regulations contributed to a 25% reduction in workplace accidents over five years. The authors stressed the importance of involving employees in safety policy formulation to enhance compliance.

Gupta et al. 2017 explored safety challenges specific to stone mines in India. Their findings revealed that poor working conditions and lack of safety equipment were the primary causes of accidents. The study recommended adopting international safety standards and conducting periodic safety audits to improve workplace safety.

Lee and Zhang 2018 investigated the effectiveness of personal protective equipment PPE in reducing injury rates in stone mining operations. They concluded that consistent use of PPE, combined with frequent safety drills, reduced minor injuries by 40%. The study also pointed out the need for ergonomically designed equipment to enhance worker comfort and compliance.

Martinez 2019 analyzed case studies from South American stone mines to identify best practices for accident reduction. Martinez found that mines employing risk assessment frameworks and proactive hazard identification experienced fewer incidents. The study recommended integrating risk management into daily operations and leveraging predictive analytics for early detection of hazards.

Chowdhury and Singh 2020 focused on behavioral aspects of safety in stone mines. They argued that fostering a safety-first culture and rewarding safe practices motivated workers to adhere to safety protocols. Their research demonstrated a correlation between leadership commitment to safety and reduced accident rates.

Park et al. 2021 studied the role of regulatory compliance in minimizing accidents in stone mines. They noted that stricter government regulations and penalties for non-compliance significantly reduced incidents. The study also highlighted the role of third-party safety inspections in maintaining high safety standards [3].

Kumar and Sharma 2022 conducted a comparative analysis of accident rates in mines using traditional methods versus mines employing modern technology. Their research showed that mines using advanced technologies such as drones for surveillance and AI-based monitoring systems had 50% fewer accidents. The study emphasized the importance of continuous investment in safety innovations.

Wilson and Ahmed 2023 evaluated the impact of emergency response planning on accident outcomes in stone mines. They found that mines with well-structured emergency plans and trained response teams managed accidents more effectively, resulting in fewer fatalities and quicker recovery times. The authors advocated for regular simulation exercises to enhance preparedness.

Singh et al. 2023 investigated the integration of sustainable mining practices with safety protocols. Their study found that environmentally sustainable practices, such as dust suppression and noise control, indirectly contributed to accident reduction by improving overall working conditions. They recommended holistic strategies combining sustainability and safety for long-term benefits.

Qureshi 1987 conducted a Hazard and Operability Study HAZOP in which potential hazards were identified by looking at the design in a dynamic manner; identified the nature and scale of the dangerous substances; described the arrangements for the installation's safe operation, the control of serious deviations that could result in a major accident, and the emergency procedures at the site; identified the type, relative likelihood, and consequences of major accidents that might occur; and demonstrated that the manufacturer operator had identified the major hazard potential of his activities and had implemented the necessary controls.

3. Methodology

The study comprises to examine the poor safety protocols by unregulated mining resulting the occurrence of accidents in stone Mines. Systematic field surveys were carried out, Field data collected from various articles and magazines and investigation has made for finding root causes of accidents and its mitigation strategies. The study comprises with identifying gaps in accident prevent strategies with collective results of aforesaid investigations.

3.1. Research Design

This study employs a mixed-methods research design, integrating both qualitative and quantitative approaches to explore the strategies for accident reduction in stone mines. The primary focus is on analyzing existing safety protocols, evaluating the effectiveness of best practices, and identifying gaps in accident prevention strategies

3.2. Data Collection

Data were mainly gathered from the primary sources through conducting case study of Borgaon Manju village from where stone mining activities is the main occupation of the people. The village Borgaon Manju Village is located in Akola Dt, Maharashtra State.

Methodology included field observations, photo documentation; A survey was also conducted on Training inputs, existing safety protocols and mineral policy of the area to assess the rate of accidents in stone mines. A structured questionnaire to know the mine workers perception about the accidents was administered in the field during the study.

Secondary data were also collected from the district mining department, and Mine Safety Department (DGMS Standard Note) to understand the role of legal frameworks in promoting safety.

A qualitative approach was adopted to carry out this study. Data were interpreted through various Statistical tools

Figure 1 Stone Mining in Akola Dt operated at unregulated work environment

3.3. Field Observations

More than 20 stone mines are operating on the ground. It was notice that the mines has developed without proper systematic benches and workers are working without proper training and safety. None of the quarries have mandatory warning sign boards and personal protective equipments which are serious threat to life of quarry workers. Many of the illegal quarries are there working without any safety and statutory Permissions and also conducting illegal blasting operations. The DMO did not have any satisfactory information about the illegal mining

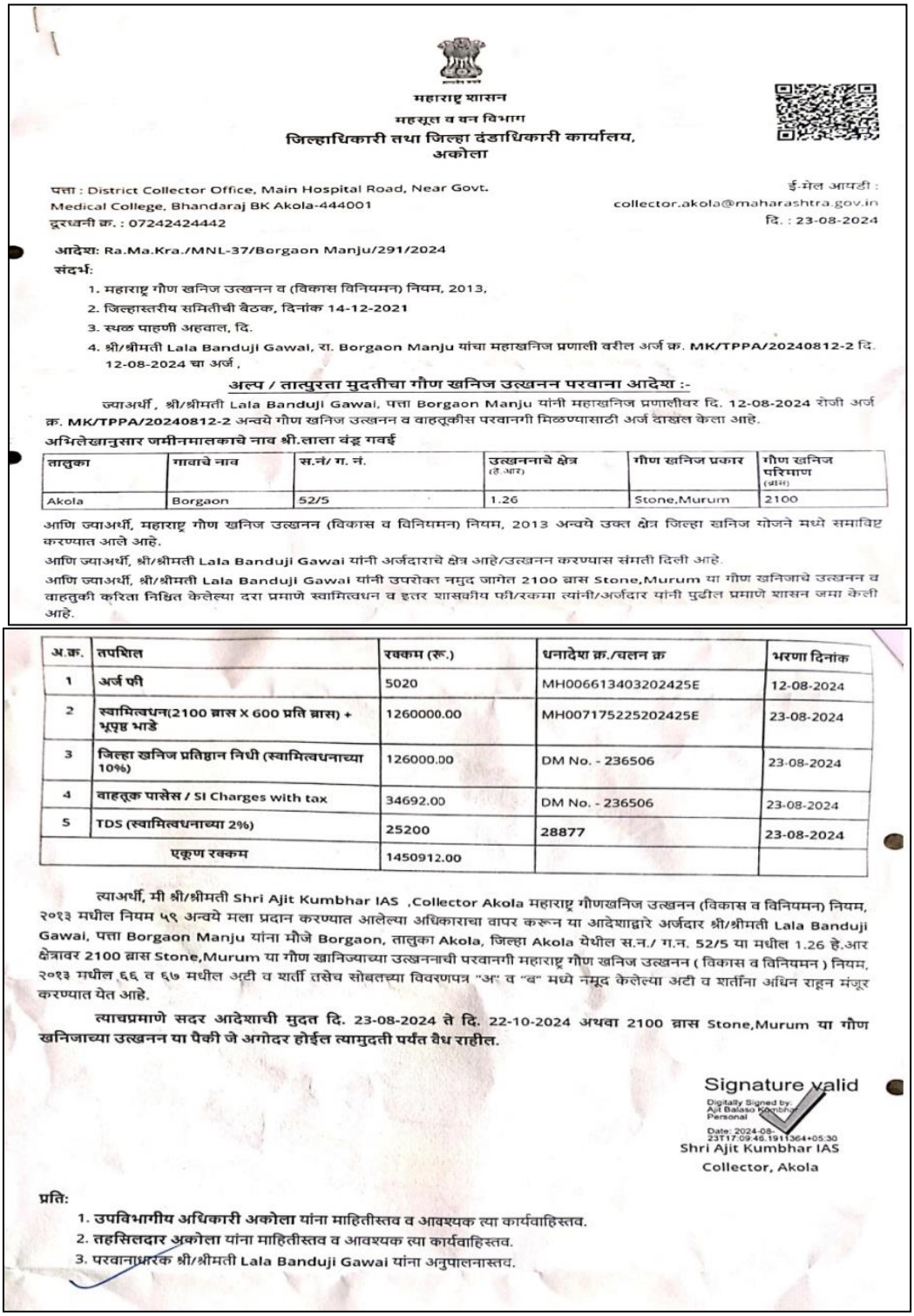
Mines safety department (DGMS) have no sufficient information about the area mines from state government. Lease holders operating the stone mines even doesn't know about the Mines Act 1952 and about Mines Safety Department (DGMS).

In field observation found that, Many of the stone mines are conducting deep hole blasting without having proper permission by using huge amount of explosives .important observation in study found that majority of the minerals are operating the mines on temporary permit basis(TP).

The mining policy of Temporary Permit Basis (TP)(TP –Temporary Permit-Granting of lease for some quantity of stone for a period of one month or three months without having environmental clearance), due to this lease holders are

violating the environmental laws and operating the mines in unregulated manner and extracting the mineral by violating the safety protocols within TP period

Short period of mining lease results in , propose for illegal mining, results in Unregulated work environment , poor equipment and infrastructure , inadequate worker Protection, Inexperienced labor force. These are all the reasons badly affecting the mining which are resulting in to accidents.



महाराष्ट्र शासन
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आदेश: Ra.Ma.Kra./MNL-37/Borgaon Manju/291/2024

संदर्भ:

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3. स्थळ पाहणी अहवाल, दि.
4. श्री/श्रीमती Lala Banduji Gawai, रा. Borgaon Manju यांचा महाखनिज प्रणाली वरील अर्ज क्र. MK/TPPA/20240812-2 दि. 12-08-2024 चा अर्ज ,

अल्प / तात्पुरता मुदतीचा गौण खनिज उत्खनन परवाना आदेश :-

ज्याअर्थी , श्री/श्रीमती Lala Banduji Gawai, पत्ता Borgaon Manju यांनी महाखनिज प्रणालीवर दि. 12-08-2024 रोजी अर्ज क्र. MK/TPPA/20240812-2 अन्वये गौण खनिज उत्खनन व वाहतूकीस परवानगी मिळण्यासाठी अर्ज दाखल केला आहे.

अभिलेखानुसार जमीनमालकाचे नाव श्री.लाला वंडू गवई

तालुका	गावाचे नाव	स.नं/ ग. नं.	उत्खननाचे क्षेत्र (हे.आर)	गौण खनिज प्रकार	गौण खनिज परिमाण (ब्रास)
Akola	Borgaon	52/5	1.26	Stone,Murum	2100

आणि ज्याअर्थी, महाराष्ट्र गौण खनिज उत्खनन (विकास व विनियमन) नियम, 2013 अन्वये उक्त क्षेत्र जिल्हा खनिज योजने मध्ये समाविष्ट करण्यात आले आहे.

आणि ज्याअर्थी, श्री/श्रीमती Lala Banduji Gawai यांनी अर्जदाराचे क्षेत्र आहे/उत्खनन करण्यास संमती दिली आहे.

आणि ज्याअर्थी, श्री/श्रीमती Lala Banduji Gawai यांनी उपरोक्त नमुद जागेत 2100 ब्रास Stone,Murum या गौण खनिजाचे उत्खनन व वाहतुकी करिता निश्चित केलेल्या दरा प्रमाणे स्वामित्वधन व इतर शासकीय फी/रक्कमा त्यांनी/अर्जदार यांनी पुढील प्रमाणे शासन जमा केली आहे.

अ.क्र.	तपशील	रक्कम (रू.)	धनादेश क्र./चलन क्र	भरणा दिनांक
1	अर्ज फी	5020	MH006613403202425E	12-08-2024
2	स्वामित्वधन(2100 ब्रास X 600 प्रति ब्रास) + भूपृष्ठ भाडे	1260000.00	MH007175225202425E	23-08-2024
3	जिल्हा खनिज प्रतिष्ठान निधी (स्वामित्वधनाच्या 10%)	126000.00	DM No. - 236506	23-08-2024
4	वाहतूक पासेस / SI Charges with tax	34692.00	DM No. - 236506	23-08-2024
5	TDS (स्वामित्वधनाच्या 2%)	25200	28877	23-08-2024
	एकूण रक्कम	1450912.00		

त्याअर्थी, मी श्री/श्रीमती Shri Ajit Kumbhar IAS ,Collector Akola महाराष्ट्र गौणखनिज उत्खनन (विकास व विनियमन) नियम, २०१३ मधील नियम ५९ अन्वये मला प्रदान करण्यात आलेल्या अधिकाराचा वापर करून या आदेशाद्वारे अर्जदार श्री/श्रीमती Lala Banduji Gawai, पत्ता Borgaon Manju यांना मौजे Borgaon, तालुका Akola, जिल्हा Akola येथील स.न./ ग.न. 52/5 या मधील 1.26 हे.आर क्षेत्रावर 2100 ब्रास Stone,Murum या गौण खानिज्याच्या उत्खननाची परवानगी महाराष्ट्र गौण खनिज उत्खनन (विकास व विनियमन) नियम, २०१३ मधील ,६६ व ६७ मधील अटी व शर्ती तसेच सोबतच्या विवरणपत्र "अ" व "ब" मध्ये नमूद केलेल्या अटी व शर्तींना अधिन राहून मंजूर करण्यात येत आहे.

त्याचप्रमाणे सदर आदेशाची मुदत दि. 23-08-2024 ते दि. 22-10-2024 अथवा 2100 ब्रास Stone,Murum या गौण खनिजाच्या उत्खनन या पैकी जे अगोदर होईल त्यामुदती पर्यंत वैध राहील.

Signature valid
Digitally Signed by: Ajit Balaso Kumbhar Personal
Date: 2024-08-23T17:09:46.191136+05:30
Shri Ajit Kumbhar IAS
Collector, Akola

प्रति:

1. **उपविभागीय अधिकारी अकोला** यांना माहितीस्तव व आवश्यक त्या कार्यवाहिस्तव.
2. **तहसिलदार अकोला** यांना माहितीस्तव व आवश्यक त्या कार्यवाहिस्तव.
3. परवानाधारक श्री/श्रीमती Lala Banduji Gawai यांना अनुपालनास्तव.

Figure 2 Temporary lease permission copy

According to a report by the International Labour Organization (ILO), the informal and illegal mining sector accounts for a disproportionately high number of mining accidents

In India, illegal stone mining is prevalent, particularly in the states of Rajasthan, Haryana, and Uttar Pradesh, Tamilnadu, data from the Indian Ministry of Labor and Employment highlights that over 1,000 mining-related fatalities are reported annually. It observed that over 30% of mining-related deaths were associated with unregulated quarries

Figure 3 Illegal stone quarry located in Tirunelveli, Tamilnadu operated at unregulated work environment

Figure 4 Stone quarry located in Karnataka operated at Zero Safety Protocol

Table 1 Trend in Fatal Accidents and Fatality in mines 2018-2024

Year	**Mines**			
	Average Accidents	**Accident Rate**	**Average Killed**	**Death Rate**
2 018-2019	228	0.67	297	0.84
2019-2020	209	0.47	264	0.65
2020-2021	185	0.49	268	0.56
2021-2022	160	0.38	186	0.36
2022 -2023	147	0.32	179	0.36
2023-2024	89	0.27	118	0.26

4. Conclusion

Rapid growth of construction activity, stone mining plays a major role in this part. Based on the identified challenges, and current practices In conclusion, this study suggest following strategies to reduce accidents in stone mines

4.1. Regulation and Enforcement

- Strengthen government regulation and monitoring of quarry operations.
- Implement regular inspections and audits to ensure safety compliance.
- Introduce penalties for illegal mining activities that cause harm to workers.
- Communication and co-ordination between state and central government departments
- Mandatory risk management plan before obtaining mining lease.
- Avoid granting temporary permit leases without obtaining Environmental Clearance.
- Mandatory to include the role of mines safety department to obtain statutory permissions.

4.2. Safety Training and Awareness

- Provide mandatory safety training programs for all workers in both legal and illegal quarries.
- Raise awareness about the dangers of illegal mining, and promote safe mining practices.

4.3. Technological Solutions

- Introduce safer and more efficient mining equipment, especially in areas where traditional methods are being used.
- Use drones and other technologies to monitor quarry operations remotely.

4.4. Community Engagement

- Foster collaboration between mining companies, local communities, and law enforcement to reduce illegal mining.
- Promote alternative livelihoods and economic activities to reduce dependence on illegal mining.

4.5. Improved Infrastructure

Ensure that quarries have adequate safety infrastructure such as protective barriers, access roads, and first-aid stations.

4.6. Risk Assessment and Planning

Regular risks assessments help identify potential hazards before they lead to accidents. Comprehensive planning is necessary to mitigate these risks.

4.7. Regulatory Inspections and Compliance

Regulatory agencies conduct regular inspections of mining operations to ensure compliance with safety standards. These agencies may impose penalties for non-compliance to encourage adherence to safety protocols.

4.8. Accident Prevention Measures

Literature on improving safety in mining operations often points to the need for better law enforcement, community outreach, and collaboration between formal and informal mining operations to reduce risks. For instance**,** ILO's Safety and Health at Work Report (2019) suggests that up to 80% of mining accidents can be prevented with proper training, better enforcement of regulations, and appropriate safety equipment.

4.9. Reducing Illegal Mining

The literature also underscores the importance of tackling the root causes of illegal mining, such as poverty and unemployment. Effective policies should promote alternative livelihoods**,** better access to formal mining opportunities, and more robust regulatory frameworks to reduce the reliance on informal and illegal mining.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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[3] Stone Mining Safety Protocols. (2022). Mining Industry Safety Guidelines, Ministry of Labor and Employment Director General of Mines Safety (DGMS) Dhanbad 2023 . *A* Standard Note issued by DGMS under the Ministry of Labor and Employment (2023), adherence to scientifically developed safety protocols in stone quarry operations is crucial for accident prevention, particularly in high-risk zones such as slopes, blasting zones, and loading areas

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