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Thematic Analysis of Mining Hazards and Jurisprudential Strategies for Their Mitigation

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Abstract

The risks associated with mining activities constitute a critical area of inquiry within Islamic jurisprudence, particularly because mineral resources serve as strategic assets that significantly influence global economic stability. A rigorous examination of these hazards through a jurisprudential framework underscores the necessity of formulating effective, ethically grounded strategies for their mitigation to ensure the responsible and equitable exploitation of mineral reserves. In modern industrial contexts, mining operations are increasingly confronted with a wide spectrum of hazards, ranging from physical and chemical risks to environmental, social, and health-related challenges, each of which poses substantial threats to human welfare, ecological integrity, and the sustainability of natural resources. Employing an analytical–descriptive methodology, this study systematically investigates these hazards and contextualizes them within established jurisprudential principles. Through this alignment, the article proposes comprehensive strategies—including targeted education, heightened awareness, expert consultation, continuous evaluation, and robust monitoring mechanisms —to reduce or eliminate mining-related risks throughout the processes of policy formulation, legislative development, and operational implementation. Adherence to these jurisprudentially informed measures not only minimizes potential harm to individuals and the environment but also ensures the provision of appropriate remedies and compensation in cases involving negligence or procedural lapses. Consequently, the study emphasizes that employers, mine proprietors, technical supervisors, mining personnel, and governmental authorities each bear distinct and critical responsibilities in the collective effort to mitigate and ultimately eliminate mining hazards.

1. Introduction

One of the most profound manifestations of divine power on land and sea is the existence of mineral resources. Mines represent some of the most beneficial blessings bestowed upon humankind immense natural assets upon which modern economies and human livelihoods fundamentally depend. In contemporary society, it is virtually impossible to imagine life without materials derived from mineral resources, highlighting their indispensable role in the advancement of civilization. Within this context, Islamic jurisprudence (fiqh) assumes a crucial role as the discipline responsible for deriving human rights and duties from the perspective of Sharia across all dimensions of life. Among these dimensions is the ethical and legal responsibility to confront, prevent, and mitigate the dangers that threaten human beings and their surrounding environment particularly those hazards emerging from natural resource exploitation. As mineral deposits constitute strategic commodities with far-reaching economic, political, and social implications for both producing and consuming nations, mining activities inherently involve diverse categories of risk. These include physical, chemical, environmental, social, and health-related hazards, all of which demand rigorous preventive and corrective measures. While the economic

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advantages of mining are undeniably significant, such benefits cannot morally or legally justify negligence regarding the risks involved. Accordingly, beyond identifying and explaining these hazards, the present study applies jurisprudential principles and legal maxims to propose actionable solutions for reducing or eliminating mining-related risks. Employers, workers, technical experts, and governmental authorities are all obligated to implement these jurisprudentially grounded strategies at every stage—ranging from planning and policy formulation to legislative drafting and operational execution. In cases of negligence or omission, Islamic jurisprudence establishes clear responsibilities for compensation and remediation. Thus, jurisprudential rules should function as a comprehensive framework ensuring that mining activities remain beneficial, ethical, and safe for current and future generations. Despite extensive literature addressing the technical and engineering dimensions of mining, very few studies have examined this topic from a jurisprudential perspective. The present study fills this gap by drawing upon primary Islamic sources —Qur'anic verses, narrations of the Ahl al-Bayt (a.s.), rational principles, and juristic texts —to enumerate the relevant jurisprudential rules and demonstrate their applicability to the mitigation of mining hazards. This study employs an analytical–descriptive methodology to systematically investigate mining hazards and contextualize them within established jurisprudential principles. The systematic steps of this research, ranging from hazard identification to the proposal of jurisprudential mitigation strategies, are illustrated in Figure 1.

Using an analytical–descriptive method, the article synthesizes these principles to propose structured, legally grounded solutions for preventing and managing mining risks. To establish a proper conceptual foundation, the key terms "jurisprudence" and "jurisprudential rules" are clarified below.

2. Jurisprudence (Fiqh)

2.1. Linguistic Background

Classically, the term fiqh denotes knowledge, understanding, and intellectual discernment. These concepts include:

- General knowledge [1];
- Specific, reflective understanding [2];
- Absolute comprehension [3];
- Deep, precise insight [4].

During the early Islamic period, fiqh evolved from its broad lexical meaning of "comprehensive understanding" to a more restricted use referring specifically to the understanding of the religion and the science of Sharia [5]. Under this early usage, fiqh encompassed doctrine, ethics, and legal rulings, rather than being confined to practical legal details [6].

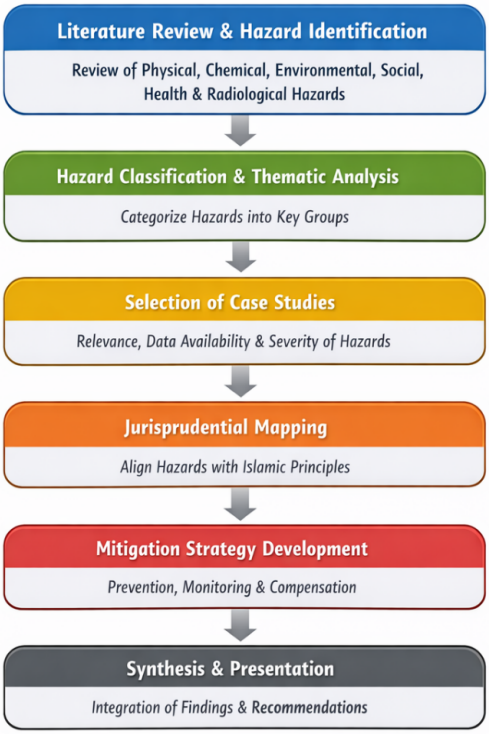

Figure 1. Flowchart of the research methodology for mapping mining hazards to jurisprudential principles and mitigation strategies

2.2. Linguistic Background

Over time, three technical definitions of fiqh have emerged:

1. General definition: divine knowledge and rulings related to belief, morality, and practice.

2. Specific definition: practical religious rulings pertaining to worship, transactions, legal matters, commercial interactions, and similar branches.

3. Technical definition (dominant in contemporary legal theory):

"Fiqh is the science of deriving detailed practical rulings from their evidentiary sources."

This definition sconsiders fiqh as a disciplined methodology for uncovering divine law through systematic reasoning [7]. In this article, fiqh is employed according to this third, technical meaning.

2. 3. Pillars of the Science of Jurisprudence

The science of jurisprudence consists of three essential pillars [8]:

1. Subject matter: the actions of legally accountable individuals.
2. Principles: foundational concepts, interpretive tools, and authoritative sources.
3. Issues: the detailed legal rulings governing the conduct and behavior of human beings.

2.4. Jurisprudential Rules

Jurisprudential rules are broad legal maxims that serve as foundational sources for deriving specific rulings. They are not confined to individual cases but function as overarching principles applicable across numerous contexts. Due to their generality, jurists rely on these rules as interpretive frameworks for resolving diverse legal questions [9]. These rules, when applied to mining, provide structured mechanisms for assessing risk, preventing harm, and ensuring accountability.

Figure 2. Classification of Hazards in Mines

3. Thematic analysis of mining hazards

Mining hazards constitute a spectrum of operational and environmental risks inherently associated with mining activities. Such hazards may result in detrimental impacts on occupational safety, public health, the socio-economic stability of local and regional communities, and the integrity of surrounding ecosystems. A summary of the most critical hazards identified in this study is provided in Figure 2 and Table 1.

In the continuation of the above table on mining hazards, numerous illustrative examples can be found worldwide, where miners have consistently been exposed to various physical, chemical, environmental, and social risks. In Iran, one of the most notable incidents occurred at the Zemestan-Yurt coal mine in Golestan Province. In May 2017, a catastrophic methane explosion claimed the lives of more than forty miners and caused multiple injuries due to burns and toxic gas inhalation. The accident was attributed to accumulated methane, which ignited during routine equipment operation, and highlighted severe deficiencies in ventilation systems and risk management practices [22]. Similarly, occupational hazards at the Golgohar Iron Ore Mine in Kerman Province, Iran, have been well documented. A detailed assessment revealed that particulate matter (PM2.5 and PM10) generated during mining operations frequently exceeded international air quality standards and contained talc, crystalline silica, and fibrous amphibole asbestos. These components are strongly associated with respiratory diseases, posing significant health risks to mine workers and nearby populations [23]. Another notable example involves chemical hazards at the Sarcheshmeh Copper Mine in Kerman, Iran. A probabilistic risk assessment evaluated acid mine drainage generation from chalcopyrite oxidation within mine tailings. Input parameters included tailings depth and concentrations of bicarbonate, chloride, nitrate, and nitric acid, while output parameters such as chalcopyrite fraction and pH were predicted probabilistically. Results indicated residual chalcopyrite of 0.1094–0.2159% and pH values of 3.13–8.04. The study underscores potential environmental and health risks, highlighting the need for monitoring, mitigation strategies, and the application of Islamic jurisprudential principles to prevent harm to workers, communities, and ecosystems [24]. This and similar incidents underscore the critical importance of applying Islamic jurisprudential principles, particularly the protection of life, the prevention of harm, and the obligation of compensation in mining operations. According to the principle of Ḍamān (guarantee), mine operators and technical personnel bear responsibility for foreseeable damages and are required to implement

preventive measures to avoid harm to workers, surrounding communities, and the environment. Moreover, such cases emphasize the necessity of continuous monitoring, risk assessment, and adherence to established safety standards to mitigate physical, environmental, and socio-economic hazards associated with mining activities.

Table 1. List of Hazards Present in Mines [10-21]

Main Hazards	Description	Hazard Category	Subcategories / Examples
Physical Hazards	Risks arising from the physical conditions of the mining work environment that affect safety, health, and productivity.	Fall and Collapse Hazards	Rockfall
			Slope failure in open-pit mines
			Tunnel roof collapse
			Soil slip and landslides
		Energy and Explosion Hazards	Explosion of explosives
			Methane gas or coal dust explosions
			Shockwaves caused by blasting
		Mechanical and Machinery Hazards	Collision with heavy machinery
			Entrapment in conveyor belts or equipment
			Mechanical failure of machines
		Environmental Condition Hazards	Extreme heat or extreme cold
			Low light or limited visibility
			Heavy rainfall, storms, or dense fog
		Vibration and Noise Hazards	Vibration from heavy machinery
			High noise levels from drilling and crushing
		Slip and Fall Hazards for Personnel	Slippery surfaces
			Working at heights without safety equipment
Geotechnical and Seismic Hazards	Risks arising from geological features, rock stability, and ground vibrations.	Ground Vibration Hazards	Natural earthquakes
			Vibrations caused by blasting
		Ground and Slope Instability	Slope failures in open-pit mines
			Displacement of rock masses
		Failure of Underground Structures	Tunnel roof collapse
			Failure of supporting pillars
		Active Tectonic Movements	Fault displacement
			Land subsidence
Chemical Hazards	Risks due to toxic gases, hazardous chemicals, and mineral dust.	Hazardous Mine Gases	Methane
			Carbon monoxide
			Hydrogen sulfide
		Mineral Dust	Coal dust
			Silica dust
			Asbestos dust
			Heavy metal dust
		Processing Chemicals	Cyanide in gold processing
			Mercury in metal extraction
			Sulfuric acid
		Chemical Pollution	Acid mine drainage
			Leakage of chemicals into water and soil
Environmental Hazards	Negative impacts on natural resources and ecosystems.	Pollution of Natural Resources	Water pollution with heavy metals
			Soil contamination with chemicals
		Air Pollution	Dust emissions
			Greenhouse gas emissions
		Ecosystem Destruction	Habitat loss
			Decline in biodiversity
		Climate Change	Global warming
		Mining Waste	Solid tailings
			Liquid tailings
Social Hazards	Socio-economic impacts of mining activities on local communities.	Forced Displacement	Forced migration
			Loss of agricultural land
		Economic Consequences	Decline of non-mining sectors
			Dependence on mining
		Public Health and Social Consequences	Spread of pollution-related diseases
			Decline in quality of life
		Conflicts and Disputes	Local protests
			Labor disputes
		Cultural Impacts	Loss of traditions and local language
Health Hazards	Injuries and diseases resulting from mining work.	Respiratory Diseases	Silicosis
			Asthma
			Bronchitis
		Musculoskeletal Disorders	Joint injuries
		Psychological Disorders	Depression
Biological Hazards	Risks caused by living organisms and pathogens.	Infectious Diseases	Various viral or parasitic diseases
		Dangerous Animals	Snakes
			Scorpions
		Microorganisms and Melds	Pathogenic fungi
Radiological Hazards	Exposure to radioactive materials or gases	Radioactive Materials	Uranium
			Thorium

4. Jurisprudential Rules and Principles Related to Mining Hazards and Solutions for Their Elimination

Mining activities, given their strategic economic role and the numerous physical, chemical, environmental, social, and health hazards they entail, constitute a critical area of concern in Islamic jurisprudence. The jurisprudential, ethical, and social principles governing the protection of human life, natural resources, and public welfare form the basis for assessing mining risks and proposing legally grounded solutions. The following sections outline major jurisprudential rules relevant to mining hazards and the mechanisms through which they contribute to reducing or eliminating such risks.

4.1. The Obligation to Protect Human Life

Derived from the Qur'anic verse, "Do not cast yourselves with your own hands into destruction" [25], this foundational principle emphasizes the sanctity of human life and the necessity of safeguarding it [26]. Islam prioritizes the protection of human life over material considerations [27]. Consequently, mining operations must be conducted in a manner that minimizes risks to workers and local communities. Employers are religiously and legally bound to:

- Prevent exposure to life-threatening conditions,
- Suspend operations when safety cannot be assured,
- Provide adequate protective equipment,
- Compensate for damages resulting from negligence, and
- Prohibit vulnerable individuals such as children and pregnant women from entering hazardous mining zones.

This principle applies not only to workers but equally to mine owners, managers, and all responsible parties.

4.2. The Rule of Respect for Muslim Property

Based on the Prophet's statement, "The blood and property of a Muslim are not lawful except with his consent" [28][29], this rule safeguards individuals' property and resources. It extends not only to present generations but also to future ones. Any action that damages mineral resources, unlawfully alters them, or exceeds contractual extraction limits violates this rule. Furthermore, damage to the property of nearby residents—such as farmland, houses, or assets —requires full compensation. Islam also protects the property of non-Muslims who are in legitimate relations with Muslims under Sharia contracts, granting their assets the same sanctity [30].

4.3. The Principle of Public Interest

This principle [31] demands that public welfare take precedence over individual gain. Mining activities must therefore safeguard:

- Publicpublic health,
- Environmentalenvironmental integrity,
- Naturalnatural resources, and
- Communitycommunity rights.

Any exploitation that harms society or promotes injustice contradicts this principle.

4.4. The Rule of Guarantee

Derived from the narration, "Whoever seizes another's property is its guarantor until he returns it" [32], this rule obligates compensation for any loss or damage that occurs under one's control, whether to the property itself or its benefits [33]. Consequently, if mining activities cause financial loss such as land erosion, pollution, or destruction of equipment the responsible party must fully compensate affected individuals.

4.5. The Rule of Waste

Based on the Qur'anic verse "Whoever transgresses against you, transgress against him in like manner" [34] and the narration, "Whoever destroys another's property is liable",," this rule addresses damage occurring even without possession of property. In contrast to the rule of guarantee, it covers destruction without physical control. Its application to mining means that employers must compensate for any harm caused to others' property—even if it occurred indirectly or unintentionally.

4.6. The Principle of "Do No Harm"

Derived from a famous hadith [35], this rule prohibits harm to oneself or others, including future generations. It mandates that mining operations ensure:

- Safe ventilation,
- Adequate protective equipment,
- Comprehensive worker training,
- Environmental protection measures.

Any activity that risks mine collapse, toxic gas release, explosions, or environmental degradation violates this principle. It also encourages halting operations when significant danger is present, adopting safer alternatives (such as bioleaching in place of cyanide for gold extraction [36]), and compensating for harm caused by negligence.

4.7. The Principle of Preventing Greater Harm Over Lesser Benefit

As a sub-rule of "no harm" [37], this principle prioritizes eliminating major risks over securing minor economic gains. If mining profits conflict with the previously mentioned hazards, eliminating risks takes precedence.

4.8. The Rule of Preventing Probable Harm

Grounded in rational jurisprudence [38], this rule obligatesmandates precaution when there is a likelihood of danger. Therefore:

- Environmental, health, and safety assessments must precede mining activities.
- Predictable risks must be mitigated.
- Operations must be halted when potential hazards exceed acceptable limits.

Employers are responsible for ensuring that all necessary equipment and preventive measures are in place.

4.9. The Principle of Consultation

Based on Qur'anic guidance, "Their affairs are conducted through consultation" [39], and relevant narrations [40], this rule emphasizes collaborative decision-making. Employers must consult:

- Local communities,
- Environmental experts,
- Economists,
- Technical specialists.

Consultation enhances transparency, fosters trust, and ensures balanced risk management.

4.10. The Principle of Consultation

Derived from the verse "And when you judge, judge with justice" [41], this principle mandates fairness in:

- Resource allocation,
- Worker compensation,
- Community engagement,
- Environmental stewardship.

The narration, "Give the worker his wages before his sweat dries" [42], reinforces the obligation of timely, fair wages and safe working conditions. Employers must ensure the equitable distribution of benefits, protect community rights, and compensate victims fairly.

4.11. Respect for Nature and Environmental Preservation

The Qur'an describes humans as Allah's vicegerents on earth [43][44], responsible for developing and protecting the environment [45]. Numerous verses temphasize:

- the purpose of creation [46],
- the prohibition of corruption on earth [47][48],
- the destructive consequences of harming nature [49],
- and ecological imbalance caused by human actions [50].

Mining activities must therefore preserve biodiversity, avoid unnecessary destruction, and prevent irreversible environmental harm.

4.12. Respect for All Creatures

The Qur'an affirms that animals and birds are "communities like yourselves" [51]. Mining operations must therefore avoid harming habitats, wildlife, and ecosystems. Any avoidable damage is considered corruption on earth and is religiously prohibited.

4.13. Returning Trusts

Natural resources are regarded as divine trusts. The verse "Allah commands you to return trusts to their owners" [52] obligates mine owners to extract and manage resources responsibly, preserving them in good condition for future generations.

4.14. The Prohibition of Extravagance

Extravagance exceeding moderation is forbidden in Islam [53][54]. Wasteful extraction or excessive exploitation of resources violates this principle. Mining operations must follow sustainable extraction rates, avoid unnecessary depletion, and compensate for any resulting damage.

4.15. Enjoining Good and Forbidding Evil

Based on the verse "You enjoin what is right and forbid what is wrong" [55][56], this principle

obligates individuals and authorities to prevent harmful mining practices. It encourages:

- Promoting safety measures,
- Enforcing ethical behavior,
- Preventing oppression and corruption,
- Encouraging safe and equitable resource use.

Governments may incentivize compliance or impose penalties for dangerous practices.

4.16. The Rule of Fulfilling Conditions

Based on the verse "O you who believe, fulfill your contracts" [57] and the narration "Believers are bound by their conditions" [58][59], this rule ensures contractual integrity. It reinforces:

- Investor confidence,
- Worker rights,
- Community agreements,
- Environmental commitments.

Broken promises constitute moral and legal violations.

4.17. The Principle of Social Balance

This principle emphasizes balancing individual and collective interests [60] and constitutes an obligation of Islamic governance (ḥisbah) [61]. Governments must regulate mining operations to ensure:

- Community welfare,
- Environmental safety,
- Worker protection,
- Sustainable practices.

They must also impose penalties for repeated violations and ensure compensation for damages.

5. Comparative analysis of jurisprudential principles and conventional risk-management frameworks

In addition to analyzing mining hazards through the lens of Islamic jurisprudence, it is important to consider how these jurisprudential principles complement or differ from conventional risk-management frameworks widely used in the mining industry, such as OSHA (Occupational Safety and Health Administration) and ISO (International Organization for Standardization) standards. While conventional frameworks primarily focus on systematic hazard identification, risk assessment, and procedural compliance, jurisprudential principles introduce an ethical and moral dimension that emphasizes responsibility, accountability, and the protection of life and property in a holistic manner.

5.1. Alignment with Conventional Standards

Several jurisprudential rules closely align with standard risk- management practices: Obligation to Protect Human Life (Ḥifẓ al-Nafs): This principle corresponds with OSHA's requirements for ensuring worker safety through hazard identification, protective equipment, and safe working conditions. Both emphasize proactive prevention of occupational injuries and fatalities. Principle of Preventing Probable Harm (Iqtidar al-Darar al-Muḥtamal): Similar to ISO 31000 risk assessment guidelines, this rule requires anticipating potential hazards and implementing preventive measures before actual damage occurs. Rule of Consultation (Shūrā): Jurisprudence encourages consultation with experts and affected communities, complementing participatory approaches in modern safety management and stakeholder engagement.

5.2. Divergences and Unique Contributions

While conventional frameworks are primarily technical and procedural, jurisprudential principles introduce broader ethical obligations that are often not explicitly addressed in OSHA or ISO standards: Liability and Compensation (Ḍamān):). Islamic jurisprudence emphasizes moral and legal accountability for any harm caused, requiring full compensation for affected individuals, whereas conventional frameworks focus more on procedural penalties and insurance claims. Respect for Property and Nature (Ḥurmat al-Māl and Ḥifẓ al-ʿĀlam): Principles such as safeguarding natural resources, avoiding waste, and preserving biodiversity extend beyond occupational safety into environmental stewardship, an area only partially addressed by ISO environmental management standards (ISO 14001). Prevention of Greater Harm over Minor Benefits (Tafḍīl al-Darar al-Akbar ʿalā al-Manfaʿa al-Ṣaghīra): This principle highlights ethical decision-making in balancing economic gains against potential harm, whereas conventional risk frameworks often prioritize operational efficiency and regulatory compliance.

5.3. Complementarity and Integration

Integrating jurisprudential principles with conventional frameworks can enhance mining safety and sustainability by:

- Providing ethical justification for safety and environmental measures beyond legal compliance.
- Strengthening community trust through consultation, compensation, and transparent risk management.
- Encouraging long-term sustainability, as adherence to jurisprudential rules ensures that resource extraction does not compromise the rights of future generations or environmental integrity.

5.4. Practical Implications

By mapping jurisprudential rules to conventional standards, mining organizations can develop a dual-framework approach, in which operational hazard management is reinforced by ethical and legal obligations rooted in Islamic jurisprudence. This integration facilitates more comprehensive decision-making, by combining quantitative risk assessment with qualitative ethical considerations.

6. Conclusions

Given the abundance, geographical distribution, and continuous human reliance on mineral resources throughout history and considering their profound economic, industrial, political, and social implications mines hold strategic importance for extraction and exploitation. Nevertheless, these critical natural reserves pose physical, chemical, environmental, social, and health-related risks to individuals, communities, ecosystems, and natural resources. In Islamic jurisprudence, recognizing these risks and their detrimental impacts on society and the environment is of essential significance. Adherence to key jurisprudential rules and principles such as the preservation of life and property, avoidance of harm, protection of public interest, liability and compensation, prevention of corruption, precaution against potential harm, consultation, justice and fairness, stewardship of nature, respect for living beings, fulfillment of trusts, prohibition of extravagance, enjoining good and forbidding evil, honoring contracts, and ensuring social balance—provides a comprehensive framework for managing and mitigating mining hazards. By applying these principles in the planning, legislation, and implementation of mining activities, employers, workers, mining specialists, and governmental authorities can substantially reduce risks and promote sustainable and ethical mining practices.

Employers and mine owners, in accordance with the aforementioned jurisprudential principles, bear the responsibility to safeguard the lives and health of their workforce, prevent harm, uphold trust, ensure justice and fairness in the distribution of rights and benefits, raise awareness, engage local communities, protect public welfare, curb corruption, utilize mineral resources reasonably, preserve reserves for future generations, and maintain transparency and accountability. Implementing these measures contributes not only to risk reduction but also to enhancing the well-being of workers and local populations. When accidents occur due to negligence or non-compliance, employers are religiously and legally obligated to compensate for the resulting damages. Mine workers play a pivotal role in preventing hazards through adherence to jurisprudential principles such as protection of life and property, maintenance of safety, prevention of harm, respect for nature, fulfillment of trust, enjoining good and forbidding evil, and compliance with contractual obligations. Their responsibilities include hazard recognition, following safety protocols, active participation in training, cooperation with supervisors, proposing solutions, and effective emergency response. These efforts enhance both personal safety and community welfare. Mining experts and technical officers also contribute significantly to hazard prevention by conducting risk assessments, designing safety plans, providing training and consultation, overseeing compliance, developing safety technologies, and managing emergencies. Their professional actions guided by jurisprudential principles of public interest, liability, harm prevention, environmental stewardship, avoidance of waste, and preservation of social balance help protect workers and improve mining conditions. Governments, as regulatory and supervisory entities, hold a critical obligation to reduce mining risks by enacting and enforcing safety standards, monitoring compliance, evaluating mining plans prior to licensing, issuing permits based on environmental and safety assessments, organizing training programs, supporting safety-enhancing technologies, and improving transport and infrastructure. These interventions, grounded in jurisprudential obligations such as protection of life and property, public interest, justice, harm prevention, and social balance, contribute to safer mining environments

and promote sustainable investment. In cases of negligence, non-compliance, or harm inflicted upon communities or the environment, governmental authorities must ensure appropriate compensation and impose penalties such as fines, suspension, or prohibition of mining activities to uphold justice and protect public welfare.

7. Limitations and Practical Challenges

While the proposed jurisprudential framework provides a robust ethical and legal foundation for mitigating mining hazards, several limitations and practical challenges must be acknowledged for its effective implementation:

7.1. Interpretational Variations across Islamic Schools

Islamic jurisprudence (Fiqh) is characterized by a diversity of interpretive traditions (Madhahib). While the core principles—such as the "Sanctity of Life" and the "Prohibition of Harm"—are universally accepted, specific applications may vary. For instance, the threshold for defining "negligence" (Taqsir) or the exact methods for calculating financial compensation (Diya and Arsh) for environmental damage might differ between Ja'fari, Hanafi, Shafi'i, Maliki, and Hanbali schools. Future studies should aim for a cross-school synthesis to develop a more unified international mining code based on Sharia.

7.2. Operational Enforcement and Regulatory Gaps

Translating abstract jurisprudential rules into concrete industrial standards requires a robust legal infrastructure. In many contexts, there is a gap between religious ethical mandates and national mining regulations. The lack of specialized monitoring bodies that understand both technical mining operations and jurisprudential requirements can hinder the enforcement of these strategies.

7.3. Complexity of Modern Mining Technologies

The rapid evolution of mining technologies, such as autonomous drilling and deep-sea mining, introduces novel risks that classical jurisprudential texts do not explicitly address. Applying traditional rules (like the Rule of Waste or the Rule of Guarantee) to high-tech environments requires continuous intellectual effort (Ijtihad) by interdisciplinary panels of engineers and jurists to ensure that modern practices remain within ethical bounds.

7.4. Economic and Practical Adaptation

Implementing comprehensive safety and environmental measures, as mandated by jurisprudence, often involves significant financial investment. For small-scale or artisanal mining operations, meeting these high ethical standards can be economically challenging. Therefore, governments and religious institutions must collaborate to provide the necessary support, training, and financial incentives to facilitate this transition without compromising the livelihoods of workers.

7.5. Summary of Jurisprudential Hazard Management

To synthesize the findings of this study and provide a practical framework for mining stakeholders, Table 2 summarizes the alignment between mining hazard categories, their corresponding jurisprudential principles, and the proposed mitigation strategies.

Table 2. Integrated Framework for Mining Hazard Mitigation based on Jurisprudential Principles

Hazard Category	Associated Jurisprudential Rule/Principle	Recommended Mitigation and Strategic Actions
Physical (Collapse, Explosions)	Preservation of Life (Hifz al-Nafs)	Mandatory safety training, use of advanced monitoring sensors, and immediate suspension of work in high-risk zones.
Chemical (Toxic Gases, Dust)	Principle of "Do No Harm" (La Darar)	Implementation of high-efficiency ventilation systems, provision of specialized PPE, and regular health screenings for miners.
Environmental (Pollution, Tailings)	Stewardship of Nature (Khilafah) & Prohibition of Corruption	Development of acid mine drainage (AMD) treatment plants, soil reclamation, and adherence to sustainable extraction rates.
Social (Displacement, Disputes)	Respect for Property & Principle of Consultation (Shura)	Transparent community engagement, fair market-value compensation for land, and local workforce development programs.
Health (Occupational Diseases)	Rule of Preventing Probable Harm	Proactive ergonomic assessments, reducing exposure limits below international standards, and robust insurance coverage.
Radiological (Radiation Exposure)	Protection of Trust (Amanah)	Specialized shielding, continuous radiological monitoring, and long-term storage safety for radioactive waste.
Operational Negligence	Rule of Guarantee (Daman) & Rule of Waste	Establishing legal liability for supervisors, mandatory compensation funds for accidents, and strict adherence to technical protocols.

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موضوع‌شناسی مخاطرات معادن و راهکارهای رفع آن از منظر فقه

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کلمات کلیدی

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چکیده

خطرات مرتبط با فعالیت‌های معدن‌کاری از جمله موضوعات حیاتی در حوزه فقه اسلامی محسوب می‌شوند، به‌ویژه آنکه منابع معدنی به‌عنوان دارایی‌های استراتژیک، نقش تعیین‌کننده‌ای در ثبات اقتصادی جهانی دارند. بررسی دقیق این خطرات با استفاده از چارچوب فقهی، ضرورت تدوین راهبردهای مؤثر و مبتنی بر اصول اخلاقی برای کاهش آن‌ها و تضمین بهره‌برداری مسئولانه و عادلانه از ذخایر معدنی را برجسته می‌کند. در زمینه‌های صنعتی مدرن، عملیات معدن‌کاری با طیف گسترده‌ای از خطرات مواجه است؛ خطراتی که شامل مخاطرات فیزیکی و شیمیایی، چالش‌های زیست‌محیطی، اجتماعی و سلامت نیروی انسانی می‌شوند و هر یک تهدیدات قابل‌توجهی برای رفاه انسان، یکپارچگی اکوسیستم و پایداری منابع طبیعی ایجاد می‌کنند. این مطالعه با بهره‌گیری از روش‌شناسی تحلیلی–توصیفی، این خطرات را به‌طور سیستماتیک بررسی کرده و آن‌ها را در چارچوب اصول فقهی موجود تبیین می‌کند. بر اساس این تطبیق، مقاله مجموعه‌ای از راهبردهای جامع را ارائه می‌دهد که شامل آموزش هدفمند، افزایش آگاهی، مشاوره تخصصی، ارزیابی مستمر و مکانیزم‌های پایش قوی می‌شوند و به کاهش یا حذف خطرات معدن‌کاری در تمام مراحل سیاست‌گذاری، تدوین قوانین و اجرای عملیاتی کمک می‌کنند. رعایت این اقدامات مبتنی بر فقه نه تنها آسیب‌های احتمالی به افراد و محیط زیست را به حداقل می‌رساند، بلکه ارائه راهکارهای جبرانی و جبران خسارت در موارد قصور یا تخطی از روندهای قانونی را نیز تضمین می‌کند. در نتیجه، این مطالعه بر این نکته تأکید می‌کند که کارفرمایان، مالکان معادن، سرپرستان فنی، کارکنان معدن و نهادهای دولتی هر یک مسئولیت‌های مشخص و حیاتی در تلاش جمعی برای کاهش و در نهایت حذف خطرات معدن‌کاری دارند.

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