

Earthquakes: An Interdisciplinary Study of Their Causes, Nature, and Human Response in the Light of Science, the Qur'an, Hadith, Classical Scholarship, and Contemporary Research

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Abstract

Earthquakes are among the most powerful natural phenomena, profoundly influencing human life, society, and intellectual thought. This interdisciplinary study examines earthquakes from the perspectives of geoscience, the Qur'an, Hadith, classical Islamic scholarship, and contemporary disaster research. It explores the scientific causes of earthquakes, including plate tectonics, fault movements, seismic waves, and aftershock patterns, while also reviewing their global and regional distribution. The study analyzes Qur'anic verses and Prophetic traditions related to earthquakes and presents the interpretations of classical Muslim scholars regarding their physical, moral, and spiritual dimensions. It further highlights the contributions of medieval Muslim scholars such as al-Kindi, Ibn Sina (Avicenna), and al-Suyuti, who discussed both natural explanations and theological perspectives on seismic events, with some advocating practical engineering measures to reduce earthquake damage. Contemporary research on disaster risk reduction demonstrates that Islamic principles of knowledge (al-ilm), responsible human effort (ikhtiyar), and trust in God (tawakkul) encourage preparedness, resilience, and proactive disaster management rather than fatalism. Case studies, particularly from India, illustrate the devastating human and economic impacts of earthquakes and emphasize the importance of resilient infrastructure, public awareness, and effective emergency planning. The study concludes that science and religion offer complementary perspectives: science explains the physical mechanisms of earthquakes and provides strategies for risk reduction, while the Qur'an, Hadith, and Islamic scholarship offer ethical guidance, spiritual reflection, and psychological resilience for individuals and communities affected by such disasters.

Introduction

Earthquakes have affected human societies throughout recorded history, causing widespread destruction, loss of life, and long-term social and economic consequences. Scientifically, an earthquake is defined as the sudden release of accumulated strain energy within the Earth's crust, producing seismic waves that propagate through the Earth and shake the ground surface. (U.S. Geological Survey [USGS], 2015)

Earthquakes frequently trigger secondary hazards, including tsunamis, landslides, liquefaction, and fires, thereby increasing their destructive impact. According to the National Academies of Sciences, Engineering, and Medicine, earthquakes cause approximately 10,000 deaths worldwide each year and result in economic losses amounting to hundreds of billions of dollars, emphasizing humanity's vulnerability because modern civilization is built upon an active and continuously deforming crust.

Because of their immense destructive power, earthquakes have been interpreted through multiple intellectual traditions, including scientific, religious, philosophical, and cultural perspectives. Modern seismology explains earthquakes primarily through the theory of plate tectonics, fault mechanics, and crustal deformation, enabling scientists to assess seismic hazards and improve disaster preparedness. (Bolt, 2004)

At the same time, religious traditions have sought to understand earthquakes not merely as physical events but also as signs carrying moral, spiritual, and existential significance. This study adopts an interdisciplinary approach by examining earthquakes through the combined perspectives of geoscience, the Qur'an, Hadith, classical Islamic scholarship, and contemporary disaster research. The Qur'an refers to earthquakes in several contexts, portraying them as manifestations of God's power, reminders of human accountability, historical punishments for certain communities, and signs associated with the Day of Judgment. (Qur'an, 7:78, 22:1, 56:4, & 99:1-8) Likewise, numerous Prophetic traditions discuss earthquakes in relation to eschatological events, moral reflection, repentance, and the importance of maintaining faith during times of calamity.

Classical Muslim scholars and scientists, including al-Kindi Ibn Sina (Avicenna) and al-Suyūṭī, offered valuable discussions concerning the causes and significance of earthquakes. While acknowledging divine wisdom behind natural events, many also explored physical explanations based on observations of the natural world and emphasized practical measures for minimizing damage. (al-Kindī, n.d.; Ibn Sīnā, n.d.; al-Suyūṭī, n.d.) Their writings demonstrate that Islamic intellectual history generally encouraged observation, rational inquiry, and responsible action rather than passive fatalism.

Contemporary disaster-risk research similarly emphasizes that religious belief can positively influence disaster preparedness when combined with scientific knowledge. Islamic concepts such as al-ilm (knowledge) ikhtiyar (human responsibility and effort) and tawakkul (trust in God after taking appropriate measures) support resilience and proactive disaster management instead of resignation. This integrated perspective is particularly relevant in South Asia, including India, Pakistan, Bangladesh, and Afghanistan, where significant seismic hazards coexist with deeply rooted religious traditions. By bringing together scientific evidence, Islamic sources, classical scholarship, and modern disaster studies, this article seeks to provide a comprehensive understanding of earthquakes that addresses both their physical mechanisms and their ethical, spiritual, and human dimensions.

Scientific Causes and Nature of Earthquakes

Modern earth science explains earthquakes primarily through the theory of plate tectonics, according to which the Earth's lithosphere is divided into several large tectonic plates that move slowly over the semi-fluid asthenosphere beneath them. (Marshak, 2019) The movement of these plates results in the accumulation of stress along faults and plate boundaries. When this accumulated stress exceeds the strength of rocks, a sudden rupture occurs, releasing enormous amounts of energy in the form of seismic waves and producing an earthquake.

The majority of earthquakes occur at plate boundaries, particularly at convergent, divergent, and transform margins. At convergent boundaries, one tectonic plate is forced beneath another in a process known as subduction, while transform boundaries generate earthquakes as plates slide horizontally past one another. India occupies the northwestern portion of the Indo-Australian Plate, which is continuously colliding with the Eurasian Plate. This ongoing continental collision has created the Himalayan Mountain range and remains the principal cause of powerful earthquakes throughout northern India, Nepal, Pakistan, and surrounding regions. Although most earthquakes occur near plate boundaries, significant earthquakes can also occur within tectonic plates when ancient faults are reactivated under accumulated stress. The devastating 2001 Bhuj earthquake in Gujarat is a notable example of such an intraplate earthquake. (Geological Survey of India [GSI], 2002)

Earthquakes begin with the rupture of rocks along a fault, generating different types of seismic waves, including Primary (P) waves, Secondary (S) waves, and surface waves. These waves propagate through the Earth and cause the ground shaking experienced during an earthquake. The size of an earthquake is measured using the Moment Magnitude Scale (Mw) which estimates the total energy released, whereas earthquake intensity is commonly measured using the Modified Mercalli Intensity (MMI) Scale, which evaluates the observed effects of shaking at specific locations.

Global seismic monitoring networks record thousands of earthquakes annually. According to the United States Geological Survey (USGS), approximately 15 earthquakes of magnitude 7.0 or greater occur worldwide each year, while earthquakes of magnitude 8.0 or greater occur roughly once annually. Furthermore, earthquake frequency follows the well-established Gutenberg–Richter relationship, whereby moderate earthquakes occur much more frequently than major earthquakes. Statistically, for every magnitude-7 earthquake, there are approximately ten magnitude-6 earthquakes.

Earthquake occurrence is irregular in both time and location, making precise prediction impossible with current scientific knowledge. Although scientists can identify regions of elevated seismic hazard and estimate long-term probabilities based on historical records and fault activity, no reliable method exists to predict the exact time, location, or magnitude of a future earthquake. Consequently, modern seismology emphasizes hazard assessment, risk reduction, earthquake-resistant construction, and early warning systems rather than deterministic prediction. Scientific evidence also indicates that global earthquake activity is controlled primarily by the continuous movement of tectonic plates driven by Earth's internal heat, and there is no long-term increase in global earthquake frequency beyond normal geological variation.

Scientific understanding has significantly influenced earthquake engineering and disaster mitigation strategies. Modern building codes incorporate reinforced concrete, steel frameworks, flexible structural systems, and base-isolation technologies to minimize structural failure during earthquakes. Interestingly, the Persian Muslim polymath Ibn Sina (Avicenna) recognized the importance of practical mitigation nearly a millennium ago. In his discussions of earthquakes, he proposed engineering measures, including deep excavations and wells, as possible means of reducing underground pressure and limiting earthquake damage, illustrating the integration of scientific observation with practical reasoning in classical Islamic scholarship. Nevertheless, scientific knowledge alone cannot eliminate earthquake losses. Effective disaster risk reduction ultimately depends upon public awareness, preparedness, resilient infrastructure, sound governance, and responsible human action.

Earthquakes in the Qur'an and Hadith

The Qur'an refers to earthquakes (zalzalah) in several contexts, presenting them as manifestations of divine power, reminders of human accountability, historical events, and signs of the Day of Judgment. Among the most explicit references is Surah al-Zalzalāh, where Allah says: "When the earth is shaken with its [final] earthquake, and the earth brings forth its burdens" (Qur'an 99:1–2). (Qur'an, 99:1–2)

Classical Qur'anic commentators explain that these verses describe the final cosmic upheaval that will precede the resurrection, demonstrating God's absolute authority over creation and reminding humanity of the certainty of the Hereafter. (Ibn Kathīr, n.d.; al-Ṭabarī, n.d.)

The Qur'an also highlights the role of mountains in maintaining the stability of the earth. Allah states: "Have We not made the earth as a resting place, and the mountains as pegs?" (Qur'an 78:6–7) (Qur'an, 78:6–7)

Similarly, another verse declares: "And He has cast into the earth firmly set mountains lest it should shake with you." (Qur'an 16:15) (Qur'an, 16:15)

Classical exegetes such as al-Ṭabarī, Ibn Kathīr, and al-Qurṭubī understood these verses as emphasizing God's wisdom in creating mountains as elements contributing to the stability and balance of the earth. While

modern geology interprets these verses differently from a scientific perspective, Muslim scholars generally agree that the primary purpose of these passages is theological, demonstrating divine wisdom and encouraging reflection upon the natural world rather than presenting a scientific explanation of plate tectonics. (al-Qurṭubī, n.d.; Ibn Kathīr, n.d.)

Far from encouraging fatalism, the Qur'an repeatedly urges believers to observe nature, seek knowledge, and exercise wisdom in dealing with worldly affairs. Numerous verses invite humanity to reflect upon the signs of creation and to pursue understanding as part of fulfilling their responsibility before God. (Qur'an, 3:190–191, 29:20, 30:9, & 39:9) Contemporary Islamic scholarship similarly argues that Islamic teachings promote disaster preparedness, scientific inquiry, and responsible human action. The concepts of al-ilm (knowledge), ikhtiyar (human effort and responsibility), and tawakkul (trust in Allah after taking appropriate measures) together establish a balanced Islamic approach to natural disasters rather than passive resignation.

The Sunnah of the Prophet Muḥammad further provides practical and spiritual guidance for responding to calamities. The Prophet instructed believers to exercise patience (ṣabr), remember Allah, and seek His assistance during times of hardship. Among the well-known supplications taught by the Prophet is:

"Inna lillahi wa inna ilayhi raji'un. Allahumma'jurni fi muṣibati wa akhlif li khayran minha." ("Indeed, we belong to Allah, and to Him we shall return. O Allah, reward me in my affliction and compensate me with something better than it.")

This supplication emphasizes spiritual resilience, hope, and reliance upon Allah without discouraging practical action. The Prophet also instructed believers to remove harm from others, assist those in distress, and fulfill their social responsibilities during times of crisis. Consequently, Muslim jurists have maintained that protecting human life (ḥifẓ al-nafs) is one of the foremost objectives (maqāṣid) of Islamic law. In situations involving earthquakes or other disasters, preserving life may justify temporary modifications in communal obligations while simultaneously encouraging relief work, charity (zakah and ṣadaqah), rescue operations, and mutual assistance. (al-Shāṭibī, n.d.)

Overall, the Qur'an and the Sunnah portray earthquakes as natural events that carry spiritual, ethical, and moral lessons without reducing them solely to divine punishment or unavoidable fate. Contemporary Islamic disaster studies likewise conclude that calamities are understood as tests from Allah that require both sincere faith and responsible human effort. Therefore, Islamic teachings encourage believers to combine trust in God with scientific knowledge, preparedness, and compassionate service to those affected by disasters.

Classical Islamic Scholarship on Earthquakes

The intellectual heritage of classical Islamic civilization demonstrates that Muslim scholars approached earthquakes through both scientific investigation and theological reflection. During the Islamic Golden Age (eighth to thirteenth centuries CE) scholars translated and critically examined Greek, Persian, and Indian scientific works while simultaneously developing original explanations based on observation and rational inquiry. Their discussions of earthquakes illustrate the integration of empirical reasoning with religious belief, rather than a conflict between science and faith. (Saliba, 2007)

Among the earliest Muslim philosophers to examine earthquakes was Abu Yusuf Yaqub ibn Ishāq al-Kindi (d. c. 873 CE), often regarded as the "Philosopher of the Arabs." In his treatise "Risalah fi al-Riyāḥ al-Dakhlīyah fi Jawf al-Ard" ("On Winds in the Bowels of the Earth") al-Kindi explored the possibility that subterranean winds and compressed air contributed to seismic activity. His work reflected the influence of Aristotelian natural philosophy while emphasizing observation of natural phenomena.

The Persian polymath Ibn Sina (Avicenna) (980-1037 CE) further developed natural explanations for earthquakes in his encyclopedic work Kitāb al-Shifā. Rejecting simplistic supernatural explanations, Ibn Sīnā

argued that earthquakes could result from the accumulation of pressure caused by trapped air, underground water, collapsing rock formations, or the movement of subterranean materials. He maintained that these physical processes were part of the natural order established by Allah and therefore worthy of scientific investigation. His approach represents one of the earliest systematic attempts in Islamic intellectual history to explain seismic phenomena through geological processes rather than attributing them exclusively to miraculous intervention. (Akasoy, 2009)

Other prominent Muslim scholars, including al-Biruni (973-1048 CE) and Ibn Rushd (Averroes) (1126-1198 CE), also contributed to discussions of geography, geology, and the structure of the earth. Although earthquakes were not the primary focus of their writings, their works promoted observation, measurement, and rational analysis of natural phenomena, laying important foundations for later scientific inquiry. Likewise, Jabir ibn Ḥayyan (Geber) discussed earthquakes in connection with mineral formation, subterranean heat, and the transformation of natural substances, reflecting the broad scientific interests of early Muslim scholars.

During the twelfth and thirteenth centuries, scholars such as Zakariyya al-Qazwini and Aḥmad al-Tifashi refined earlier theories by proposing that highly compressed gases and vapours trapped beneath the Earth's surface could suddenly escape, producing earthquakes and volcanic eruptions. These explanations demonstrate an increasing effort to interpret earthquakes through natural mechanisms based on observation and inherited scientific traditions. Alongside these rational approaches, some medieval scholars also preserved cosmological explanations rooted in popular tradition. For example, al-Nuwayri described the legendary Mount Qaf theory, according to which movements of a cosmic mountain under divine command could produce earthquakes in different regions of the world. Such accounts illustrate the coexistence of empirical inquiry and symbolic cosmology within medieval Islamic thought.

A significant shift occurred during the late medieval period with the writings of the Egyptian scholar Jalal al-Din al-Suyuti (1445-1505 CE). In his treatise “Kashf al-Ṣalṣalah an Waṣf al-Zalzalah”, regarded as the first Arabic work devoted entirely to earthquakes, al-Suyūṭi compiled historical accounts of more than one hundred earthquakes across the Muslim world. Unlike earlier natural philosophers, he emphasized Qur'anic verses, Prophetic traditions, and historical reports that interpreted earthquakes primarily as divine warnings or punishments resulting from widespread sin and moral corruption. (al-Suyūṭi, n.d.) His work profoundly influenced later scholars, including al-Dawudi, who continued recording earthquakes from theological and historical perspectives.

Similarly, the sixteenth-century scholar Ibn al-Jazzar, after witnessing the devastating Damascus earthquake of 1576, argued that earthquakes should ultimately be understood as manifestations of Allah's decree rather than merely physical events. While such scholars emphasized divine wisdom and moral accountability, they did not necessarily reject practical responses to natural disasters.

Indeed, classical Islamic scholarship consistently encouraged practical measures to reduce harm and protect human life. Historical evidence indicates that architects in earthquake-prone regions constructed mosques, fortifications, and public buildings using deep foundations, thick supporting walls, and structural techniques intended to improve stability. Ibn Sīnā even proposed digging deep wells or excavations to relieve underground pressure, reflecting an early appreciation of engineering approaches to earthquake mitigation. Historical chronicles further record that when earthquakes struck major cities, inhabitants often evacuated damaged buildings and gathered in open areas until aftershocks subsided. Muslim jurists generally supported such precautionary measures, maintaining that the preservation of human life (ḥifẓ al-nafs) takes precedence over remaining inside unsafe structures for communal worship. (Hallaq, 2009)

Overall, classical Islamic scholarship presents a remarkably diverse understanding of earthquakes. Muslim thinkers did not adopt a single explanation; rather, they combined theological reflection, philosophical reasoning, historical observation, and practical experience. Their works reveal an intellectual tradition that

sought to understand the natural world while affirming divine sovereignty, thereby demonstrating that scientific inquiry and religious belief were viewed as complementary rather than contradictory approaches to understanding seismic phenomena.

Contemporary Research and Earthquake Risk

Contemporary earthquake research has become increasingly interdisciplinary, integrating the fields of geology, geophysics, civil engineering, disaster management, environmental science, and social sciences. Advances in satellite geodesy, Global Positioning System (GPS) technology, remote sensing, and digital seismic monitoring have enabled scientists to measure crustal deformation with remarkable precision and identify active fault systems capable of generating destructive earthquakes. These technologies have significantly improved seismic hazard assessment, allowing governments and scientific institutions to develop probabilistic hazard maps that guide urban planning and disaster mitigation.

India represents one of the world's most seismically active regions because of the continuing collision between the Indo-Australian Plate and the Eurasian Plate. Scientific studies conducted by the National Centre for Seismology indicate that the majority of destructive earthquakes occur along the Himalayan plate boundary, although damaging intraplate earthquakes have also occurred in the Peninsular region, including the devastating 2001 Bhuj earthquake. (National Centre for Seismology [NCS], n.d.; GSI, 2002)

To facilitate disaster planning, the Bureau of Indian Standards (BIS) has divided the country into Seismic Zones II, III, IV, and V, representing increasing levels of seismic hazard. The Himalayan region, northeastern India, parts of Jammu and Kashmir, Uttarakhand, Himachal Pradesh, and the Kutch region of Gujarat fall within Zones IV and V, where the probability of severe ground shaking is greatest.

Earthquake engineering has made remarkable progress during the past few decades. Modern structural engineering employs reinforced concrete, ductile steel frames, base-isolation systems, seismic dampers, and energy-dissipating devices to reduce structural damage during earthquakes. At the same time, many countries have developed Earthquake Early Warning (EEW) systems that utilize dense networks of seismic sensors to detect the faster-moving Primary (P) waves and transmit warnings before the arrival of the more destructive Secondary (S) and surface waves. Countries including Japan, Mexico, Taiwan, the United States, Türkiye, and India have implemented or are expanding such systems, providing several seconds to nearly a minute of advance warning depending on the distance from the earthquake epicentre. (Allen & Melgar, 2019) Although these warning periods are brief, they are sufficient to stop trains, shut down industrial systems, suspend surgical procedures, and allow individuals to take protective actions.

Beyond geological and engineering research, contemporary disaster studies increasingly examine the social and psychological dimensions of earthquake risk. Research conducted in Muslim-majority societies such as Indonesia, Malaysia, Pakistan, and Türkiye demonstrates that religious beliefs significantly influence public perceptions of disasters and preparedness strategies. While some individuals interpret earthquakes solely as manifestations of divine decree, recent studies indicate that Islamic teachings, when properly understood, encourage disaster preparedness rather than fatalism. Scholars emphasize that the principles of *al-ilm* (knowledge), *ikhtiyar* (responsible human effort), and *tawakkul* (trust in Allah after taking appropriate measures) complement modern disaster risk reduction policies. One recent interdisciplinary study concluded that neither the Qur'an nor authentic Hadith instruct believers to remain passive in the face of natural disasters; instead, Islamic teachings encourage scientific knowledge, planning, engineering, evacuation, and community resilience alongside spiritual reliance upon God.

Modern seismological research also provides important insights into global earthquake frequency. According to long-term records maintained by the United States Geological Survey (USGS), approximately 15 earthquakes of magnitude 7.0 or greater occur worldwide each year, while earthquakes of magnitude 8.0 or

higher occur approximately once annually. Apparent increases in earthquake activity during particular years, such as 2004 or 2011, reflect natural statistical clustering rather than a sustained increase in global seismicity.

Improved seismic instrumentation has increased the detection of small earthquakes, but scientific evidence indicates that the long-term occurrence of major earthquakes has remained relatively stable over the past century. Contemporary disaster research further emphasizes that earthquakes become disasters primarily because of human vulnerability rather than geological processes alone. Rapid urbanization, population growth, poorly enforced building regulations, and inadequate emergency preparedness substantially increase earthquake losses, particularly in developing countries. Following major disasters such as the 1993 Latur earthquake and the 2001 Bhuj earthquake, India strengthened national seismic building codes and established comprehensive disaster management policies through the National Disaster Management Authority (NDMA). Publications such as the Simplified Guidelines for Earthquake Safety of Buildings have promoted earthquake-resistant construction, public awareness, and preparedness at both governmental and community levels.

Consequently, contemporary earthquake research recognizes that effective disaster risk reduction requires not only scientific understanding of seismic hazards but also resilient infrastructure, informed public policy, social awareness, and community participation.

Case Studies and Examples

Historical and contemporary earthquakes provide valuable insights into the scientific, social, and humanitarian dimensions of seismic disasters. They demonstrate that although earthquakes are natural geological phenomena, their consequences are largely determined by factors such as population density, building quality, preparedness, emergency response, and governance. The following examples illustrate how scientific understanding, engineering practices, and community resilience have evolved through experience. (United Nations Office for Disaster Risk Reduction [UNDRR], n.d.)

India has experienced several devastating earthquakes due to its location along the active boundary between the Indo-Australian and Eurasian tectonic plates.

Between 1897 and 1950, four major earthquakes of magnitude 8.0 or greater struck the Himalayan region, including the 1897 Assam Earthquake, the 1905 Kangra Earthquake, the 1934 Bihar-Nepal Earthquake, and the 1950 Assam-Tibet Earthquake. These events significantly advanced scientific understanding of Himalayan tectonics and highlighted the urgent need for earthquake-resistant construction throughout northern India.

One of the most destructive earthquakes in modern Indian history was the Bhuj (Kachchh) Earthquake of 26 January 2001, which registered a magnitude of 7.7.

The earthquake caused approximately 20,000 deaths, injured more than 167,000 people, and destroyed hundreds of thousands of homes and public buildings across Gujarat. Geological investigations documented extensive ground deformation, surface ruptures, soil liquefaction, and the reactivation of ancient faults. The disaster also exposed serious weaknesses in building construction and emergency preparedness, prompting the Government of India to strengthen national building codes, improve seismic hazard assessments, and establish more comprehensive disaster management policies.

Another significant event was the 2005 Kashmir Earthquake (Magnitude 7.6), which struck the mountainous border region of Pakistan and India on 8 October 2005. The earthquake resulted in approximately 87,000 fatalities, injured tens of thousands of people, and left millions homeless. Difficult terrain, damaged transportation networks, and severe weather complicated rescue operations. Alongside governmental and international humanitarian agencies, religious institutions—including mosques, Islamic charities, and local community organizations—provided emergency shelters, food distribution, medical assistance, and psychological support. Islamic practices such as *zakah*, *ṣadaqah*, and voluntary charitable service played a

significant role in relief and rehabilitation efforts. (International Federation of Red Cross and Red Crescent Societies [IFRC], 2008; Islamic Relief Worldwide, n.d.)

The 2015 Gorkha (Nepal) Earthquake, measuring Magnitude 7.8, caused widespread devastation throughout central Nepal. Approximately 9,000 people lost their lives, while more than 22,000 were injured. (U.S. Geological Survey [USGS], 2015; United Nations Development Program [UNDP], 2015)

The earthquake damaged thousands of homes, schools, hospitals, and historical monuments, including several UNESCO World Heritage Sites in Kathmandu Valley. International rescue teams, engineers, humanitarian organizations, and local volunteers participated extensively in relief operations. Religious communities also contributed by providing temporary shelters, organizing prayers, and offering emotional and spiritual support to affected populations, illustrating the complementary roles of humanitarian action and religious solidarity during disasters.

Beyond South Asia, several major earthquakes have transformed global approaches to earthquake engineering and disaster management. The 1906 San Francisco Earthquake, the 1923 Great Kanto Earthquake, the 1985 Mexico City Earthquake, and the 1995 Great Hanshin (Kobe) Earthquake each exposed weakness in urban infrastructure while stimulating important advances in seismic building design, emergency planning, and public education. In particular, the Kobe earthquake, which caused approximately 6,500 deaths, prompted Japan to strengthen structural design standards, modernize emergency response systems, and expand community-based disaster preparedness programs that continue to influence international best practices today.

Global earthquake statistics further reinforce the scientific principle that destructive earthquakes remain relatively infrequent but carry enormous humanitarian consequences. According to long-term records maintained by the United States Geological Survey (USGS), the world experiences, on average, approximately one magnitude 8.0 or greater earthquake and around 15 earthquakes of magnitude 7.0-7.9 each year. However, earthquake fatalities vary greatly because the severity of disasters depends more upon human vulnerability than upon earthquake magnitude alone. For example, the 2010 Haiti Earthquake (Magnitude 7.0) caused an estimated 230,000 deaths, largely because of poor construction standards and limited emergency capacity.

Similarly, the 2004 Indian Ocean Earthquake (Magnitude 9.1-9.3) generated a catastrophic tsunami that killed approximately 230,000 people across fourteen countries, making it one of the deadliest natural disasters in recorded history. (U.S. Geological Survey [USGS], 2007; National Oceanic and Atmospheric Administration [NOAA], 2004)

These case studies clearly demonstrate that earthquakes become humanitarian disasters primarily when vulnerable populations, inadequate infrastructure, and insufficient preparedness intersect with seismic hazards. Scientific advances in hazard mapping, earthquake-resistant engineering, and early warning systems have substantially reduced disaster risk in many countries. At the same time, ethical values, community solidarity, religious institutions, and humanitarian cooperation remain essential components of effective disaster response and long-term recovery. Consequently, both scientific knowledge and social resilience are indispensable for minimizing the human impact of future earthquakes.

Human Response and Preparedness

Earthquake disasters demonstrate that the severity of their consequences depends not only on the magnitude of seismic events but also on the preparedness and resilience of affected communities. Contemporary disaster management therefore emphasizes a comprehensive approach that integrates engineering, public policy, community participation, psychological support, and ethical values. Effective earthquake preparedness significantly reduces casualties, economic losses, and long-term social disruption.

From a physical perspective, preparedness begins with the construction of earthquake-resistant infrastructure and the enforcement of modern building codes. Engineers recommend the use of reinforced concrete, ductile steel structures, seismic isolation systems, and flexible foundations capable of absorbing seismic energy during ground shaking. Governments also promote hazard-sensitive land-use planning by restricting construction on unstable slopes, active fault zones, and areas vulnerable to liquefaction. In addition, Earthquake Early Warning (EEW) systems, emergency communication networks, evacuation planning, and public awareness campaigns have become essential components of disaster risk reduction. Educational institutions throughout many earthquake-prone countries regularly conduct "Drop, Cover, and Hold On" drills to prepare students and staff for emergency situations. In India, the National Disaster Management Authority (NDMA) coordinates nationwide awareness campaigns, mock drills, and capacity-building programs designed to improve community preparedness and institutional response.

The social dimension of earthquake response is equally important. Immediately after major earthquakes, local communities often become the first responders, providing rescue assistance, emergency shelter, food distribution, and medical care before external agencies arrive. Community-based disaster management has therefore become an internationally recognized strategy for strengthening resilience. Religious institutions frequently play a significant humanitarian role during such emergencies. Mosques, churches, temples, and other places of worship are commonly converted into temporary shelters and relief centres, while charitable organizations mobilize volunteers and financial assistance for affected populations. Within Islamic societies, *zakah*, *sadaqah*, and voluntary humanitarian service constitute important mechanisms for supporting disaster victims and rebuilding damaged communities. (Islamic Relief Worldwide, n.d.; Muslim Aid, n.d.)

Earthquakes also produce profound psychological and emotional effects. Survivors frequently experience fear, anxiety, grief, trauma, and uncertainty, particularly during prolonged aftershock sequences. (World Health Organization [WHO], 2003)

Contemporary disaster psychology recognizes that emotional recovery requires not only medical and psychological care but also strong family relationships, community support, and cultural or religious resources that promote resilience.

In Islamic teaching, concepts such as *ṣabr* (patience) *dua* (supplication) *tawakkul* (trust in Allah), and mutual assistance provide spiritual comfort while encouraging believers to remain hopeful and compassionate during times of hardship. (Qur'an, 2:155-157, 94:5-6; Ṣaḥīḥ Muslim, n.d.)

These teachings foster psychological resilience without discouraging practical efforts to reduce future risks. Modern Islamic scholarship strongly rejects the misconception that belief in divine decree requires passive acceptance of disasters. Rather, contemporary Muslim scholars emphasize that *tawakkul* must always be accompanied by *ikhtiyar*, responsible human effort, and *al-ilm*, the pursuit of beneficial knowledge. Islamic teachings consistently encourage believers to seek knowledge, adopt preventive measures, and protect human life while placing ultimate trust in Allah. (Ibn Rajab al-Ḥanbalī, n.d.; al-Ghazālī, n.d.)

Studies conducted in Muslim-majority societies demonstrate that disaster education becomes more effective when scientific information is presented alongside Islamic ethical values. Educational programmes incorporating relevant Qur'anic teachings and Prophetic guidance have been shown to improve public awareness, strengthen preparedness, and reduce fatalistic attitudes toward natural disasters.

Several international disaster responses illustrate the successful integration of scientific expertise and religious values. Following the 2004 Indian Ocean tsunami, which was triggered by a massive undersea earthquake, numerous Islamic humanitarian organizations-including Islamic Relief Worldwide, Muslim Aid, and national charitable foundations-provided emergency relief, temporary housing, healthcare services, educational support, and long-term reconstruction through the principles of *ṣadaqah jariyah* (continuous charity). Likewise, after the 2011 Great East Japan (Tohoku) Earthquake and Tsunami, Japan combined

advanced engineering, early warning technology, efficient emergency management, and strong community cohesion with cultural and religious practices that supported emotional healing and collective recovery.

These examples demonstrate that scientific preparedness and spiritual support are not competing approaches but complementary elements of comprehensive disaster resilience.

Contemporary interdisciplinary research increasingly supports this integrated perspective. Scholars argue that the most effective disaster risk reduction strategies combine scientific knowledge (al-ilm) responsible human action (ikhtiyar) and trust in divine wisdom (tawakkul). This "knowledge-effort-trust" framework encourages communities to adopt earthquake-resistant construction, participate in disaster education, strengthen emergency preparedness, and maintain psychological resilience through faith and social solidarity.

Consequently, successful earthquake preparedness requires cooperation between scientists, engineers, governments, educators, religious leaders, and local communities to create societies that are both physically resilient and spiritually prepared to face future disasters.

Conclusion

Earthquakes are among the most significant natural hazards confronting humanity, affecting millions of people through loss of life, destruction of infrastructure, economic disruption, and long-term psychological consequences. This interdisciplinary study has demonstrated that a comprehensive understanding of earthquakes requires the integration of insights from earth science, Islamic scripture, classical Muslim scholarship, and contemporary disaster research.

Rather than presenting competing explanations, these perspectives complement one another by addressing different dimensions of the same phenomenon. From the scientific perspective, modern geology and seismology explain earthquakes as the result of tectonic plate movements, fault rupture, and the release of accumulated geological stress within the Earth's crust. Advances in geophysical research, satellite monitoring, seismic hazard mapping, earthquake engineering, and early warning systems have substantially improved humanity's ability to reduce disaster risks and protect vulnerable populations. (U.S. Geological Survey [USGS], 2015; Bolt, 2004)

Although precise prediction of earthquakes remains beyond current scientific capability, modern science provides reliable methods for assessing seismic hazards, designing earthquake-resistant structures, and strengthening emergency preparedness.

Islamic teachings provide an equally important ethical and spiritual framework for understanding earthquakes. The Qur'an presents earthquakes as signs of Allah's power, reminders of human accountability, and events that encourage reflection upon the temporary nature of worldly life. (Qur'an, 16:15, 22:1, 56:4, & 99:1-8)

Likewise, the Sunnah of the Prophet Muḥammad emphasizes patience (ṣabr) compassion, prayer, mutual assistance, and responsible action during times of calamity. Rather than promoting passive fatalism, Islamic teachings consistently encourage believers to seek knowledge (al-ilm), adopt preventive measures, preserve human life, and place their trust in Allah only after making sincere human efforts (ikhtiyar) through the principle of tawakkul. (Ibn Rajab al-Ḥanbalī, n.d.; al-Ghazālī, n.d.; Qur'an, 3:159, 65:3)

The review of classical Islamic scholarship further reveals that Muslim intellectuals approached earthquakes through a balanced combination of scientific inquiry and theological reflection. Scholars such as al-Kindi, Ibn Sina (Avicenna), al-Biruni, and Ibn Rushd investigated natural explanations for seismic activity while affirming that the natural world operates according to the laws established by Allah. Later scholars, including

Jalal al-Din al-Suyuti, emphasized the moral and spiritual dimensions of earthquakes without entirely dismissing the importance of practical measures for protecting human life. This intellectual tradition demonstrates that Islamic civilization historically viewed scientific investigation and religious belief as complementary sources of knowledge rather than opposing worldviews.

Contemporary interdisciplinary research reinforces this integrated understanding. Studies in disaster risk reduction indicate that communities achieve greater resilience when scientific education is combined with ethical, cultural, and religious values that encourage responsibility, cooperation, and preparedness. In Muslim societies, disaster management programmes that incorporate Islamic concepts such as al-ilm, ikhtiyar, and tawakkul have proven effective in reducing fatalistic attitudes and promoting proactive disaster preparedness. This approach enables religious leaders, educators, engineers, policymakers, and emergency responders to work collaboratively toward protecting lives and strengthening community resilience.

Ultimately, earthquakes illustrate that scientific knowledge and religious wisdom address different but complementary aspects of reality. Science explains how earthquakes occur and provides practical methods for minimizing their destructive effects, whereas the Qur'an, Hadith, and Islamic scholarship provide ethical guidance, spiritual meaning, and psychological resilience for individuals and communities facing such calamities. Neither perspective alone fully addresses the complexity of earthquake disasters. A truly interdisciplinary approach recognizes the value of scientific research, engineering innovation, religious teachings, humanitarian action, and community participation as mutually reinforcing elements of disaster preparedness and recovery. Such an integrated framework not only contributes to academic understanding but also promotes safer, more resilient, and more compassionate societies capable of responding effectively when earthquakes occur. (National Disaster Management Authority [NDMA], 2007; UNDRR, 2019)

References

- Akasoy, A. (2009). Interpreting earthquakes in medieval Islamic texts. In C. Mauch & C. Pfister (Eds.), *Natural disasters, cultural responses: Case studies toward a global environmental history*. Lexington Books.
- Allen, R. M., & Melgar, D. (2019). Earthquake early warning: Advances, scientific challenges, and societal needs. *Annual Review of Earth and Planetary Sciences*, 47, 361–388. <https://www.annualreviews.org/content/journals/10.1146/annurev-earth-053018-060457>
- al-Ghazālī, Abū Ḥamid Muḥammad. (n.d.). *Iḥyā' 'ulūm al-dīn*.
- al-Kindī. (n.d.). *Risālah fī al-zalāzil* [Treatise on earthquakes].
- al-Qurṭubī, Muḥammad ibn Aḥmad. (1964). *Al-jāmi' li-aḥkām al-Qur'ān* (2nd ed.; A. al-Bardūnī & I. Aṭṭāyish, Eds.). Dār al-Kutub al-Miṣriyyah. <https://kawakib.ppj.unp.ac.id/index.php/kwkib/article/view/70>
- al-Shāṭibī, Abū Ishāq. (n.d.). *Al-muwāfaqāt fī uṣūl al-sharī'ah* (Vol. 2).
- al-Suyūṭī, Jalāl al-Dīn. (n.d.). *Kashf al-ṣaḥālah 'an waṣf al-zalzalah*. <https://deadseaquake.info/EarthquakeCatalogOfTheDeadSea/AuthorBios/Refs/AsSoyuti.html>
- al-Ṭabarī, Muḥammad ibn Jarīr. (n.d.). *Jāmi' al-bayān* [Commentary on the Qur'an].
- Bolt, B. A. (2004). *Earthquakes* (5th ed.). W. H. Freeman. <https://obnb.uk/p6930875-earthquakes>
- Geological Survey of India. (2002). *The 2001 Bhuj earthquake: Geological studies*. Geological Survey of India.
- Hallaq, W. B. (2009). *Sharī'a: Theory, practice, transformations*. Cambridge University Press. <https://www.cambridge.org/core/books/abs/sharia/preface-and-acknowledgments/0C61939333643A5978173D39DF101A45>
- Ibn Kathīr, Ismā'il ibn 'Umar. (n.d.). *Tafsīr al-Qur'ān al-'aẓīm* [Commentary on the Qur'an]. <https://hurqalya.ucmerced.edu/node/3531>
- Ibn Rajab al-Ḥanbalī, 'Abd al-Raḥmān ibn Aḥmad. (2003). *Jāmi' al-'ulūm wa-al-ḥikam fī sharḥ khamsin ḥadīthan min jawāmi' al-kalim*. Dār al-Fikr.
- Ibn Sīnā, Abū 'Alī al-Ḥusayn ibn 'Abd Allāh. (n.d.). *Kitāb al-shifā'* [The Book of Healing].
- International Federation of Red Cross and Red Crescent Societies. (2008). *A review of the Pakistan earthquake operation: 2005–2008*. <https://www.ifrc.org/evaluation/review-pakistan-earthquake-operation-2005-2008>
- Islamic Relief Worldwide. (n.d.). *Disaster response and humanitarian assistance*.
- Marshak, S. (2019). *Essentials of geology* (6th ed.). W. W. Norton & Company. <https://ci.nii.ac.jp/ncid/BB28518607>
- Muslim Aid. (n.d.). *Emergency relief programmes*.
- National Centre for Seismology. (n.d.). *Seismicity of India*. Ministry of Earth Sciences, Government of India. <https://seismo.gov.in/>
- National Disaster Management Authority. (2007). *Guidelines on management of earthquakes*. Government of India. https://upsdma.up.nic.in/ndma_guidline.htm
- National Oceanic and Atmospheric Administration. (n.d.). 2004 December 26: Indian Ocean tsunami. National Centers for Environmental Information. <https://www.ncei.noaa.gov/products/natural-hazards/tsunamis-earthquakes-volcanoes/tsunamis/recent-significant-events>
- Saliba, G. (2007). *Islamic science and the making of the European Renaissance*. MIT Press.
- Ṣaḥīḥ Muslim. (n.d.). *Kitāb al-janā'iz* [Book of funerals].
- The Holy Qur'an. (1301–1373), I. i. (1999). *Tafsīr al-Qur'ān al-'Aẓīm*. Dār Ṭayyibah, Riyadh (or Dār al-Kutub al-'Ilmiyyah, Beirut editions).
- United Nations Development Programme. (2015). *Rapid earthquake recovery in Nepal*. <https://www.undp.org/sites/g/files/zskgke326/files/migration/np/0955962caef6f2655934d4489b305569a5942637fd8d5f06f43a6ad3ccb6afcc.pdf>

United Nations Office for Disaster Risk Reduction. (2019). Global assessment report on disaster risk reduction 2019. United Nations. <https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2019>

U.S. Geological Survey. (n.d.). Earthquake hazards program. U.S. Department of the Interior. <https://www.usgs.gov/earthquake-hazards>

U.S. Geological Survey. (2015). Assessment of existing and potential landslide hazards resulting from the April 25, 2015 Gorkha, Nepal earthquake sequence (Open-File Report 2015-1142). U.S. Department of the Interior. <https://pubs.usgs.gov/publication/ofr20151142>

U.S. Geological Survey. (2007). Seismicity associated with the Sumatra-Andaman Islands earthquake of 26 December 2004. U.S. Department of the Interior. <https://www.usgs.gov/publications/seismicity-associated-sumatra-andaman-islands-earthquake-26-december-2004>

World Health Organization. (2003). Mental health in emergencies: Mental and social aspects of health of populations exposed to extreme stressors (WHO/MSD/MER/03.01). <https://www.who.int/publications/i/item/mental-health-in-emergencies>

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