Chapter 3

# Earthquake Culture: A Significant Element in Earthquake Disaster Risk Assessment and Earthquake Disaster Risk Management

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Additional information is available at the end of the chapter

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**Abstract**

This book chapter brings to attention the dramatic impact of large earthquake disasters on local communities and society and highlights the necessity of building and enhancing the earthquake culture. Iran was considered as a research case study and fifteen large earthquake disasters in Iran were investigated and analyzed over more than a century-time period. It was found that the earthquake culture in Iran was and is still conditioned by many factors or parameters which are not integrated and do not work harmoniously towards building and sustaining an earthquake culture in Iran. A historical possibility of an earthquake culture in Iran was mainly severed by culture, especially beliefs, strong geopolitics in Iran and in Middle East, a complex and dynamic political landscape in Iran, foreign invasions and wars. However, there is a great potential in Iran for the earthquake culture to be built and developed. The earthquake culture is recommended to be integrated within earthquake disaster risk assessment and earthquake disasters risk management studies which are performed and carried out in Iran and other countries at seismic risk. The contribution of this book chapter is towards the earthquake disasters studies and policies for the countries at earthquake risk.

**Keywords:** earthquake, earthquake culture, earthquake disaster risk assessment, earthquake disaster risk management, Iran, earthquake disaster risk reduction

## 1. Introduction

Earthquakes are the manifestation of a living Earth [1] and occur at "unpredicted times and in unpredicted places" ([2], p. 352). Their rapid and dramatic effects on nature, culture and on unprepared communities and societies can cause the "archetypal sudden-impact disaster"

with high death tolls, injuries and massive destructions ([3], p. 42). Earthquake disasters claim the highest number of lives among other type of disasters in the world. Nowadays, earthquake disaster risk reduction is a key term within disaster research arena. Earthquake disaster preparedness is a highly nonlinear phenomenon and can bring huge positive results on earthquake disaster risk reduction. Even small steps can significantly reduce the death tolls and injuries. Moreover, the focus needs to be shifted from response and recovery to prevention and mitigation, building resilience, reduction of risk to acceptable or tolerable levels, implementation of lessons from past disasters, past experiences and failures [4–6].

This research study brings to attention the dramatic impact of large earthquake disasters on society and local communities in Iran and particularly emphasizes the necessity of investigation and the importance of building an earthquake culture in Iran. Moreover, highlights the necessity to integrate the earthquake culture within the framework of earthquake disaster risk assessment and earthquake disaster risk management.

The following sections provide theoretical insights about risk, risk assessment, risk management, and earthquake culture. Further on, an investigation of 15 case studies of earthquakes and earthquake disasters in Iran over more than a century time-period (1909–2014) is presented. For investigation of the earthquake culture in Iran, a geo-historical and socio-cultural study was performed with an emphasis on an interdisciplinary approach. Narratives of earthquake disasters survivors, archival documents, earthquake field reports, cartographic and various academic studies were used for this study.

## 2. Risk

Risk can be basically defined as the likelihood multiplied by consequences or Hazard x Potential worth of loss [7]. Furthermore, with reference to the fundamental definitions of risk, Faber [8] and Lacasse et al. [5] advised that risk is seen as an equation such as $R = P \cdot C$, where R is Risk, P is Probability that an event will occur multiplied by expected Consequences or severity of adverse effects to life, health, properties and environment.

We live in a "world risk society" ([9], p. 1) where it is out of reality and practice to eliminate the risk. The disaster risk can never be eliminated, but it can be reduced to levels which are acceptable or tolerable by society [5, 10]. Moreover, Lacasse and Nadim [7] and Lacasse [10] warned that societies proved to be very less tolerant of an event where a huge number of lives is lost all of a sudden, compared with the same number of lives which is lost over the time in a number of separate events. Earthquake disasters are example of such events which test the tolerance and acceptance limits from communities and society [11, 12]. Risk can be expressed as individual risk and societal risk to people and assets. Societal risk can be presented through F-N diagrams or F-N curves expressing the risk level that a society is apparently willing to accept. Acceptable risk is the level of risk which a society aims to achieve it, and the tolerable risk refers to the risk level that can be reached after compromises in order to gain some benefits. The societal acceptable risk levels vary among national codes and standards around the world. The F-N curves relate to the annual or other temporal

occurrence probability (F) of an event capable for causing (N), or more fatalities. The term N can be replaced by other quantitative measures of consequences, for instance, costs. As a note, the F-N curves offer statistical observations and not the acceptable or tolerable thresholds. The F-N curves can be also used to describe the safety levels of particular facilities. Moreover, the F-N curves offer a good illustration for comparison of the calculated probabilities with observed frequencies of failure for facilities [5, 7, 10].

Very often, the risk analysis is seen as a magic wand that will transform the unpredictable in predictable [13]. "The risk of risk analysis" and the ontological matter that an uncertainty even analyzed and calculated is still an uncertainty was also emphasized ([14], p. 810). Woo [15] highlighted that uncertainty is an inexorable feature of human world and brought to attention the requirement to consider both the epistemic and aleatory uncertainty. The relation between risk, space and time needs to be also considered as a risk analysis "only reflects the situation at a certain point in time, and for a given location with a distinct spatial dimension of scale" ([16], p. 194). Interdisciplinary approaches have been seen as essential strategies for risk analysis and disaster risk reduction (DRR).

## 3. Risk assessment

Lacasse [10] highlighted that risk assessment and reliability analysis are important tools for informed decision-making. According to Faber [8], risk assessment is seen as a comparison between estimated risk and accepted risk which initially was stated in risk acceptance criteria. Lacasse and Nadim [7] and Lacasse [10] warned that one of the most difficult tasks in risk assessment and risk management is the selection of risk acceptance criteria. Societies which experience very frequently geohazards may have a different risk acceptance level comparative with those societies which experience them rarely. In case that risk is not acceptable within the specified risk acceptance criteria, there are various ways for risk treatment: risk mitigation, risk reduction, risk transfer and risk acceptance [8].

Risk analysis and risk evaluation are basically seen as component parts of risk assessment. Risk analysis comprises hazard and risk identification, risk estimation and risk calculation. For robustness, increased accuracy and value of risk assessments it is required among others, to address the interconnection between physical and human systems, to consider both spatial and temporal scales, to address, analyze and communicate the uncertainties. Various formal and informal tools are utilized within the risk assessment [7, 10, 17]. Multi-risk assessments which studied the interaction and amplification of risk, cascading hazards, dynamic vulnerabilities to multi-risk have stirred a great interest, but still is a field yet to be developed and requires intensive collaboration and expertise from various disciplines [5, 7, 10].

With reference to the assessment of disaster risk in various countries around the world, there is the danger of oversimplifying and misunderstanding problems, priorities and concerns of people at risk. Moreover, there is a permanent struggle between the quantitative or the so-called technical risk approaches and the socio-cultural risk [18]. A cooperation among these approaches would be beneficial to disaster risk assessments.

## 4. Risk management

Risk management integrates recognition and assessment of risk with development and implementation of adequate strategies of risk mitigation and risk reduction. Risk management represents a systematic application of policies, procedures and practices to the tasks of communication, consultation, establishing the context, identification, analysis, evaluation, monitoring and implementation of risk mitigation measures. Due to epistemic and aleatory uncertainty, risk management is decision-making under the condition of uncertainty. Likewise risk assessment, risk management requires also a multi-disciplinary approach [5, 7, 10].

Disaster risk management (DRM) confronted around the world various difficulties linked to political will, governance, available budget, implementation of legislation. Moreover, Okada [19] advised that DRM needs to have pre-disaster orientation instead of being focus on post-disaster phase, to take in consideration multiple hazards, to be closely linked to urban planning and management and to be inclusive and not limited only to governmental organizations and institutions, but to engage citizens, Non-Governmental Organizations (NGO)s, private companies, local communities, individuals. DRM needs to start from the local level or community level. Furthermore, for the present century, the integrated disaster risk management (IDRIM) is a necessary and required perspective in dealing with disaster risk.

## 5. State of the art on the earthquake culture

Earthquake culture is particularly linked to earthquake hazard, earthquake risk, and earthquake disasters and refers to the capacities of communities and society of knowing to live with earthquake risk. Seismic culture, local seismic culture, seismic prevention cultures are examples of other interchangeable terms with the earthquake culture. The earthquake culture concept has roots in theoretical insights and research studies carried out during the time in different geographical places around the world.

Mileti and Darlington [20] analyzed the existence of an earthquake culture in the San Francisco Bay Area, years after the Loma Prieta 1989 earthquake. Earthquakes were not frequent in that specific area, but earthquake risk was known and local culture was abundant of accounts of the last and previous other earthquake disasters. Earthquake preparedness and readiness was seen as a part of local culture. Helly [21] emphasized that origins and development of local seismic cultures are influenced by frequency of earthquakes, their intensities, death toll and injuries, and extent of damages. Ferrigni [22] highlighted that a visible cultural adaptation to earthquakes is the seismic architecture or vernacular seismic architecture which develops over the time. However, Ferrigni [22] advised that earthquakes do not always generate a local seismic culture, particularly connected to earthquake resistant buildings. Nevertheless, according to Pierotti [23], the seismic culture can develop during the time, and the case of Japan is given as an example. In Japan, the memory of earthquake disasters has been kept alive through written records, oral accounts, legends, stories, through the lessons from earthquake disasters. Homan ([24], pp. 1–2) employed the hypothesis launched by the European

University Centre for Cultural Heritage (CUEBC) that there is a correlation among frequency of earthquakes and local building practices. Consequently, two types of seismic cultures might develop: a "seismic prevention culture" when earthquakes are frequent and a "seismic culture of repairs" when earthquakes are low in frequency.

Homan and Eastwood ([25], p. 629) analyzed the seismic culture in Turkey, after the Kocaeli (Izmit) 1999 earthquake disaster, and advised that "Seismic cultures could be described as being the knowledge (both pragmatic and theoretical) that has built up in a community exposed to seismic risks through time." Degg and Homan [26] emphasized that the earthquake vulnerability in the Middle East was seen possible to be reduced through the seismic cultures. Karababa and Guthrie ([27], p. 32) analyzed the seismic culture, and particularly "the seismic construction culture" for the Lefkada Island, situated on the west part coast of Greece. They warned that "… the seismic construction culture expressed tangibly by buildings and tacitly in the local know-how is only a small subset of the seismic culture." Karababa and Guthrie ([27], p. 32) advised that a seismic culture can include "all the activities, attitudes, behaviors, and perceptions of the local population regarding earthquakes." Halvorson and Hamilton ([28], p. 322) analyzed the seismic culture for Mountainous Central Asia, in Pakistan, Afghanistan, Tajikistan and Kyrgyzstan and defined the term of "seismic culture as a broad concept that encompasses a range of cultural adaptations to seismic risk and hazard."

For Iran, other terms were used in connection with culture and earthquake disaster, for instance, seismic safety culture or culture of earthquake safety. Moreover, in Iran, the emphasis has been on disaster education, the culture of safety, public awareness and preparedness, especially education and trainings. Parsizadeh et al. [29] highlighted the importance of earthquake awareness and preparedness for all school levels and their contribution for building a culture of earthquake safety. Formal and informal school earthquake education, safety of school buildings and development of the national earthquake safety drill have been seen as priorities.

Berberian [1] with concern of many earthquake disasters in Iran, highlighted the necessity of creating a culture of prevention in Iran. Furthermore, Berberian [1] examined for a time period of many centuries, various cultural aspects linked to earthquakes and earthquake disasters in Iran. Berberian [1, 30] and Berberian and Yeats [31] emphasized that demographic changes, rapid urbanization, the raise of mega-cities, increased seismic urban risk, poor construction of buildings, the corrupted building industry, inaction, ignorance and non-accountability with regards to enforcement of building codes and land-use severely have impacted the earthquake disaster preparedness and have highly increased the seismic risk in Iran.

Ibrion et al. [4, 11, 12, 32, 33] and Parsizadeh et al. [34] investigated various aspects of the earthquake culture in Iran with focus on cultural aspects of resilience and earthquake disaster risk reduction. Ibrion et al. [11] explored and analyzed several aspects of the meanings and perceptions of time with reference to earthquakes and earthquake disasters in Iran and how the earthquake culture is built over the time. Ibrion et al. [4, 12, 32] and Parsizadeh et al. [34] explored how the earthquake culture was impacted by different places of Iran and more precisely, by the landscapes and cultural landscapes of arid, semi-arid and mountainous areas

of Iran. Aspects of the intricate relationships between the cultural landscapes of arid and semi-arid areas, cultural beliefs, earthquake disasters and the communities' earthquake risk perceptions and resilience were further investigated by Ibrion et al. [4, 12, 32] and Parsizadeh et al. [34]. Ibrion et al. [12] particularly analyzed how the beliefs, cultural traditions and rituals impacted the handling of the dead people, the earthquake disaster risk management and the resilience of survivors after large earthquake disasters in Iran. The impact of lessons and socio-cultural learning from large earthquake disasters in Iran on the earthquake culture was examined by Ibrion et al. [4, 33].

## 6. Earthquake culture in Iran

15 earthquake disasters which affected different places of Iran were investigated as research case studies: *Silakhor 1909*, *Salmas 1930*, *Torud 1953*, *Buyin Zahra 1962*, *Dasht-e Bayaz 1968*, *Ferdows 1968*, *Karzin-Qir 1972*, *Tabas 1978*, *Golbaf 1981*, *Sirch 1981*, *Rudbar 1990*, *Zirkuh (Qa'enat) 1997*, *Bam 2003*, *Ahar 2012* and *Shonbeh-Bushehr 2013*, see **Figure 1**.

All of these 15 earthquakes and earthquake disasters in Iran over more than a century time-period (1909–2014) can be considered as important wake-up calls toward building an earthquake culture in Iran. Their massive destruction, injuries and particularly, death tolls require long-term sustainable strategies for earthquake disaster risk reduction Iran, see **Figure 2**.

In Iran, there is no linear correlation between magnitude and number of dead people, as even a medium magnitude earthquake caused one of the highest number of death (e.g., Bam 2003), see **Figure 2**. Furthermore, it was observed that all the 15 earthquakes over more than a century time-period have the magnitude $M_w$ less than 7.5. Moreover, over the time, the number of dead people on a given magnitude can largely vary, and many examples can be identified: Buyin Zahra 1962 and Sirch 1981, both with $M_w$ 7.0, but with different death tolls, Golbaf 1981 and Bam 2003, both with $M_w$ 6.6, Salmas 1930 and Dasht-e Bayaz 1968, both with $M_w$ 7.1, and Silakhor 1909 and Tabas 1978, both with $M_w$ 7.4, see **Figure 2**. The demography of Iran suffered many changes in the last and present century and major urban areas and many towns and villages are situated in the proximity of fault lines in Iran [1, 30]. Tehran with a population of almost 15 million people, a well documentation of historical earthquakes, and close proximity to at least eight adjacent and other inner city active faults lines is at risk from a moderate-magnitude to a large-magnitude earthquake, more precisely in the range of approximately 6.5 till 7.4 $M_w$. Tehran is at risk from "an earthquake time bomb" and a large earthquake disaster [31]. This high seismic disaster risk in Tehran, the 15 earthquake disasters in Iran over more than a century time-period (1909–2014), and many other earthquake disasters over the centuries can be basically considered as required conditions for the existence and development of an earthquake culture in Iran.

The earthquake culture is highly motivated by frequency of earthquakes, their intensities, death tolls, injuries and extent of damages and destruction. However, in Iran, over more than a century time-period (1909–2014) the earthquake time became equivalent with the earthquake

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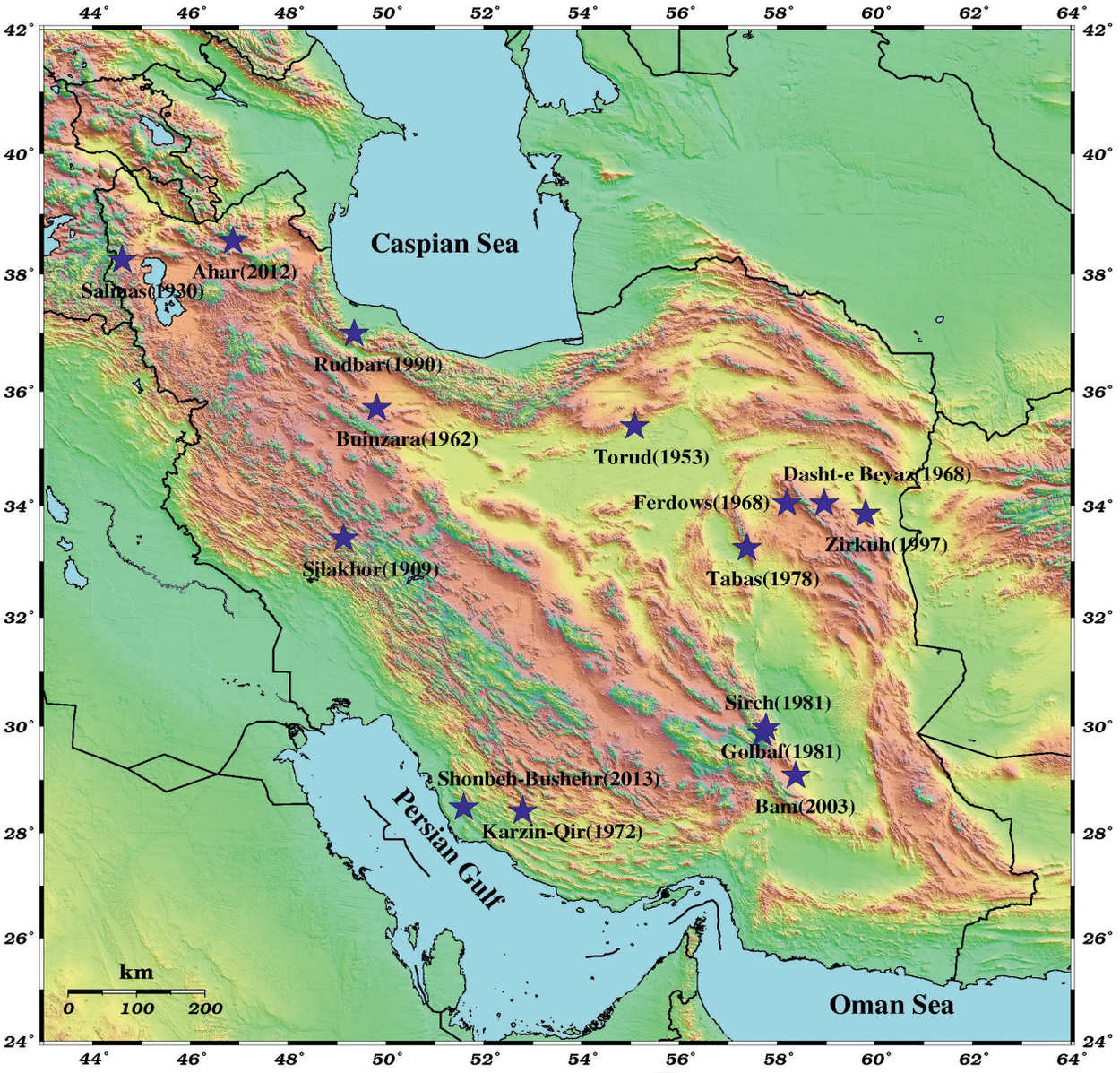


**Figure 1.** Earthquakes and earthquake disasters in Iran over more than a century time-period (1909–2014) and Iran map. Source: Prof. Mohammad Mokhtari and Mr. Arash Islami, International Institute of Earthquake Engineering and Seismology (IIEES).

disaster time. Many lessons from earthquake disasters in Iran have remained ignored and forgotten. When an earthquake disaster occurs, the forgotten and ignored old lessons emerge together with new lessons, and all are categorized under the label of "Lessons-Learned." An amalgam of old and new lessons from earthquake disasters is being repeated again and again, over the time, in different places of Iran. The next earthquake disasters are only a matter of time, if the lessons from earthquake disasters are yet pending to be learned and implemented [4, 33]. Moreover, if no earthquake preparedness is in place and resilience of communities is not improved, the next earthquakes will be again followed by earthquake disasters. Almost 10 years after Bam 2003, an earthquake disaster survivor declared "If an earthquake happens

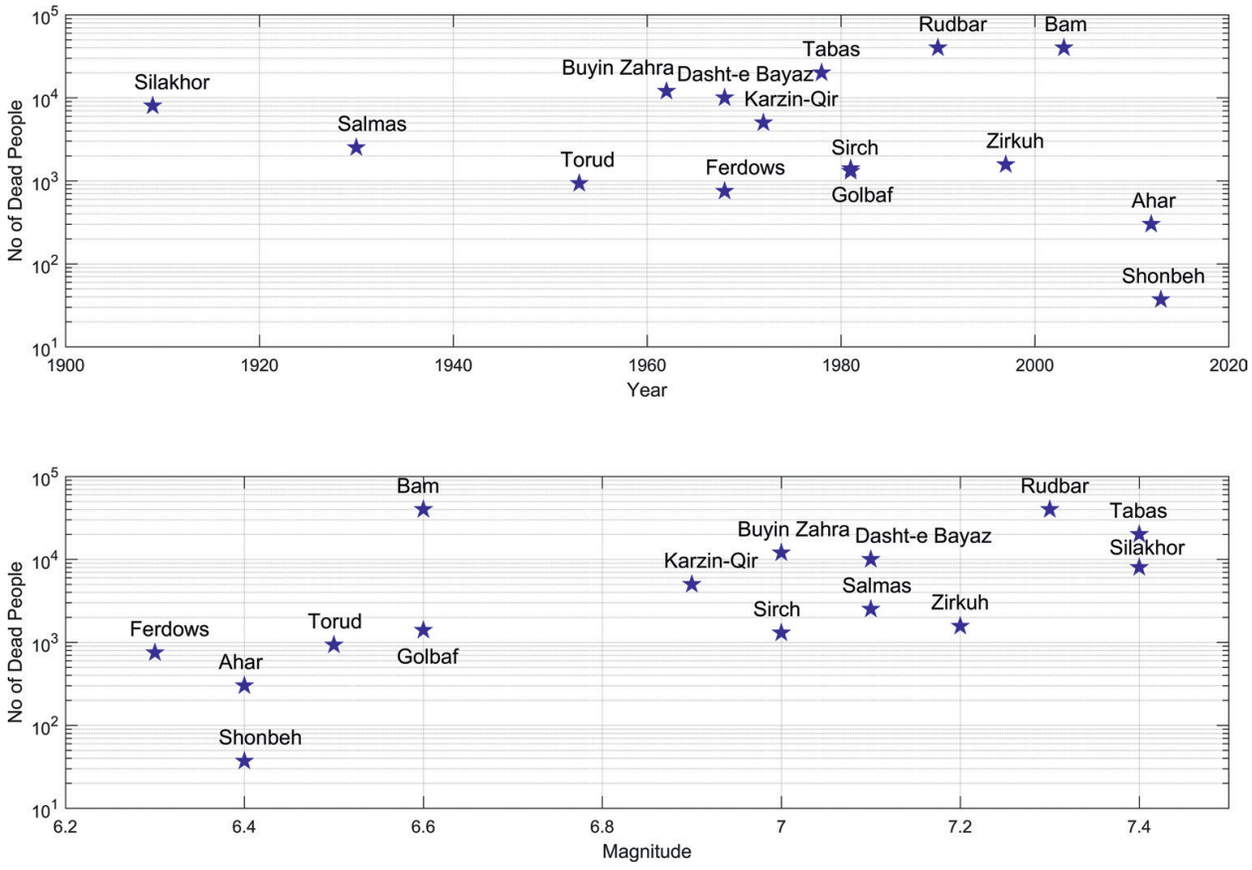


**Figure 2.** Earthquakes and earthquake disasters in Iran over more than a century time-period (1909–2014), number of dead people versus year and magnitude.

again, the same things will be repeated" and "We think that disaster is in the news, disaster is not for us, it is for others. But people do not realize that the next person might be them. It is just a matter of time" ([11], p. 16). Over more than a century time-period (1909–2014), the rhythm of socio-cultural learning from earthquake disasters or even large earthquake disasters is very slow in Iran. Furthermore, Ibrion et al. [4, 33] advised that the socio-cultural learning from earthquake disasters needs to become integrated and to involve various levels of participation and accountability for, see **Figure 3**.

Learning from earthquake disasters in Iran over more than a century time-period is a dynamic and complex process which requires long-term strategies, responsible earthquake disaster risk management and especially, a sustainable framework such as a culture of resilience and earthquake disaster risk reduction or an earthquake culture [4, 33].

Strong politics and geopolitics in Iran and in the Middle East, complex and dynamic power structures in Persia/Iran, and dramatic history of Persia/Iran [30, 35–39] have contributed during the time and still contributes nowadays to the erosion of an earthquake culture in Iran. The earthquake culture has not been seen as a top priority in Persia/Iran over more than a century time-period (1909–2014). The focus of Persia/Iran and the resources of country have been concentrated on other more important and dramatic priorities and events including and not limited to the effervescent events during the last kings Qajars, implementation of

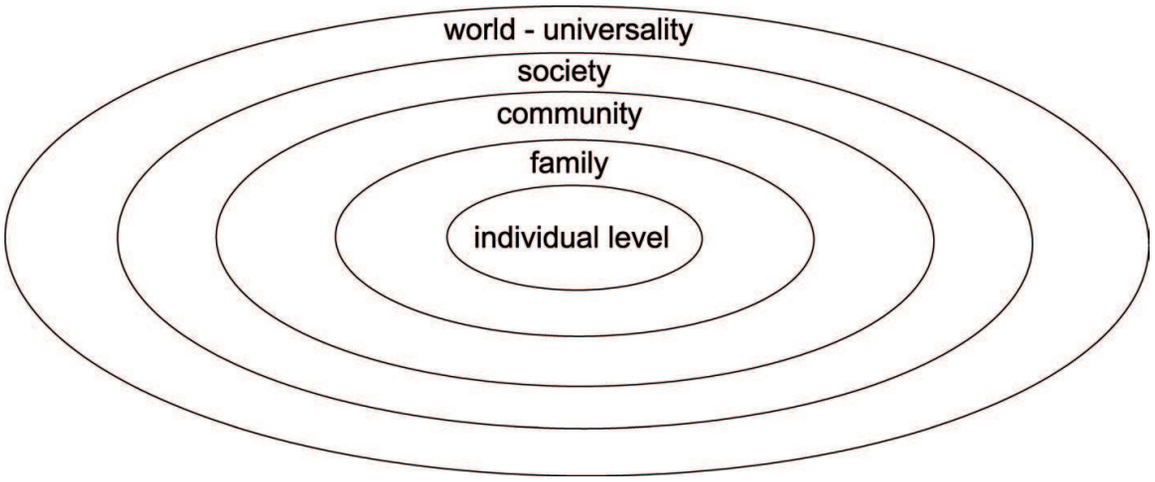


**Figure 3.** Integrated socio-cultural learning from earthquake disasters—levels of participation and accountability.

the Anglo-Russian Convention in 1907, military occupation of country after the second war, the forced abdication and exile of Reza Shah Pahlavi, the 1953 coup d'etat in Iran, political turbulence in the country and the collapse of Mohammad Reza Shah Pahlavi, the Iranian Revolution, the Islamic Republic in 1979, the 8 years Iran-Iraq war (1980–1988), national safety and security of Iran, dynamic political landscape in Iran, economical-political sanctions, and many others, and then, far from a sustainable and long-term social-cultural learning from large earthquake disasters and building an earthquake culture in Iran. In this entire effervescent context, the earthquake disaster preparedness was not truly seen as a high priority in Iran. Many large earthquake disasters in Iran occurred during or around tumultuous political events and turbulent geopolitical arena in the area. The earthquake disasters of Silakhor 1909, Torud 1953, Tabas 1978, Golbaf 1981, Sirch 1981, Rudbar 1990, Bam 2003, Ahar 2012 and Shonbeh-Bushehr 2013 are just few examples. The building and development of the earthquake culture in Iran was overshadowed by strong geopolitics and various interests of the global and regional powers in Iran and in the area of the Middle East or West Asia.

The discovery of oil in Iran in 1908 was the first oil discovery in the Middle East area [40]. After more than 100 years of exploration, production and export, Iran still has "gigantic energy reserves", vast oil deposits and "mammoth reserves of gas" ([41], p. 48, 59). According to Abbaszadeh et al. [42], Iran has the fourth largest oil reserves and the second largest natural gas reserves in the world. However, over more than 100 years' time-period (1909–2014), and despite rich oil and gas resources of Iran and high economic revenues from oil over the years, the number of earthquake disasters in Iran increased together with a high raising death toll.

Indeed, there is more than one century from the discovery of oil in Iran, but the revenues from oil exports began to have an important role in the Iranian economy just after the 1960s [43]. Reasons for this situation were linked to the fact, that for almost a period of 50 years, from 1908 till late 1953, Iran received very low level of royalties from the foreign oil company which operated and controlled all oil operations in Iran; more precisely, from the Anglo-Persian Oil Company (APOC) and later, the Anglo-Iranian Oil Company (AIOC) with a majority of shares

owned by the British Government. Nationalization of oil industry in Iran and establishment of the National Iranian Oil Company (NIOC) by Mohammad Mosaddeq was followed by tough British sanctions and coup d'etat in 1953, in Iran, organized by a close collaboration between the American Central Intelligence Agency (CIA), British Military Intelligence section 6 (MI6), governmental institutions of USA and Britain, USA Embassy in Tehran, and with the support from Mohammad Reza Shah Pahlavi, Palace, Majlis members, clerics, notably Abul Qassem Kashani, merchants, and other supporters inside of Iran. After the 1953 coup, the oil concession in Iran was given to a consortium of major international companies which gained full control over production, refining, management and distribution of oil; 40% of shares went to the Anglo-Iranian Oil Company which was renamed British Petroleum (BP) and 40% went to a group of American companies. This consortium was supposed to give 50% of profits to Iran and this was the type of agreement signed by USA and Britain with other countries in Middle East at that time [35]. Creation of OPEC in 1960, and various geopolitics in the Middle East impacted the production and prices of oil in Iran. The oil revenues started to increase significantly for Iran, especially, in the period 1960–1978. A high dependence on oil incomes of the Iranian government, a higher volatility of international prices, a risen inflation, a political effervescence in Iran, and strong geopolitics in Iran and Middle East area, contributed to the downfall of the Pahlavi dynasty and to the 1979 events. After the 1979 Islamic Revolution, the production of oil was reduced by the political choice. Following the invasion of Iran by Iraq and the Iran-Iraq war (1980–1988), the production of oil was considerably reduced and affected by war and its massive destruction. High oil revenue volatility and many waves of economic sanctions applied on Iran, by United States and later on, by the European Union had also their impact on the Iranian economy.

A high dependency on oil revenues, the complexity of the political landscape in Iran and a very reduced transparency has negatively affected the accountability of state, governmental institutions and other many organizations in Iran and negatively impacted the economy of Iran [35, 42, 43].The accountability toward the earthquake disaster risk reduction in Iran was also negatively impacted. Over more than a century time-period (1909–2014), despite some registered progress, the rhythm of socio-cultural learning from earthquake disasters is slow in Iran and an earthquake culture is yet pending to be developed. An integrated earthquake disaster risk management in Iran requires urgent and critical strategic measures and actions. However, if responsible and sustainable planning and actions are applied and carefully monitored, the abundance of oil and gas resources of Iran can have a highly positive impact on the earthquake culture and earthquake disaster risk reduction in Iran.

Earthquake culture in Iran is definitely strongly influenced by the Iranian culture. The culture in Persia/Iran has been strongly articulated through the power of beliefs system which is very deeply rooted and has a strong influence over local communities, governance, rites and rituals, meanings of the time and place, earthquake disaster preparedness and mitigation, daily life, just to name few [1, 11, 12, 30, 32, 34, 37, 44, 45]. Double impact of beliefs on the resilience of survivors, earthquake disaster risk management and earthquake disaster risk reduction in Iran was highlighted by Ibrion et al. [12] and Parsizadeh et al. [34]. Moreover, the earthquake risk perception in Bam, before the Bam 2003 earthquake disaster was negatively impacted by the strong cultural beliefs linked to the cultural landscape of Bam, represented by Arg-e Bam, Qanats and gardens of khorma trees [32, 34].

Earthquakes and earthquake disasters are present in geo-mythology, legends, stories, oral traditions, poems, spiritual texts, inscriptions of Persia/Iran [1, 30] and theoretically, they have the role to indicate the existence of an earthquake culture in Iran. However, in Iran, myths, legends, stories, poems, and many other cultural manifestations are considered to be just part of the Iranian culture and not linked at all to an earthquake culture. Moreover, in practice, they do not have an active role toward earthquake disaster mitigation and particularly, earthquake disaster awareness and education. These cultural parameters/factors such as myths, legends, stories, oral traditions, poems, spiritual texts, inscriptions, etc., are interpreted as a sign of the cultural resilience of Persia/Iran over the centuries and they are just passive and not active toward building an earthquake culture in Iran. This was identified also by Parsizadeh et al. [34] for the case of Bam 2003 earthquake disaster. Moreover, Parsizadeh et al. [34] recommended that myths, legends, poems, stories, oral traditions, and various other oral and written accounts cultural manifestations need to be integrated within earthquake disaster awareness and the efforts of building an earthquake culture in Iran, see **Figure 4**.

In the world, it seems that a successful way of learning from earthquake disasters and mega-disasters was shown by Japan and its status of "earthquake nation" [46, 47]. Moreover, in Japan, there is a mature earthquake culture and of a culture of disaster prevention and the

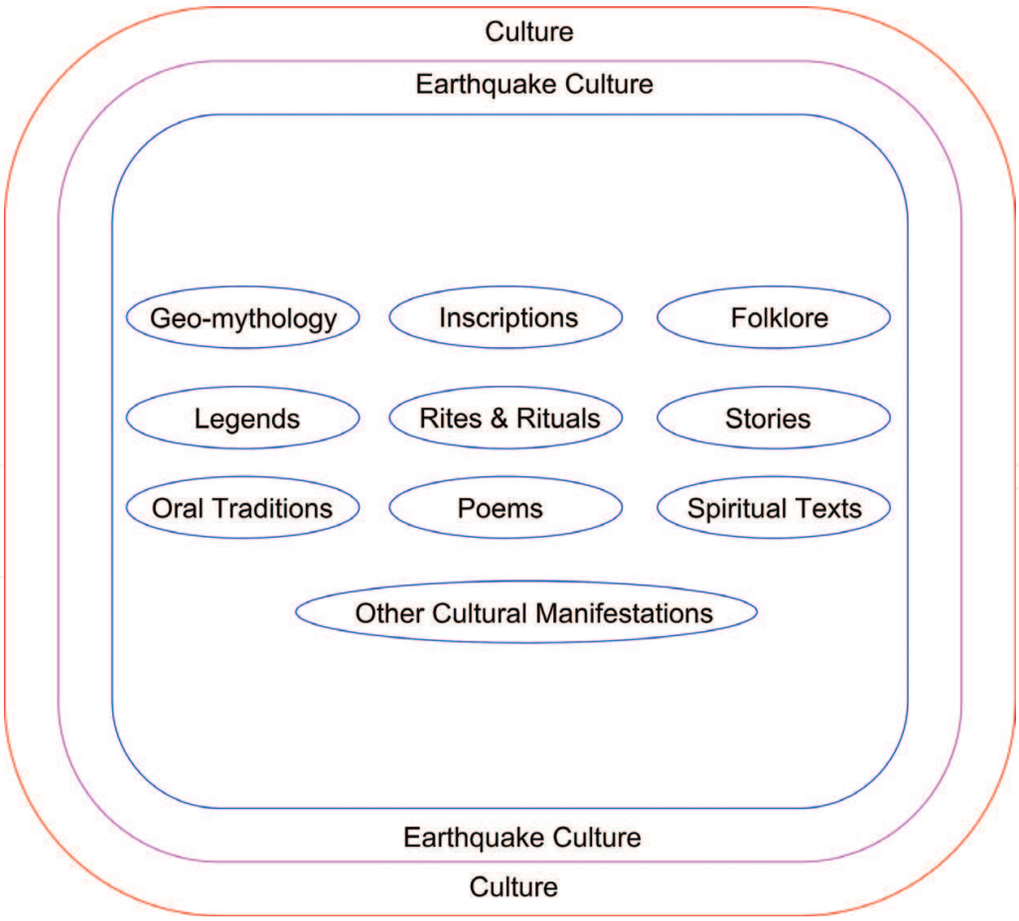


**Figure 4.** The framework of culture, earthquake culture and cultural parameters.

rhythm of socio-cultural learning from large earthquake disasters is very high. However, the March 2011 cascading disasters highlighted for Japan and other countries around the world that "Preventive investments pay, but be prepared for the unexpected" as it is important to understand that "…the risks from natural hazards can never be completely eliminated…" ([47], p. 5, 6). After a necessary adaptation to the Iranian local context, the Japanese culture of continuous learning from past earthquake disasters, continuous improvements of the earthquake disaster preparedness, the status of a strong earthquake culture and the progress of integrated earthquake disaster risk management can serve as learning models for Iran [4, 33].

Over more than a century time-period (1909–2014), the existence and development of the earthquake culture in Iran has been conditioned by a large array of parameters or factors [4, 11, 12, 32–34], see **Figure 5**.

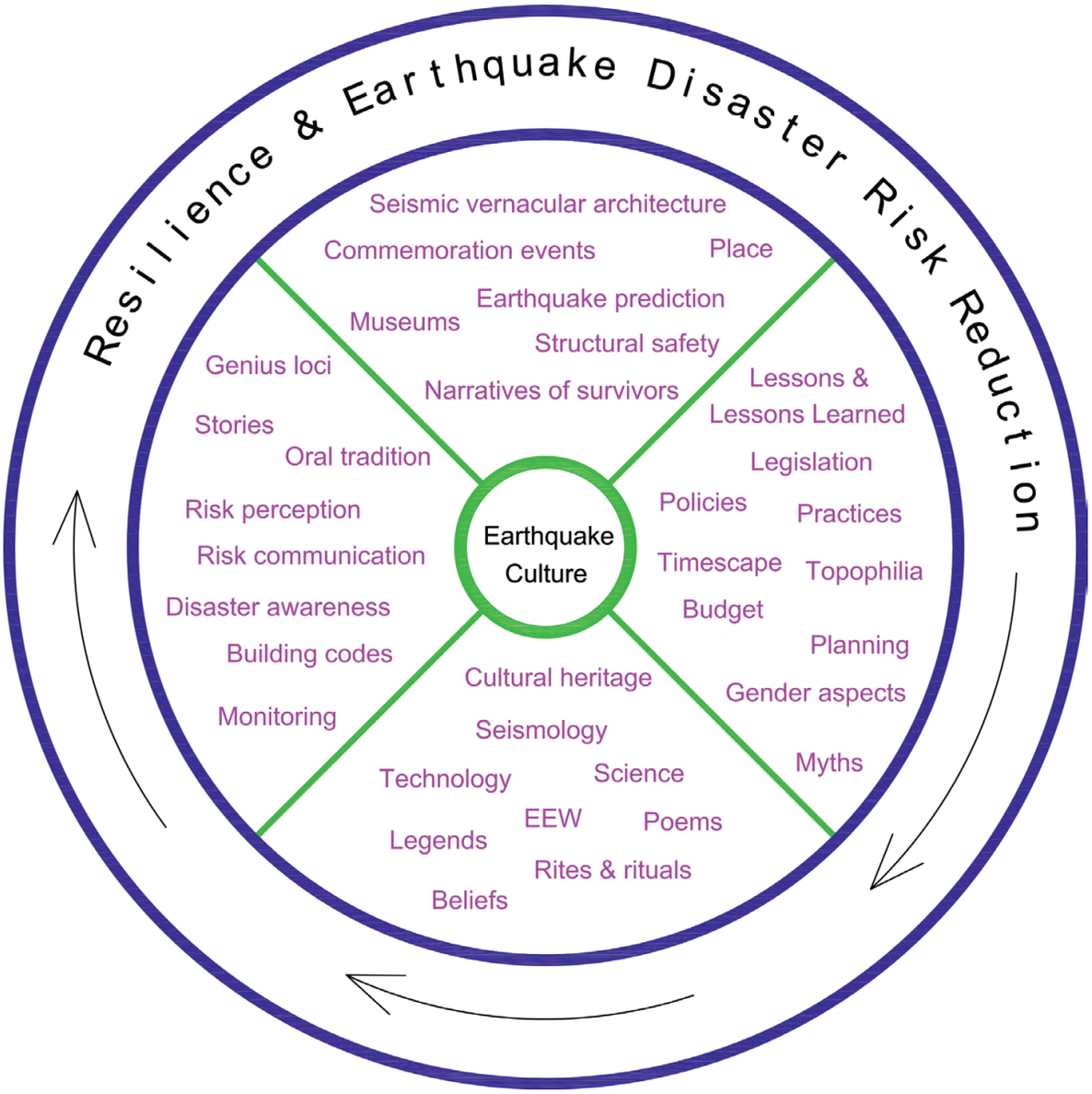


**Figure 5.** The wheel of earthquake culture and its parameters/factors.

All of these parameters or factors exist till a degree in Iran, but they are not integrated and do not work in harmony toward building and sustaining an earthquake culture. Moreover, the development and even existence of such parameters/factors is hindered by inadequate long-term planning, evaluation and monitoring, improper budget, lack of accountability, socio-cultural and political will and implementation of sustainable strategies and actions.

An assessment of the earthquake culture's existence and development required to be incorporated into the earthquake disaster risk assessment. Assessment of the earthquake culture status needs to be considered as one of the important criteria within risk analysis, and risk evaluation phases. Moreover, the earthquake culture needs to be also highly considered as part of the risk treatment strategies and plans and to be carefully monitored over the time, see **Figure 6**.

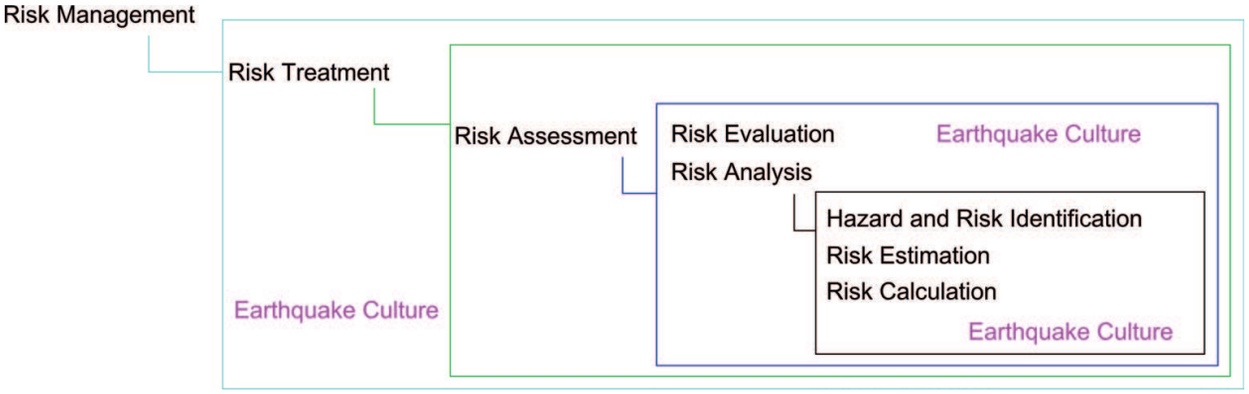


**Figure 6.** Earthquake disaster risk assessment, earthquake disaster risk management and earthquake culture.

The risk estimation and risk calculation considering the earthquake culture's parameters require awareness, transfer of knowledge, communication, a feasible time framework and further research investigations. Moreover, while interdisciplinary approaches are not easy to achieve, they are nonetheless essential and need to be applied within the investigation of the earthquake culture and within the earthquake disaster risk assessment and management.

## 7. Concluding remarks

Earthquake culture in Iran is highly motivated by the frequency of earthquake disasters over the last and present century and particularly, by the high death tolls, injuries, and massive damages and destructions. Based on the investigated case studies over more than a century time-period (1909–2014), the earthquake culture in Iran is yet pending to become a coherent and well-functioning *present reality*, but there is a great potential in Iran for the earthquake culture for being build and developed.

A *historical possibility* of an earthquake culture in Iran was mainly severed by the powerful influence of culture, especially beliefs systems, strong politics and geopolitics in Persia/

Iran and in Middle East area, complex and dynamic power structures in Iran, wars, foreign invasions, massive destructions and even by existence of rich oil and gas resources in Iran. The last twentieth century and even the beginning of present century made no exemption from this dramatic course of the Persian/Iranian history. The earthquake culture was not seen as a national top priority in Persia/Iran over more than a century time-period (1909–2014). The focus and the resources of the country have been concentrated on other more important and dramatic priorities and events very tightly connected with the national safety and security, dynamic and complex political and geopolitical landscape in Iran and in Middle East area, waves of economical-political sanctions and far from building an earthquake culture in Iran.

Earthquake culture requires time to develop, but it is also over the time that the earthquake culture can become forgotten and lost. Consequently, long-term sustainable actions, transdisciplinary approaches, accountability and integrated efforts from local communities, various institutions and organizations, researchers, practitioners, policy makers, governance, society, legal frameworks, appropriate budget, planning and monitoring are recommended for fostering an earthquake culture in Iran and to prioritize it at national, regional and local levels. Place specific strategies for the earthquake disaster risk reduction, enhancing resilience and building an earthquake culture are also recommended. Iran is a cultural nation, but not yet a nation with an earthquake culture. Iran needs to integrate the earthquake nation within its framework of cultural nation. The collective cultural memory represented by geo-mythology, legends, stories, oral traditions, poems, spiritual texts, inscriptions and other oral and written accounts about earthquakes and earthquake disasters needs to play an active role, to be integrated and to actively contribute to the earthquake disaster awareness and mitigation and to the efforts of building an earthquake culture in Iran. The rhythm of implementation of lessons and the socio-cultural learning from large earthquake disasters is very slow in Iran. Living with earthquake disasters in Iran needs to be replaced by learning to live with earthquakes in Iran.

Existence and assessment of the earthquake culture's development stages needs to be incorporated as an important step into the earthquake disaster risk assessment and earthquake disaster risk management. To encourage and support the earthquake culture as a *future probability* is highly recommended, if the reduction of the high earthquake disaster risk is strongly aimed for in Iran. Demography and a high urbanization in Iran together with a high seismic vulnerability of buildings demand the existence and development of an earthquake culture in Iran. The rich oil and gas resources of Iran can have a high positive impact and contribution to the building and development of the earthquake culture in Iran.

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