

# Past Earthquakes Lessons for Disaster Risk Financing

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## ABSTRACT:

Damages caused by natural disasters are on the rise due to increasing concentration of population and assets in high-risk areas and growing urbanization. Catastrophic risks associated with earthquakes are of great importance to financial markets, institutions and other quarters, including governments, whose stakes are greatly affected by such natural disasters. This article attempts to study the lessons of past earthquakes in Japan and Iran to propose strategies for developing countries and specially Iran. The proposed strategies are in particular concerned with Disaster Risk Management (DRM) and risk transfer tools. The proposed DRM strategies are mostly related about promotion of coherence of different programs which as a result reduces financial losses. Risk transfer tools on the other hand are concentrated on financial aspects of the subject.

**Keywords:** Earthquake, Disaster risk management, Risk transfer tools

## 1. INTRODUCTION

Over the past three decades natural disasters worldwide have caused close to \$4 trillion in economic losses, much of that in the developing world. Evidence shows that mainstreaming DRM into policies, strategies, regulation, and building codes can save lives and assets when adverse natural events hit (Ranghieri & Ishiwatari, 2014).

Damages caused by natural disasters are on the rise due to increasing concentration of population and assets in high-risk areas and growing urbanization. Catastrophic risks associated with earthquakes are of great importance to financial markets, institutions and other quarters, including governments, whose stakes are greatly affected by such natural disasters. In developing countries with low insurance penetration, governments are often expected to provide support for private reconstruction, in addition to reconstruction of public buildings and infrastructure after disasters occur. Lack of capacity of domestic capital markets is not a unique problem to developing countries. Large magnitude earthquake with long return period can cause economical losses far beyond capacity of domestic markets.

Earthquake hazard is considered as one of the main natural catastrophes to affect Iran. High severity and low frequency of earthquake damage in developing countries exposed to seismic activity such as Iran is due to vulnerably built environment being close to seismic sources. Property catastrophe insurance programs can cover private and public assets and promote ex-ante natural disaster risk financing. In developed countries with mature capital markets, big losses are usually transferred to global markets. However, Iran as a developing country has neither a developed property catastrophe insurance program in place nor capital markets that could transfer such losses to global markets.

## 2. DISASTER MANAGEMENT POLICIES AND FINANCING MECHANISMS

Considering lessons from the great east Japan earthquake (2011) the following strategies could be anchored in an integrated framework of DRM system in other countries:

**2.1. Community-Based Disaster Risk Management:** Empower community members/ Raise awareness/ Support community organizations.

**2.2. Disaster Management Plans:** Keep plans up to date/ Keep plans local/ Agreements made during normal times ensure quick post disaster responses/ Agreements could be designed and signed at the local level with key sectors specifying responsibilities for emergency response measures, rescue operations and evacuation plans.

**2.3. Include community members in designing:** The reconstruction plans should reconsider the future needs of in particular the Education Sector.

**2.4. Tsunami and Earthquake Warning Systems:** Warning systems can save people's lives and reduce economic damages from natural disasters, which can start with simple methods. Low-cost equipment, such as fire bells and sirens, were widely utilized as warning tools during the GEJE (Great East Japan Earthquake). Warning systems and other measures organized by communities may be particularly relevant in developing countries where government capacity and resources are limited. Although various technologies, such as earthquake monitoring are all needed to develop effective warning systems, their limitations must be taken into account.

Communities, governments, and experts should exchange information and ideas about potential risks. Communities should be able to understand the information delivered in the warning, while also being aware of the system's limitations. Also, government staff must understand communities' response to disasters to design warning systems. The organizations should tailor the contents of warning messages to the users' needs. Such messages need to be simple, timely, and encourage evacuation. End-to-end systems should be established to ensure that warnings reach the communities at risk. Multiple communication channels should be established so that information keeps flowing in case of power and communication failures. Services should be available 24 hours a day and 7 days a week.

**2.5. Mobilizing and Coordinating Expert Teams, Nongovernmental Organizations, Nonprofit Organizations, and Volunteers:** Prepare response teams/ Develop capacity/ Establish coordinating mechanisms/ Consider vulnerable groups.

**2.6. Infrastructure Rehabilitation:** Establish financial arrangement mechanisms/ negotiations with governments should cover: *i*-Procedures for applying for a subsidy to the central government, *ii*-The cost-sharing ratio of rehabilitation works, shared between national and local governments and *iii*-Team formulation and procedures for damage assessment/ Arrange pre disaster agreements with the private sector specially in financial aspects/ Arrange support teams/ Develop disaster-resilient infrastructure/ Identify key infrastructure.

**2.7. Reconstruction Policy and Planning:** Involve community members in planning, Make recovery plans before disasters strike./ Balance central and local control of resources/ Integrate many viewpoints into recovery plans/ Use recovery to improve spatial planning in general and open and transparent information sharing is a key prerequisite to successful planning.

**2.8. Risk Assessment and Hazard Mapping:** Assess risk./ Prepare for the worst case/ Prepare and promote hazard maps and share hazard and risk data and information.

**2.9. Risk Communication:** Establish trust between information senders (for example, the government) and receivers (local communities)/ Use a variety of tools to communicate risk.

**2.10. Measuring the Cost- Effectiveness of Various Disaster Risk Management Measures:** Use CBA (cost-benefit analysis) to prioritize DRM measures/ Set clear rules about when, how, and on what CBA should be performed/ Set clear connections between decision making and CBA.

**2.11. Economic Impact:** Consider possible effects on supply chains/ Vulnerability is particularly high in many developing countries because political and economic activities are excessively concentrated in capital cities. An urgent need exists for bold measures aimed at decentralization and establishing backup systems for emergencies/ A pressing need exists to remedy such weaknesses under international cooperation. Coordination among neighboring countries is also necessary in such areas as cross-border transportation systems and water resource management/ Consider widespread impacts.

**2.12. Financial and Fiscal Impact:** Treat disaster risks as a contingent liability of the government/ Reduce the contingent liability of the government in the long term.

**2.13. Strategies for Managing Low- Probability, High- Impact Events:** Every country needs a national integrated DRM strategy./ Forecasting and early warning is fundamental./ Hazard maps are useful tools to help people save their own lives./

Archiving disaster records and experiences in disaster databases is essential for designing viable DRM strategies./ Education, drills and awareness raising are indispensable to avoid high death tolls in low-probability, high-impact extreme events.

**2.14. Earthquake Risk Insurance:** Japanese earthquake insurance programs demonstrated considerable resilience after the GEJE. From this experience, recommendations can be made to disaster-prone developing countries willing to promote catastrophe risk insurance to help them promote viable sustainable and affordable programs and clearly define the role of the government in public-private partnerships (PPPs).

- Structural policies to allow for sustainable and affordable programs. Catastrophe risk insurance policies should be designed to enable insurance companies control their liabilities and offer affordable coverage. The policy structure can be revised over time to better respond to the needs of the policyholders, while also ensuring the system’s resilience to major disasters.
- Insurance premium should be based on risk. Provide incentives to invest in disaster risk mitigation. Additional financial incentives, such as discounts on premium rates or lower deductibles, can be offered to the policyholders who invest in risk reduction.
- Develop detailed catastrophe risk models. Detailed catastrophe risk models and databases are essential for detailed risk assessment, premium rate calculation, and efficient management of catastrophe risk insurance liabilities.
- Develop catastrophe risk insurance market infrastructure. Catastrophe risk insurance markets require major investments in basic infrastructure, such as catastrophe risk models, exposure databases, product design and pricing, and the like. Governments can play a major role in developing this kind of infrastructure to help the private insurance industry offer cost effective and affordable insurance solutions.
- Necessary mechanisms for enforcing insurance purchase. Voluntary catastrophe risk insurance does not typically generate high penetration rates, even in highly developed insurance markets. Some types of compulsory mechanisms, such as an automatic catastrophe guarantee in fire insurance policies, may be necessary to ensure that a large proportion of the population is insured against natural disasters.
- Promote multiple-catastrophe risk insurance delivery channels. Multiple distribution channels for catastrophe risk insurance should therefore be explored.
- Promote enabling legal and regulatory environments. The legal and regulatory framework should enforce adequate pricing, reserving, and reinsurance buying to ensure that insurers will meet their claims in full in the event of a disaster.
- Governments can play a role as the financier of last resort. Governments should make financial capacity available to domestic insurers through public reinsurance or (contingent) credit (Ranghieri & Ishiwatari, 2014).

### 3. PROMOTION OF COHERENCE IN DRM FINANCING PROGRAMS IN IRAN

Recent disasters during past one and half decade can be seen in table 1:

Table 1: Recent disasters in IRAN

year	disaster type	occurrence	Total deaths	Affected	Injured	Homeless	Total affected	Total damage
2000	Earthquake	2	1	2500	15	500	3015	
2000	Epidemic	1	76					
2000	Flood	3	10	400			400	6000
2000	Storm	1	3			5500	5500	
2001	Earthquake	1		1000			1000	
2001	Flood	4	476	1205250	284		1205534	103800
2002	Earthquake	5	230	145750	1406		147156	300000
2002	Flood	3	61	200000		4500	204500	63060
2002	Wildfire	1						
2003	Earthquake	5	26797	208550	22739	65760	297049	521666
2003	Flood	1				1370	1370	838
2003	Landslide	1	20		4		4	
2004	Earthquake	1	35	220	278		498	165000
2004	Flood	2	40		53	4000	4053	

year	disaster type	occurrence	Total deaths	Affected	Injured	Homeless	Total affected	Total damage
2004	Storm	1		2500			2500	240
2005	Earthquake	4	625	115267	1621		116888	80000
2005	Flood	4	109	3000		1750	4750	
2005	Storm	1		8000			8000	
2006	Earthquake	3	63	167000	1494		168494	42262
2006	Flood	1	14	2800			2800	16000
2007	Flood	1	12					22000
2007	Storm	1	12	185000	9		185009	
2008	Earthquake	2	6	20500	215		20715	
2008	Flood	2	22	1400	80		1480	
2008	Storm	1	28					
2009	Earthquake	1			269		269	
2010	Earthquake	6	11	750	535	3500	4785	
2012	Earthquake	3	312	65040	2267		67307	500000
2012	Flood	1	7	1000			1000	
2013	Earthquake	3	45	3500	997	1500	5997	600000
2014	Earthquake	2	1	300	280	12000	12580	43000
2014	Flood	1	37	440000			440000	49000
2015	Flood	5	49	24400	30		24430	576000

(EM-DAT, 2015)

Key lessons learned from the Tabas, Rudbar, and Bam earthquake disasters present great potential for the improvement of earthquake disaster preparedness and reduction of toll of death, injuries, and massive destruction, and can make a sound contribution to the resilience of communities in Iran. Studies and research about the past earthquakes in Iran shows there were many problems in various aspects of planning that is classified in Table2.

Table 2: The management and planning obstacles

Aspects	obstacles
Design	Lack of coherent programs
	Lack of proper information
Need assessment	Lack of attention to the needs of health care
	Lack of coherent programs and assistance to transport the injured by air
Coordination- support	poor coordination between agencies and organizations
	Lack of coherent program to collect donations search
manpower	The absence of a coherent plan for human resources and public education
	Lack of appropriate training of volunteers and people

(Nekoi-Moghadam, Amiresmaili, & Aradoei, 2016)

The Japanese culture of learning from earthquake disasters can also serve as a model for the earthquake risk reduction in Iran. In this regard a sustainable long term framework such as an earthquake culture that creates an environment in which policy makers, laws and regulations system, decision making processes, academia, and local communities unite their efforts towards promoting such culture could be effective. Such an earthquake culture prepares the ground for ex-ante coordination and coherence in disaster risk management and financing planning and programs which can include:

**3.1. Ex-Ante Risk Financing:** Transfer risk via capital and/or global re/insurance markets. Past experience of insurance coverage in IRAN in case of 2012 earthquake in Eastern Azerbaijan province is as table 3:

Table 3: The performance of insurance companies in case of 2012 earthquake in Eastern Azerbaijan province

The name of insurance company	Number of loss paid	loss paid(IR million rial)
Iran	7480	108263/556
Asia	3414	55385/115

Alborz	171	5938/247005
Dana	537	5094/999658
Moalem	339	1624/195
Parsian	54	1483/985759
Karafarin	47	201/085
Razi	6	432
Mellat	21	191/798454
Sina	92	1808/64
Novin	38	659/022974
Mihan	23	4700
Ma	46	1102/697
Dey	6	158/2461
Kosar	2760	47074/833605

(Bastami, 2013)

**3.2. Public Policy Recommendations:** Considering the advantages of ex-ante financing of catastrophic risk there is a need for public policy support for such risk financing.

**3.3. Diversification of Risk financing Methods:** Diversify on different types of risk financing including use of international financial organizations.

#### 4. CONCLUSION

Risk financing and risk transfer tools can play a fundamental role in reducing the negative economic impact of catastrophic risks. It is, therefore, very important to fully recognize the policy implications of their use in the context of national or regional disaster risk management strategies. The lessons learned from past earthquakes in Japan and Iran propose some risk transfer instruments and programs such as:

- Integrated framework of coherent policies and programs which reduces financial losses.
- Re/insurance which absorbs earthquake financial shocks by providing predictable financial relief.
- Catastrophe bonds which transfer risk to investors by allowing the issuer not to repay the bond principal if an earthquake occurs.
- Property catastrophe insurance pool which creates a mechanism to make liquidity available to those affected by an earthquake.

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