Post-Event Reconstruction in Asia since 1999

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Post-Event Reconstruction in Asia since 1999: An Overview Focusing on the Social and Cultural Characteristics of Asian Countries

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Abstract

The concentration of human population in Asia continues to turn its seismic events into what appears to be more than its fare share of disasters. While it is home to just over 60% of the world population, during the past 50 years it has experienced 73% of global death toll due to earthquakes. It is reasonable to expect that such frequent disasters would result in changes in societal attitude towards risk that would express itself as measures aimed at reducing seismic vulnerability of the population.

This paper attempts to assess such changes in societal attitudes towards seismic vulnerability through instances of post-event reconstruction. For this purpose it utilizes the inverse relationship between vulnerability and capacity of society as a touchstone and adopts two parameters of reconstruction drives as valid indicators of attitude of a society to enhance the capacity of its affected population. The first of these is adoption of owner driven reconstruction as the primary mechanism of reconstruction, while the second of these is sensitivity of a reconstruction drive towards socio-cultural characteristic of the affected population and their traditional construction systems.

The study utilizes bibliographical sources and cutting-edge research and concludes that in general there is decided positive shift in societal attitudes towards reducing vulnerability through post-event reconstruction. However while this approach is clearly evident in the cases of large events, tendencies remain to neglect these higher objectives in other cases. The study also tends to indicate that this positive attitude has yet to permeate in the normal developmental activities of the societies for their larger vulnerability to reduce with time.

Keywords: Vulnerability; Risk mitigation; Reconstruction; Owner driven reconstruction; Vernacular construction; Sustainability

1. Introduction

A decade-wise comparison of deaths due to earthquakes in Asia since the beginning of the 20th century indicates that the highest number of deaths has taken place during the last decade (Fig. 1). Indeed since 1960, Asia has experienced 73% of all deaths caused worldwide due to earthquakes, and nine out of twelve most lethal earthquakes (Fig. 2) have occurred here [1].

Considering that seismology and earthquake engineering had taken roots in late 19th century and seismic risk reduction had been a growing public concern throughout the 20th century, a decrease in building destruction (and resultant mortality) was expected during the 21st century. While obviously this expectation has not been fulfilled, this study aims to explore whether there has been any significant effort during the past decade to reverse the trend.

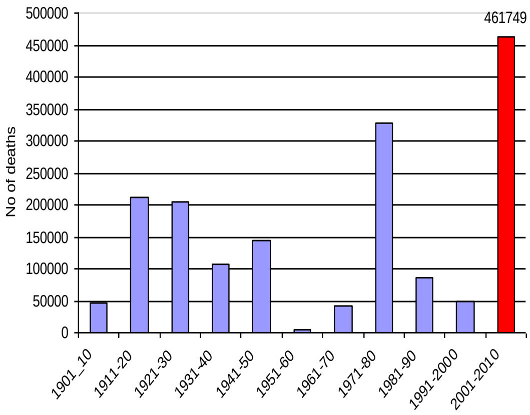

Fig 1: 1000 or more earthquake deaths in Asia since 1900 indicating last decade to be worst; source [1]

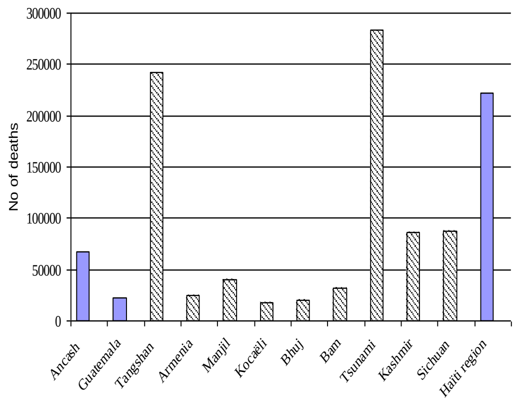

Fig. 2: Twelve most lethal earthquakes of the world during last fifty years, hatched bars indicate Asian countries; source [1]

Attempting to answer one aspect of this question, this paper attempts to assess the societal attitudes towards risk reduction. It is argued in the following that attitudes revealed in the post-event reconstruction drive are a good measure to assess such societal attitudes. To this end, two characteristic of reconstruction drives have been identified which are then used to assess societal attitudes.

In order to identify these two characteristics, initially the relationship between vulnerability and capacity is explored, which leads towards an enquiry into the nature of capacity building through reconstruction. This is followed by case studies of four Asian countries, Turkey, India, Iran, and Pakistan with respect to these characteristics. In each case, it has been attempted to identify trends in reconstruction with respect to these characteristics in a ten-year period largely corresponding to the last decade.

Table 1: Significant earthquakes in India, Iran, Pakistan and Turkey since 1999; Sources [1] to [11]

Earthquake	Date	Mag.	Deaths	Homeless	Buildings Damaged
Kocaëli, Turkey	1999	7.6	17,118	500,000	132,892
Duze, Turkey	1999	7.2	894	30,000	2,682
Bhuj, India	2001	7.6	20,085	1.7 Million	1,122,000
Avaj, Iran	2002	6.5	261	50,000	15,000
Bam, Iran	2003	6.6	31,000	65,000	61,761
Bingöl, Turkey	2003	6.4	177	15,000+	12,758
Indian Ocean Tsunami, India	2004	9.1	10,881	70,000	154,000
Kashmir, Pakistan	2005	7.6	86,000	2,800,000	600,000
Zarand, Iran	2005	6.4	650	32,000	30 to 100% (50 villages)
Quetta, Pakistan	2008	6.4	166	117,500	9,881

2. The Relationship between Vulnerability and Capacity

The relationship between vulnerability and capacity is complex and multifaceted. In the final analysis and notwithstanding other factors, both are inversely related. This relationship permits a reasonable (though short of comprehensive) description of vulnerability in terms of capacity, viz. vulnerability is the sum-total of characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. Here capacity is used as implying the ability of a group or household to resist a hazard's harmful effects and to recover easily [12][1]. Furthermore, this ability to recover can include both internal strengths (of the individual or the group) and external opportunities provided by the society at large [14].

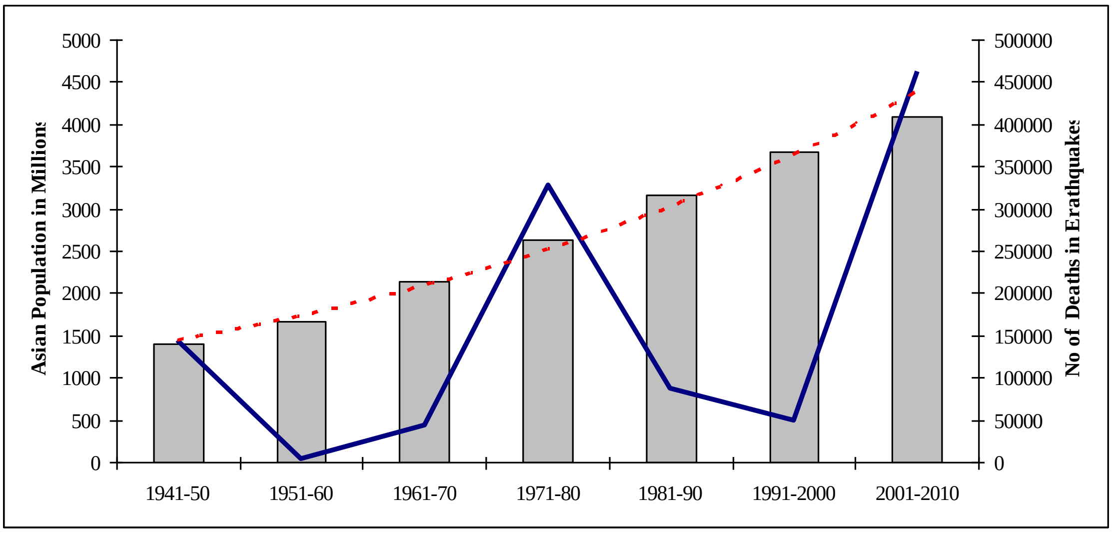

Fig. 3: The graph shows a gradual increase in Asian population through time compared with abrupt change in deaths due to earthquakes. The 30-year peaks in fatalities maintain a steady relationship with population growth indicating that seismic vulnerability of the Asian population has not reduced since 1940.

It can be deduced from the above mentioned that vulnerability may be reduced through increasing the capacity of the population at risk. This approach may well be part of the normal development process of any society, but such development of capacity (or reduction in vulnerability) is difficult to assess under normal circumstances. It is only in the immediate aftermath of a seismic event that the effectiveness of capacity-building measures of a society may be assessed through the seismic performance of its building and human populations.

One good measure of the seismic performance of a building stock is the number of fatalities incurred which is essentially a function of building collapse. Indeed it is a valid indicator of the overall vulnerability of the population as well since it expresses societal preferences and attitude towards seismic risk, and also includes socio-economic and governance aspects of the society.

Viewed through this parameter, Asia does not appear to have reduced its overall seismic vulnerability during the past 70 years. Figure 3 juxtaposes population with number of fatalities due to earthquakes since 1940. Considering the 30-year peaks in the data, population and fatalities have maintained a steady relationship, essentially indicating that the vulnerability of the Asian population has not reduced (or the capacity of the population has not increased) significantly.

3. Measurement of Capacity Building through Reconstruction

Among the large number of options available to a society, post-event reconstruction is the most direct and effective medium for reducing vulnerability and enhancing capacity of population at risk. Reconstruction programs, by very definition, enhance the internal strengths of the population, incorporate external opportunities, and hold the advantage of comparatively easier assessment. Considering the scope of this study, two parameters of reconstruction drives have been selected as

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[1] For a society, vulnerability and capacity analysis focuses mainly on four fields_ social, physical, economic and environmental [13]. In order to maintain the focus of this paper, many relevant but less significant aspects have not been described.

indicators of capacity building attitudes.

The first one of these is *promotion of owner driven reconstruction* (ODR). This approach has been in practice since 1970s albeit in the development sphere [15]. For earthquake reconstruction, this approach was first employed in 2001 after Gujarat India earthquake [16] and showed exceptional results when united with financial and technical assistance [17]. During past few reconstruction drives in Asia, ODR confirmed several advantages [18] that include (i) Lower administrative burden, (ii) Higher social adaptability and acceptability, (iii) Speed and quality in reconstruction, and (iv) 'Penetration' of improved construction techniques into the local culture of construction.

The second of these parameters is *acceptance of vernacular construction practices*. A large number of vernacular building types offer excellent seismic performance, and the reconstruction drive provides the opportunity to introduce additional enhancement in them. Other reasons in favor of using these building types include (i) Social acceptability of materials, finishes, and architectural forms; (ii) Use of locally available material; (iii) Utilization of existing skills within the society; (iv) Institution of enhanced construction techniques within the local construction industry; and (v) Preservation and expression of local cultural identity.

In the following case studies these two parameters have been used as a measure of societal attitudes towards enhancing capacity of the affected population and reducing their vulnerability

4. Case studies

4.1 The Case of Turkey: 1999 - 2009

Considering life loss and building damage, Turkey experienced three significant earthquakes during the ten-year period causing over 18000 deaths and a building damage toll exceeding 148000 buildings (see Table 1). All three events were followed by reconstruction programs. Over 90% of deaths and building damage, however, were caused by the August 1999 Izmit earthquake.

In a detailed and comprehensive study focusing on both of the 1999 earthquakes Gülhan and Güney [19] compare the performance of reinforced concrete and traditional structures namely timber-frame Himis and Baghdadi construction systems. In the comparative study across two provinces they show that seismic performance of traditional structures was far better than the reinforced concrete structures. In particular, instances of collapse and heavy damage were far less in traditional structures. Many later studies such as Gülkan and Langenbach [20] also support similar conclusion.

However the Turkish government did not encourage the traditional building types for reconstruction [21]. Indeed the reconstruction programs launched after 1999 earthquakes showed a strong rejection of traditional construction techniques. An excerpt after Orta earthquake 2000 describes this trend as: "*In a number of instances, government inspectors predictably recommended that the himis houses be replaced by new ones of concrete and hollow clay tile because of what they thought (falling of plaster) was irreparable structural damage"* [20].

Multiple studies also indicate that the 'disrespect' of traditional building structures in Turkey is institutional, and built into their training programs: "*All too often, cultural heritage takes an unnecessary hit in the post-earthquake inspection process, especially with vernacular cultural properties that are not officially recognized. Inspectors sent into areas after a disaster often have no training and even less sympathy for vernacular buildings and archaic construction simply because their training is remote from that which would be relevant to understanding of how such buildings can competently resist earthquakes"* [22].

A small percentage of reconstruction has taken place where the population has been involved in decision making and reconstruction process. After the Duze earthquake in 1999, several local and international NGOs as well as World Bank projects and government did not adopt participatory approach for reconstruction. Arslan and Unlu [23] report a higher satisfaction level of people for participatory approach used in a small project by an NGO than housing provided by the World Bank. Despite such feedback the reconstruction approach of Turkish government did not change, and in the aftermath of 2003 Bingöl earthquake the government took up reconstruction of 98% of destroyed houses itself [24]. Another negative characteristic of Turkish reconstruction drives is frequent relocation without any public participation in the decision making process [23].

On the whole reconstruction policies in Turkey do not appear to promote owner driven reconstruction nor are they sympathetic to vernacular construction practices, the two parameters of reconstruction policies that had been identified as indicating capacity building of the population at risk.

4.2 The Case of India 1999-2009

During the past decade, India experienced two devastating earthquakes. The first and the larger of the two was the 2001 Gujarat (M 7.6) earthquake which caused over 20,000 deaths and damaged or destroyed 1,122,000 buildings [1]. The other disaster was caused by the Indian Ocean Tsunami, secondary effect of M 9.1 earthquake that took place near the west coast of Sumatra, Indonesia. The tsunami caused 10,881 deaths and destroyed or damaged 154,000 houses in India [5]. Both of the events were followed by large scale reconstruction programs, but with contrasting approaches.

In the case of Gujarat earthquake, right from day one, Indian government adopted an owner driven reconstruction approach. Furthermore, based upon their reasonably good seismic performance, the government also accepted *Bhungas,* the vernacular building type in the affected area, as an acceptable option in the reconstruction program. Large scale efforts were made by NGOs to propose and promote several enhancements in this construction system which was endorsed by the government by publishing it as an official Guideline Document [25].

The construction process as well as the product earned widespread approval. In a detailed study of five different permanent housing programs following the 2001 Gujarat earthquake, Duyne Barenstein compared the quality of houses and levels of satisfaction as expressed by homeowners. The analysis clearly indicated that the participatory approaches scored much higher on homeowners satisfaction with i) the house location, ii) the size of the house, iii) quality of materials and iv) construction quality. She concluded that, within a context where people are used to constructing their own houses, and with the provision of adequate financial and technical support, a leading role of the homeowners in the construction process is more likely to lead to houses which are a good match with local needs and preferences as compared to houses provided by outside agencies [18].

On the whole, owner driven reconstruction and acceptance of vernacular building type had been a resounding success, eventually leading to construction of almost 200,000 houses, some 87% of all destroyed structures, were rebuilt by their owners with financial and technical assistance from the government [18].

The positive Gujarat experience encouraged the government to continue with the same approach, and reconstruction after the 2004 tsunami was planned to focus on community participation approach [26]. During policy making period researchers also raised their voices in favor of saving cultural heritage of the area [27]. However a change in the administrative approach to the reconstruction led to a reversal of the overall strategy. The government invited NGOs and private enterprises to adopt villages and reconstruct with their own choice of architects and reconstruction approach [5].

Their adopted methodology of *"full reconstruction by means of construction companies"* translated in the aim *"to replace all self-built traditional houses with 'modern' settlements of flat-roofed reinforced concrete buildings"* which assumed, contrary to the reality, that the affected population was composed of nuclear families. This (and other similar decisions) resulted in a reconstruction that was severely insensitive to local culture and attracted strong disapproval by the local population. Eventually the reconstruction after tsunami was characterized by massive demolition of undamaged vernacular houses, provision of culturally and climatically inappropriate houses, poor quality of construction, depletion of habitat and trees and dramatic changes in way of life. [28]

Although learning from Gujarat did not happen in Tamil Nadu [28], India did own and practice the enlightened strategy of increasing the capacity of its population at risk through adoption of ODR and improved vernacular construction in its reconstruction drives.

4.3 The Case of Iran 1999-2009

During the decade in question Iran experienced three earthquakes (see Table 1) that were followed by significant reconstruction programs. The first one of these, the 2002 Avaj earthquake caused 261 deaths and damaged 15000 structures. Most of the reconstruction related decisions and the process of reconstruction for this event was controlled by the Housing Foundation which is Iranian government's implementing arm for its construction activity including post-event reconstruction programs.

The Housing Foundation did not include people in the decision making or implementing phases of reconstruction. The reconstruction of residential units was based on model plans that were prepared by the Housing Foundation. These single or two storey structures embodied earthquake resistant design, however the affected population did not approve of them because they did not fulfill social and cultural needs. The reconstruction also involved relocation of several villages where the local population was not involved in the decision-making process and the reconstructed-relocated villages were not welcomed by the villagers [29].

The second and worst of these events was the 2003 Bam earthquake which caused 31000 deaths and damaged over 61000 structures. The almost exclusive construction system in the affected region consisted of mud and dried brick load-bearing walls which exhibited low seismic performance and resulted in near total destruction of the building stock, more than 86% suffering Heavy Damage or higher [30]

During the first year of reconstruction, the Housing Foundation attempted contractor built construction but the poor performance and slow delivery by the contractors and their numerous claims for cost increases led the HF to shift after the first year to ODR with technical assistance [17].

The participatory approach to reconstruction was worked out in detail. It involved comprehensive planning of the city, protection of natural environment, sensitivity to historical sites and structures, in-situ reconstruction, and an aim to protect social and cultural characteristics of the city. However vernacular construction system was not included in the program as most of the traditional adobe buildings were destroyed under this earthquake and the government as well as the local population had strong reservations about its seismic performance.

Several attempts were made to create awareness for traditional building styles [31]. However the efforts did not bring fruit and the adobe construction was prohibited. Despite this almost complete negation of the vernacular construction systems, the participatory approach in Bam was largely successful. One major tool used in the participatory process was the establishment of an exhibition complex in order to provide technical services, materials exhibition and housing samples with reference to resistance, cost-effectiveness, climatic & environmental compatibility and long life operation [32]. However some studies do show that people did not participate more during implementation phase of reconstruction and nor were they trained for new forms of building safety.

The 2005 Zarand earthquake caused over 600 deaths and between 30 to 100% destruction in 50 villages (Table 1). It has been reported that despite official claims, inclusion of people in the reconstruction, especially in the early phases had been limited. The same study also reveals that "t*he new houses have modern architectural plans, which are not acceptable for villagers, and many have left the village"* [33]. The 2006 Lorestan earthquake caused destruction in 330 villages ranging from 30 to 100%. In this case it was decided to execute reconstruction through an accelerated program. Thus the temporary settlement phase was eliminated altogether and public participation in the programming and designing phase was not carried out. The implementation of reconstruction, however, was based upon public participation [29].

In terms of government as well as societal response, the Bam earthquake did prove to be a turning point. The government recognized and formally adopted public participation in reconstruction as a public policy. Similarly it also generated a lot of debate about traditional building practices which resulted in research focusing on mechanisms of damage and improvement in their seismic performance.

While Iran did abandon vernacular construction in the affected region of Bam earthquake due to almost total destruction of such building stock, it has shown sensitivity towards traditional building construction and ODR appears to be its primary strategy for reconstruction.

4.4 The case of Pakistan 1999-2009

On 8th October 2005, northern areas of Pakistan and Kashmir were hit by M 7.6 earthquake resulting in 86,000 deaths and destruction of 600,000 houses in Pakistan and Pakistan administered parts of Kashmir. Significant damage was also inflicted in the Indian administered parts of Kashmir where at least 1,350 people were killed and over 32,000 buildings were damaged [1].

The hastily set up Earthquake Reconstruction and Rehabilitation Authority (ERRA) had been quick to adopt owner driven reconstruction with financial and technical assistance as its reconstruction strategy. The reasons for adopting this policy included huge quantum of reconstruction spread over a large geographical area with difficult to access mountainous terrain, the objectives of long-term risk reduction, and advice from donor countries and agencies. However, in a negative twist ERRA used the promised financial support as leverage to ban the use of wood as a construction material. This was certain to delay the reconstruction process by several years since local construction systems invariably involved timber in some form [34].

Initially only reinforced masonry construction was permitted by ERRA. However a near zero reconstruction one year after the earthquake forced ERRA to include Dhajji (a sort of timber-frame construction) in the list of approved construction systems. However it remained reluctant to approve other vernacular construction systems.

It was only a combination of extremely slow progress in reconstruction and continuous feedback and lobbying from partners in the reconstruction such as UN-Habitat that forced ERRA to accept, albeit reluctantly and one by one, other traditional construction systems as suitable for reconstruction. The time line of acceptance of various construction systems (Fig. 4) indicates the policy delay for traditional construction systems which took over five years to complete the ODR based rural reconstruction program.

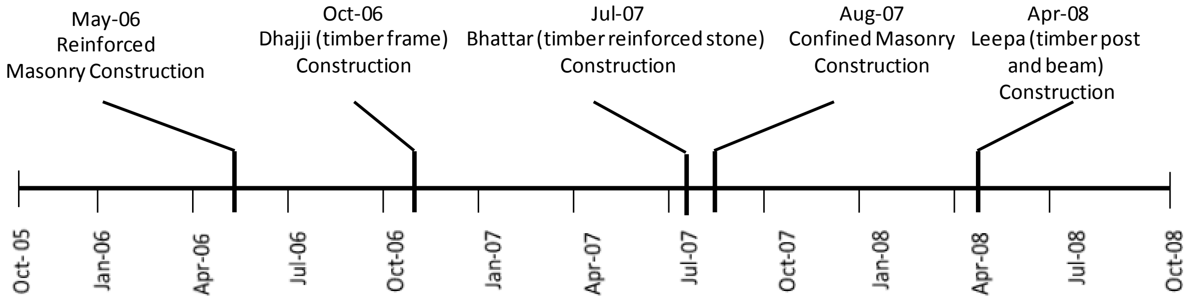

Fig. 4: Timeline of Approved Construction Styles by ERRA; based on Progress Reports of UN HABITAT [35]

Though included late in the reconstruction portfolio, the enhanced traditional building types were promoted very well through technical training and assistance. UN-Habitat, Skills Development Council (SDC), and ERRA developed posters, conducted training programs, and provided onsite technical assistance to make Dhajji reverse its pre-event declining trend. Within two years of its approval, 65,000 Dhajji timber framed houses were reconstructed up to lintel level [35]. The enhanced construction technique was "*rapidly adopted by local communities and it provided a high level of satisfaction among beneficiaries* [17].

The combination of traditional construction systems and ODR resulted in much higher rate of reconstruction and the quality of work was also reported to be far higher than expected [15]. Indeed the same reconstruction effort provides an excellent comparison between ODR (adopted for rural housing reconstruction) and agency based reconstruction (adopted for education, health, and government buildings). Five years after the event 96% of ODR based housing units (419,624) were completed whereas only 27% (1581) of education buildings, 46% (141) of health buildings and 53% (363) of government buildings were reconstructed through contractor based program [36].

Almost exactly three years after the Kashmir earthquake Pakistan experienced another damaging earthquake in October 2008 (see Table 1). In order to take up this reconstruction ODR *with* financial assistance was adopted but *without* any technical assistance [11]. As it turned out, this much smaller reconstruction (less than 10,000 residential units) remained plagued by an extremely slow rate, construction of vulnerable building types, and misuse of financial aid.

Sixteen months after the event, only 2 % of houses were reconstructed despite a financial package almost twice that of the Kashmir earthquake. Older vulnerable construction practices including unsafe foundations are reported as well as self-devised innovations some of which were assessed as likely to increase the vulnerability of the structures rather than decreasing it. One suggested reason of these problems may lie with the reconstruction policy that excluded technical assistance and hence onsite regulation [11].

On the whole Pakistan, though it took its time, appears to have done admirably well in the reconstruction drive targeting the huge quantum of rural housing reconstruction. It adopted both ODR as well as enhanced vernacular construction systems, and reaped the benefits. However it does appear to be somewhat lost in handling the Quetta event.

5. Concluding Comments: Are Asian Countries Still Vulnerable?

From Turkey to Pakistan, a big change in reconstruction approach is evident. There is a decided shift in the attitude of governments towards affected populations, who are increasingly being given a say and a role in the reconstruction process, and their traditional construction systems appear to gain respect. In particular ODR appears to have become a norm rather than exception, especially in the aftermath of large earthquakes.

Yet we are unable to say that the reconstruction programs in the decade under study have reduced the vulnerability of societies to any significant extent [14]. Turkey is still practicing government based reconstruction and there is no acceptance for traditional construction techniques; India observed good results after Gujarat reconstruction program but does not apply them again; Iran decided to forego in totality the strong and distinctive vernacular construction of a large area, and Pakistan takes so long in policy making that people start construction without proper guidance. Considering the overall scenario, it is probably in order to conclude that the inverse relationship of vulnerability and capacity remains to be fully exploited by the Asian countries under study.

Asian countries continue to remain hugely vulnerable to seismic risk. In Pakistan, its largest city Karachi which falls in the zone of highest hazard continues to produce highly vulnerable structures due largely to corruption and poor code enforcement [37], [38]. In India, majority of buildings in its National Capital Region have been found to be inadequate for the expected ground shaking hazard indicating a very poor enforcement of code [39]. In Iran’s capital Tehran, Dr. Bilham has calculated that one million people could die in a predicted quake similar in intensity to the one in Haiti. And as for Istanbul Turkey, a study led by Dr. Erdik mapped out a scenario wherein a quake could kill 30,000 to 40,000 people and seriously injure 120,000 at the very minimum [40].

The current situation may be as it is, what is important is to change the direction sufficiently to continue to increase capacity and reduce vulnerability. While India and Pakistan have changed their direction, they remain to be countries with growing risk [41]. In the final analysis all stakeholders need to participate in the process of disaster risk reduction. Experts need to conduct research and develop appropriate solutions, the governments must be sensitive to socio-cultural aspects of affected communities and involve them in the decision-making process, while people need to be more aware of the risks they face and must give it sufficient weight to learn the extra bit and spend the extra bit.

Furthermore reconstruction can attain sustainability only if it is shifted from implementation by an external agency to penetration within the culture of a society. This is achievable only if earthquake risk is accepted by the society at large as a daily life threat. This acceptability for earthquake risk should be similar to the use of umbrella for rain risk, of pullovers for winter risk and of vaccination for disease risk. And in order to attain this objective, disaster risk reduction must become a public campaign and government priority, with professionals becoming as a binding force between the two.

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