Earthquake Risk Perception among Citizens in Kathmandu, Nepal

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Abstract

Preparedness plays a very significant role in creating the seismic safety and thereby contributes to move forward to the path of peace, progress and prosperity. It is equally important for a nation like Nepal which is situated in the highly earthquake prone geographical location. Kathmandu valley, which is the capital of the country and the main hub for trade, commerce, education and administration, is considered as one of the earthquake prone areas. It is a highly populated area with an estimated population of about 2 million. The people and the development are concentrated in the three cities of the valley namely Kathmandu, Bhaktapur and Lalitpur. Any future large earthquake is likely to cause serious effect to its citizens if the country fails to make adequate preparedness in advance

The present study tries to determine the linkage between the earthquake preparedness and other parameters in the urban parts of the Kathmandu valley using the household survey data collected from 430 respondents. The result shows that the variables such as experience of an earthquake and concern for the future damage significantly influenced the preparedness among the respondents in the study area.

Keywords: *Disaster, Earthquake Awareness, Preparedness*

Introduction

The Himalayas is one of the youngest and active mountain ranges in the world. It ranges from Afghanistan in the west to Myanmar in the east. The constant pushing of Indian plate towards the Eurasian plate has made the region seismically active. Earthquakes in the Indian subcontinent have been recorded even in ancient Sanskrit texts (Bilham 2005). Lying between India and China, Nepal is a landlocked mountainous country with an area of 147,181 square kilometer (Figure 1). The capital of Nepal is Kathmandu which lies in the valley. Nepal has been regularly hit by earthquakes and this has been recorded in olden colophon and written history (UNDP 1994).

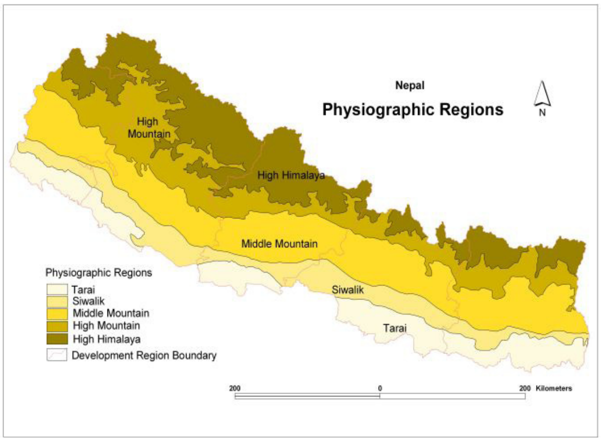


Figure 1. Map of Nepal

The major historical earthquakes recorded in Kathmandu valley include 1255, 1408, 1681, 1810, 1833, 1866, and 1934 A.D. During the 1255 earthquake, one-third of people including reigning King Abhaya Malla died. Many palaces, temples and dwellings were badly damaged. It is said that aftershocks continued for three years (Bilham 1995). The 1934 earthquake, magnitude of 8.4 in Richter scale with an epicenter some 10 kilometers south of Mt. Everest, claimed 16,875 lives and destroyed 3,18,139 houses. Kathmandu valley was severely affected with 4,296 deaths and 55,793houses damaged. Many heritage monuments were damaged or destroyed during the earthquake. Similarly, the 1988 Udayapur earthquake in the Eastern Nepal claimed 721 lives and damaged property worth millions of rupees. Its effect was also felt in the valley, with the death of eight people and damage to many buildings

The analysis of historical data suggests that a great earthquake in the Himalayan region generally occurs in an interval of 80 to 100 years. The 1934 earthquake is the largest disaster event in terms of death toll and property loss (serious damages to 60% of the buildings in the Kathmandu Valley) in 20th century (JICA 2002 and EMDAT 2007). Since seismologists are predicting a severe earthquake in the near future, it is a matter of great concern. Given that earthquakes are inevitable for the Kathmandu valley, there is a need of finding ways to cope with it. Advanced preparedness for an earthquake can be undertaken to reduce the risk and possible harm.

Kathmandu valley, with an area of 667 km^2 and population of about 2 million, is the exclusive center of politics, economy, education and administration of Nepal. Three cities in valley viz., Kathmandu, Bhaktapur and Patan were old city-states and presently they house world heritage sites in the city cores. Due to increased population, poor subsoil condition and haphazard development, seismic vulnerability of the valley has been increasing. If a major earthquake occurs similar to that of the 1934 (magnitude 8.4 Richter scale), the situation is likely be very catastrophic. An estimate by National Society of Earthquake Technology (NSET) has predicted about 40,000 deaths with a hundreds of thousands people rendering homeless if earthquake similar to the 1934 Nepal earthquake occurs in the Kathmandu valley (NSET 1998). This will severely imperil the ability of the nation to operate effectively following the disaster. The development of not only Kathmandu valley itself but the whole nation will be regressed.

In the valley there are mostly brick built houses on the plains and stone buildings on the mountainous region. Japan International Cooperation Agency (JICA) has classified the buildings of valley into adobe, stone, brick in mud, brick in cement, reinforced concrete frame and others (that include buildings like stone and adobe). The greatest stock is building in reinforced concrete frame (23%) followed by brick in cement (21%). Stone buildings make up the lowest percentage of buildings by 7%. Two building construction systems, namely private and public building, are dominant. In the private building system, construction is mostly carried out by the owner and less often by the contractors and housing companies. Most of the buildings in the cities were built before the application of the building codes was enforced by the state. It is to be noted that only after 2005 A.D. building code is made mandatory for the new buildings. The situations described above have added increased vulnerability to building stocks and their occupants. Buildings are also deteriorating due to old age and lack of maintenance. These issues have added increased vulnerability to building stocks and their occupants.

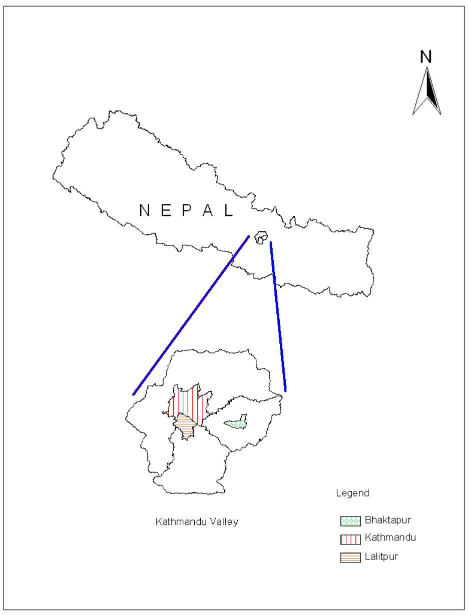
Earthquake preparedness is essential to achieve sustainable development of valley and of Nepal as a whole (JICA, 2002). The impacts of natural hazards such as earthquakes can be reduced if people adopt pre impact hazard adjustments (Burton et al 1993). The purpose of our research is to inquire into the state of awareness and level of preparedness in the communities located in the Kathmandu valley as well as finding out ways for awareness-raising on the seismic safety.

Materials and Methods

Selection of the study area

The study was conducted between September 2007 and April 2008, in both old and newly settled areas of Kathmandu valley to represent the diverse urban context.

Figure 2. Katmandu Valley and its main cities



City cores were selected near historical monuments. Surveys were carried out in three cities of Kathmandu valley (see Figure 2) covering four areas, namely, Yatkha, Shantinagar, Bhaktapur and Patan. Yatkha, Bhaktapur and Patan which represent city cores of Kathmandu, Lalitpur and Bhaktapur respectively, where as, Shantinagar represents the newly settled area in the Kathmandu city. The city cores are the old areas where traditional planning methods created by the Malla rulers (1201-1769) were used where as, in Shantinagar, which is recently developed area without following any urban planning guidelines. During the Malla ruling period, Kathmandu, Bhaktapur and Patan were independent city-states. As in the past, most of the inhabitants in the city cores belong to indigenous Newar community. Inhabitants of the area are of mixed races that have migrated from different parts of country mostly from the 1970s onwards.

Sampling and data collection

A questionnaire was used to conduct face-to-face interviews. Initially, it was planned to be 100 respondents in each location but at the end of the survey, the total respondents turned out to be 430 households which was just an accident. The sample distribution was 100 each in Lalitpur and Bhaktapur, 112 in Yatkha and 118 in Shantinagar. Data were collected from as many respondents as possible because of rather short research period. The survey intends to gather information regarding risk perception and preparedness against the earthquake. Table 1 shows questions that were asked during the interview. Since the questions were in English, in most of the cases translation into Nepali was necessary to assist the interviewees to understand the questions. After the field survey, a descriptive analysis was prepared and statistical analysis was undertaken to find out the relationship between the level of knowledge on earthquake, concern to future earthquake damage and earthquake preparedness.

Table 1. Questionnaire form

Experience of earthquake	Yes	No
Concern about earthquake damage	Yes	No
Level of preparedness	Yes	No

Hypothesis and statistical analysis

Following hypotheses were tested to find risk perception among Kathmandu citizens.

Case 1

H_0= Experience of earthquake and damage concern are independent events.

H_1= Experience of earthquake and damage concern are not independent events.

Case 2

H_0= Damage concern and preparedness are independent events.

H_1= Damage concern and preparedness are not independent events.

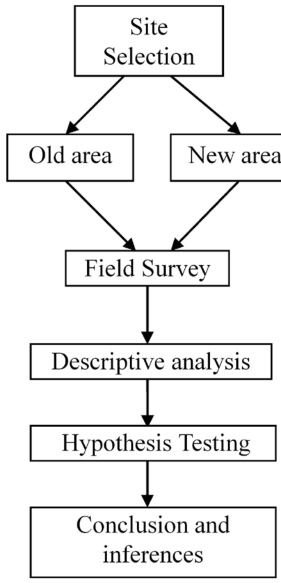
Case 3

H_0= Earthquake experience and earthquake and preparedness are independent events.

H_1= Earthquake experience and earthquake and preparedness are not independent events.

Descriptive analysis was done for the response analysis while Chi square test was done for hypothesis testing. Figure 3 clearly shows the flow chart of methodology adopted in the study.

Figure 3. Flow diagram of research work



Results and Discussion

Descriptive analysis of the respondents

Out of 430 respondents, 80 respondents did not respond to the query regarding the preparedness and concern, so they were removed from the analysis. Therefore, views of only 350 respondents were used for the analysis. High proportion (91.1%) of respondents had experienced an earthquake in their lifetime while 8.9% had no experience. Likewise, 92.6% respondents were concerned about future earthquake damage while 7.4% were not concerned. This change can be attributed to the increase in the awareness following the political change in 1990 A.D. Before that, the country had a single-party autocratic monarchy system known as Panchayat system with a heavy control over the media. Many organizations and groups have been making efforts towards sensitizing people including through providing disaster related information. During the interview, it was found that 49.7% respondents were prepared for an impending earthquake while 50.3% had undertaken no preparation. A high proportion (92.6%) respondent with an experience of earthquake also expressed concern about damage, as seen in Table 2. This may be also due to the belief among many people that severe earthquake will not come in their lifetime. Likewise, only half (49.7%) of respondents who expressed concern for future damage had undertaken preparedness and about half (49.7%) of the respondents having experience of earthquake had undertaken as seen in Table 3 and 4.

Statistical analysis result

Results from the Chi square hypothesis testing can be seen in Table 5 and are elaborated for each case as following:

Case 1

It was found that there is statistically significant relationship between the variables viz., experience of earthquake and damage concern (chi-square with 1 degrees of freedom = 289.01, p = .000). The phi coefficient of association is 0.909. This means earthquake experience and concern about damage are dependent events. Based on the sample information, it can be said that when people undergo through

Table 2. Cross tabulation of earthquake experience by damage concern

			Concern about future damage		Total
			Concern	No concern	
Experience of earthquake	Yes	Count	319	0	319
		% within Experience of earthquake	100.0%	.0%	100.0%
		% within Concern to damage	98.5%	.0%	91.1%
		% of Total	91.1%	.0%	91.1%
	No	Count	5	26	31
		% within Experience of earthquake	16.1%	83.9%	100.0%
		% within Concern to damage	1.5%	100.0%	8.9%
		% of Total	1.4%	7.4%	8.9%
Total		Count	324	26	350
		% within Experience of earthquake	92.6%	7.4%	100.0%
		% within Concern to damage	100.0%	100.0%	100.0%
		% within Concern to damage	100.0%	100.0%	100.0%

Table 3. Cross tabulation of earthquake preparedness by damage concern

			Preparedness		Total
			Yes prepared	No preparedness	
Concern to damage	Concern	Count	174	150	324
		% within Concern about damage	53.7%	46.3%	100.0%
		% within Preparedness	100.0%	85.2%	92.6%
		% of Total	49.7%	42.9%	92.6%
	No concern	Count	0	26	26
		% within Concern to damage	.0%	100.0%	100.0%
		% within Preparedness	.0%	14.8%	7.4%
		% of Total	.0%	7.4%	7.4%
Total		Count	174	176	350
		% within Concern to damage	49.7%	50.3%	100.0%
		% within Preparedness	100.0%	100.0%	100.0%
		% of Total	49.7%	50.3%	100.0%

Table 4. Cross tabulation of earthquake experience by damage concern

			Preparedness		Total
			Yes prepared	No preparedness	
Experience of earthquake	Yes to experience	Count	174	145	319
		% within Experience of earthquake	54.5%	45.5%	100.0%
		% within Preparedness	100.0%	82.4%	91.1%
		% of Total	49.7%	41.4%	91.1%
	No to experience	Count	0	31	31
		% within Experience of earthquake	.0%	100.0%	100.0%
		% within Preparedness	.0%	17.6%	8.9%
		% of Total	.0%	8.9%	8.9%
Total		Count	174	176	350
		% within Experience of earthquake	49.7%	50.3%	100.0%
		% within Preparedness	100.0%	100.0%	100.0%
		% of Total	49.7%	50.3%	100.0%

earthquake experience, they become more concerned about the future earthquake damage.

Case 2

Likewise, there is significant relationship between the damage concern and earthquake preparedness (chi-square with 1 degrees of freedom = 27.767, p = .000). The phi coefficient of association is 0.282.

This means that concern about earthquake damage and preparedness are dependent events. Based on the sample information, it can be said that the higher the damage concern people have, the more likely they are to be prepared for earthquakes.

Case 3

Similarly, there is significant relationship between the earthquake experience and earthquake preparedness (chi-square with 1 degrees of freedom = 33.62, p = .000). The phi coefficient of association is 0.310. From this, it can be concluded that those having the earthquake experience tend to be more prepared.

Table 5 (i). Chi-Square Tests. Earthquake experience by damage concern

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	289.018(b)	1	.000		
Continuity Correction(a)	276.951	1	.000		
Likelihood Ratio	157.819	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	288.193	1	.000		
N of Valid Cases	350				

a Computed only for a 2x2 table

b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.30.

Table 5 (ii). Chi-Square Tests. Damage concern and earthquake preparedness

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	27.767(b)	1	.000		
Continuity Correction(a)	25.661	1	.000		
Likelihood Ratio	37.812	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	27.688	1	.000		
N of Valid Cases	350				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.93.

Table 5 (iii). Chi-Square Tests. Experience of earthquake and preparedness

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	33.626(b)	1	.000		
Continuity Correction(a)	31.480	1	.000		
Likelihood Ratio	45.604	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	33.530	1	.000		
N of Valid Cases	350				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 15.41.

Conclusion and Recommendation

It is said that people will be more motivated to prepare themselves once they feel and observe a disaster but after a disaster, the correlations of risk perception with the adoption of hazard adjustments tend toward zero as time moves on (Weinstein and Nicolich 1993). After the 1988 Eastern Nepal earthquake, Kathmandu has not experienced major earthquake and only has watched devastating earthquakes in India, Turkey, and Algeria through the media.

It was revealed from the survey that earthquake experience and concern for damage from a future earthquake among respondent are related events. Likewise, people with damage concern are more prepared and people with earthquake experience tend to have better preparedness. The result is also consistent with the other studies which indicate to the fact that the people start to increase preparedness measures once they get warning of earthquake or feel the earthquake themselves (Turner et al 1986, Mulilis et al 1990, Mileti and O'Brien 1992, Mileti and Fitzpatrick 1992, 1993; Showalter 1993, Farley et al 1993, Mileti and Darlington 1995, Dooley et al 2006). Since, experiencing a large earthquake in the area is not a common phenomenon in one's lifetime, it is recommended to utilize a system of providing an experience to those who have not experienced an earthquake. Figure 4 shows the mobile vehicle employed in Japan for simulation of earthquake environment. Here, the situation similar to the 1995 Kobe earthquake is simulated thereby giving the experience of an earthquake. This simulation helps individuals to experience an earthquake scenario. As discovered in the studies and research that personal experience affects responses to hazards (Weinstein 1983), similar simulation environment like the 1934 great earthquake can be introduced through use of simulation vehicle in Nepal to increase awareness and preparedness. A simulation environment can help to raise concern about future damage, and may be very effective in achieving the goal of seismic safety.

Figure 4. Earthquake simulation vehicle employed in Japan. This vehicle simulates the 1995 Kobe earthquake environment.

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