Seismic Risk Perception Concerning Non-engineered Houses

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SUMMARY:
In earthquakes disasters, many people are killed by collapse of their own houses, most of which are non-engineered. In order to better understand the seismic risk perception and willingness of residents, government officers, and masons/builders, who are directly responsible to improve the safety of non-engineered houses, we conducted a joint survey with partner institutions in 8 countries, namely Indonesia, Nepal, Pakistan, Turkey, Fiji, India, the Philippines, and Japan. The study revealed that seismic risk perception differs from country to country, and from community to community. For example, people in Indonesia and Pakistan tend to invest more to protect their house property than their family members while people in Turkey and Japan tend to invest more o protect their family members than their house property. In most countries, house builders/masons are confident about the safety of the houses which they constructed although many masons/builders do not know the building codes.

Keywords: *risk perception, non-engineered houses, residents, masons, government officers*

1. INTRODUCTION

1.1. Background

People in developing countries are more vulnerable to, and affected by, natural disasters. Many people in these countries live in vernacular houses built of adobe, brick, stone, and wood. They are non-engineered and thus, are vulnerable to natural disasters, particularly earthquakes. As a result, many people are killed by their own houses during an earthquake. To reduce causalities from earthquakes, it is important to make these houses safer. Non-engineered houses can be strong when they are constructed with appropriate and practical techniques that are affordable to ordinary people. A big challenge, however, is that the house owners lack the motivation to invest to secure the safety of their houses, particularly to retrofit existing vulnerable houses. The stakeholders such as the house builders/masons and the government officers, who are directly involved in construction of houses or related policies and regulations, also lack interest in securing sufficient safety mainly because house owners are not concerned with the safety of their houses. It is thus crucial to convince the stakeholders that the investment in safer housing will eventually prove to be worthwhile.

Choices and decisions regarding housing safety are made, not based on the actual risk, but on the perceived risk. Therefore, we conducted surveys on risk perception of the residents, masons/house builders, and the government officers, to better understand their seismic risk perception from 2007 to 2008 in Indonesia, Nepal, Pakistan, Turkey, Fiji, India, the Philippines, and Japan. The survey results will help the governments develop disaster risk management policies and initiatives and help NGOs develop strategies that would raise awareness and disseminate technologies for safer housing at community level, and convince people to invest in housing safety against earthquakes.

1.2. Studies on Disaster Risk Perception and Human Behaviour

Several studies have examined earthquake risk perception and human behavior. In 1974, Juckson and Makerjee pointed out that high awareness of earthquake risk did not significantly affect residents' motivation to implement safety measures to reduce damage from natural disasters. Edwards (1993) conducted surveys in Tennessee, United States, and showed that economically better-off people were more willing to invest in retrofitting and safer housing. In a similar vein, Okazaki (2006) pointed out that most people would be reluctant to opt for seismic retrofitting even if they were highly aware of earthquake risk.

Regarding risk perception, Wachdorf and Sheng (2002) pointed out that differences in people's values and personal characteristics were associated with differences in people's risk perception. Palm and Carroll (1998) showed that people's earthquake risk perception was affected by their background and cultural differences such as those between Japan and the United States. They showed that in these two countries, those who had higher levels of perceived earthquake risk were more likely to perform retrofitting or engage in other activities to reduce potential damage from disasters than people who had lower levels of perceived earthquake risk.

Turner, Nigg, and Paz (1986) showed the importance of people's earthquake risk perception in relation to their behavior in times of disasters. They found through a survey conducted in California that even when people understood earthquake risk, they did not take any action to reduce that risk. Sattler, Kaiser, and Hittner (2000) showed that people were optimistic about their houses, believing that they would withstand disasters despite having a clear understanding that a hurricane could strike and cause damage to their house. Similarly, Mileti and Fitzpatrick (1993) found that 80% of respondents in their survey believed that their house would withstand an earthquake even though they also believed that an earthquake could strike and cause significant damage to their house. Mileti and Darlington (1997) pointed out the influence of neighbors and relatives on disaster preparedness and understanding of disaster risk. Major (1993) found in her survey in Missouri and Illinois that conversations with others about earthquake risk had a great effect on individual risk perception. She acknowledged the importance of the media in promoting the benefits of disaster preparedness and seismic retrofitting. Other studies (e.g., Lindell and Perry 2000; Lindell and Whitney 2000) pointed out the importance of residents' awareness of the benefits of disaster preparedness because this awareness could motivate people to opt for seismic retrofitting.

In Japan, Kohiyama and others (2006) conducted a survey of homeowners of both wooden and non-wooden houses about their willingness to retrofit their houses. They showed that people's tendency towards reconstruction and their distrust of seismic retrofitting were negative factors in their decision to retrofit. As part of this study on residents' willingness to improve housing safety against earthquakes, Umemoto and others (2009) conducted a field survey in Shizuoka city, Chiba, and in Mito city in Japan. They identified through conceptual structural modeling that several factors affected residents' decisions to retrofit their house. Eraybar and others (2010), who conducted field surveys as part of this study in the earthquake-prone districts of Baklkyoi and Abjiral in Istanbul, Turkey, also analyzed residents' willingness to undertake seismic retrofitting of their houses.

No previous studies have compared earthquake risk perception among residents of various developing countries and their willingness to retrofit their houses. Thus, it is not clear what kind of methods or policies would motivate residents and homeowners in these countries to undertake seismic retrofitting of their houses. Furthermore, it is not clear how earthquake risk perception differs among residents of different countries and regions.

2. SURVEY METHOD

2.1. Survey of the residents

The surveys of the residents were conducted from 2007 to 2008 in Indonesia, Nepal, Pakistan, Turkey,

Fiji, the Philippines, and Japan, using the identical questionnaire developed by Okazaki, National Graduate Institute for Policy Studies (GRIPS). The questionnaire was slightly modified by the partner institution to reflect the local conditions. The survey was conducted in two different kinds of communities in each country for the purpose of comparison. The partner institution in each country decided what two kinds of communities should be selected in that country. For example, Indonesia and Pakistan selected one community which was severely hit by a recent earthquake and the other community which was not. Nepal selected one community where a community based disaster management activities are implemented and the other where such activities are not implemented. Fiji selected a community from urban areas and the other from rural areas.

Approximately 400 households were randomly selected in each community so that the sampling error should be less than approx. 5 percent. The trained surveyors visited the selected houses to conduct an interview with the head of each household (or spouse) and filled in the questionnaire through an interview. The questionnaire asks whether the respondents think their house is safe against earthquakes, how they want to avoid the risks of damage to their house and harm to their family, what they know about retrofitting, and so on, in addition to questions about their sex, age, number of family members living together, household income, occupation, and house-related information such as floor area, structural type, cost, and ownership. The questionnaire was pre-tested in October 2006 in Nepal by the National Society for Earthquake Technology Nepal (NSET).

2.2. Survey of the house builders / head masons

The targeted house builders or head masons were those who were actually constructing the conventional or common houses, particularly in urban areas. Approximately 50 house builders or head masons were asked with the questionnaire in each country. In many cases, the interviewers visited them to conduct the questionnaire interview. This survey was conducted in Nepal, Pakistan, Indonesia, Turkey, Fiji, the Philippines, and India in 2008.

2.3. Survey of the local government officers

The targeted local government officers were those responsible for disaster risk management or safer building construction at local level. The local governments were cities and towns that are responsible for disaster management and building control. The local governments were selected from the Capital region, or randomly nation-wide. Approximately 30 local government officers were targeted in each country. In many cases, the interviewers visited them to conduct the questionnaire interview. This survey was conducted in Nepal, Pakistan, Indonesia, Turkey, Fiji, the Philippines, and India in 2008.

3. RISK PERCEPTION OF RESIDENTS

3.1. Attributes of the respondents

While about half of the respondents in Nepal and Fiji were male, male respondents were dominant in Pakistan (96%), Japan (73%), and Indonesia (71%). On the contrary, female respondents were dominant in Turkey (64%) and the Philippines (69%). With regard to the period of living in the current house, the majority answered ‘less than 25 years’ in Indonesia (93%), Pakistan (50%), and Nepal (38%). **Figure 3.1** shows the ownership of the house. Almost all the respondents (98%) owned their houses in Pakistan. In the other countries, owned houses are dominant except in Nepal, where only half of the respondents in Nepal owned their houses and the remaining half were renting.

Figure 3.2 shows house types. Detached houses were dominant in Fiji, Japan, Philippines, and Indonesia, while townhouses or flats were dominant in Nepal and Turkey. With regard to the major structure, ‘Bricks with Reinforced Concrete (RC) frame’ was the dominant structure in Indonesia (74%) and Nepal (72%), while almost all the buildings in Turkey were RC structure. There were also many ‘bricks without RC frame’ structures in Nepal. Timber is dominant in Japan and Fiji. The

majority in Indonesia and Turkey purchased their houses while the majority in Pakistan built their houses by themselves. Most respondents in Indonesia purchased their houses with less than US$5,500, while respondents in Turkey paid more than ten times that amount to purchase a house. The majority of respondents in Pakistan built their houses with US$800–1,600. In Nepal, the monthly rental fee of US$15–30 was the majority.

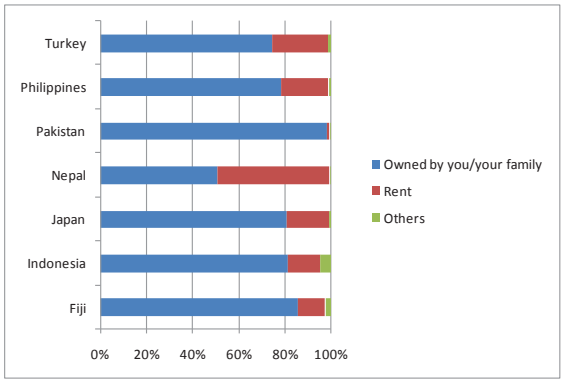

Figure 3.1. Ownership

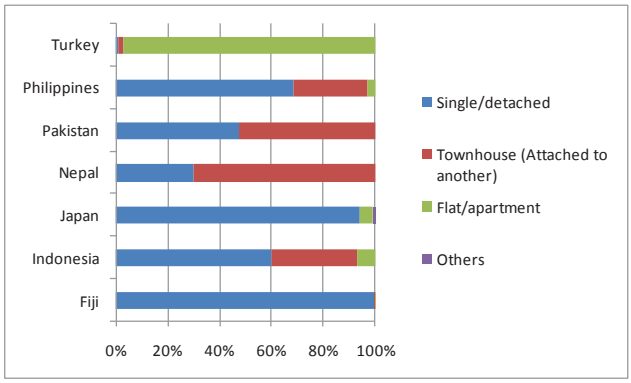

Figure 3.2. House types

Local masons were the dominant means of house building in Indonesia (61%), Pakistan (90%), and Philippines (47%) while contractors were dominant in Turkey. Most respondents in Turkey, Pakistan, and Indonesia had experienced earthquakes in the past. As for educational attainment of the respondents, school education was the attainment level of the majority in Indonesia, Pakistan, and Turkey while many respondents attained college/university level in Philippines and Nepal. The illiteracy rate was comparatively high in Pakistan and Nepal.

3.2. Risk perception and behaviour

3.2.1. Future risk which may affect life

There were two questions about future risk which might affect the life of the respondents: 'What do you think will most severely affect your life?' and 'What kind of disaster do you think will most affect your life?' In Indonesia, Pakistan, Turkey, and Fiji, respondents were most afraid of disasters while respondents in the other countries were afraid of disease and/or unemployment. Among the disasters, all the respondents were most afraid of earthquakes, particularly in Japan, Turkey, Pakistan, and Nepal, except Fiji where people were more afraid of storms, as shown in **Figure 3.3**.

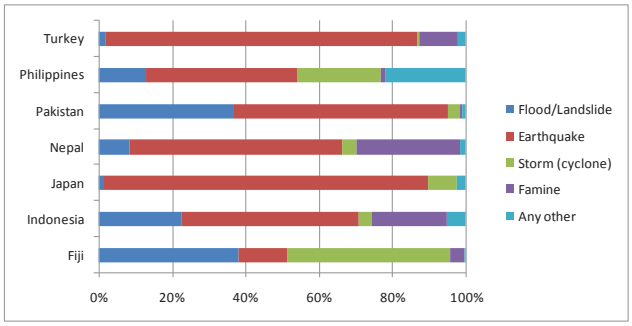

Figure 3.3. What kind of disaster do you think will most affect your life?

3.2.2. Estimated damage by earthquakes

In response to the question 'What kinds of impacts do you anticipate due to a big earthquake?', respondents anticipated both loss of themselves/family and loss of their house/property to the same extent, except Japan where people anticipated less deaths and more injuries (see **Figure 3.4**). While few Japanese anticipated deaths, many anticipated

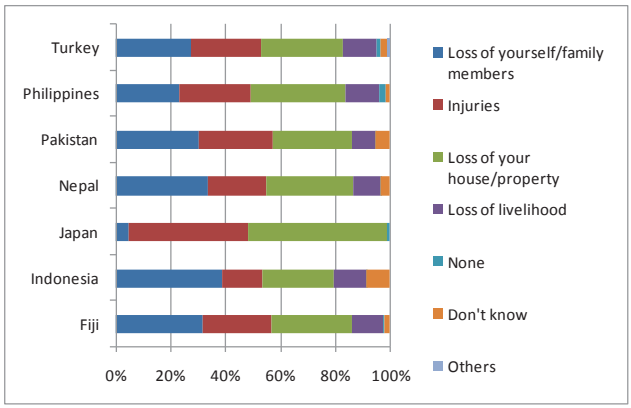

Figure 3.4. What kinds of impacts do you anticipate due to a big earthquake? (Multiple answers)

loss of the house/property.

3.2.3. Actions to reduce the impacts of earthquakes

In response to the question 'What have you done to reduce the impacts of earthquakes?', the majority of respondents in Pakistan and Nepal had done nothing in particular while the majority of Philippines, Indonesia, and Fiji had strengthened their house. More than half of the respondents in Turkey had insured their houses. It should be noted that this ratio should be higher in Turkey according to its obligatory disaster insurance system.

3.2.4. Safety of the house

In response to the question 'Do you think your house is strong enough to withstand a big earthquake?', most respondents in Turkey and Philippines answered 'yes', while the majority answered 'no' in Indonesia (71%), Pakistan (94%), Nepal (62%), and Fiji (69%) as shown in **Figure 3.5**. To those who answered 'no', an additional question was asked: 'Do you plan to make your house safer? (Or do you plan to move due to the unsafe house?)' The majority in Indonesia, Turkey, Philippines, and Fiji answered 'yes', while two thirds in Nepal answered 'no'. To those who answered 'no' to the question about a future plan to make the house safer, one more question was asked: 'Are you worried about collapse of your house due to earthquakes?' More than half of the respondents in Indonesia answered 'no' while most of the respondents in the other countries answered 'yes'.

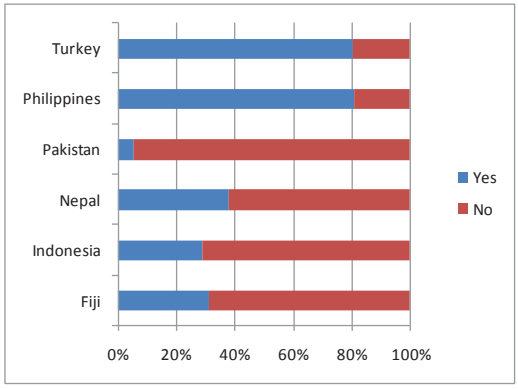

Figure 3.5. Do you think your house is strong enough against a big earthquake?

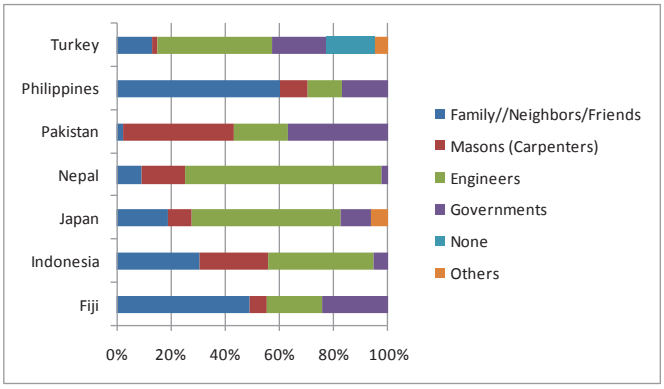

Figure 3.6. Whom do you rely on for a safer house?

3.2.5. Responsibility for housing safety

In response to the question 'Whom do you rely on for a safer house?', the majority answered 'engineers' in Indonesia (39%), Nepal (72%), Japan (55%), and Turkey (42%), while the majority in Pakistan (41%) answered 'masons', and the majority in Philippines (60%) and Fiji (49%) answered 'family/neighbours/friends' as shown in **Figure 3.6**. Respondents in Indonesia, Nepal, and Japan did not appear to rely on the government for safer housing.

In response to the question 'If your house collapsed and killed some of your family due to a big earthquake, who would you blame?', the majority in Indonesia, Pakistan, and Japan answered 'don't know', while the majority in Nepal (42%) and Fiji (37%) answered 'Myself', and the majority in Turkey answered 'house builders' (34%) and 'government' (30%) as shown in **Figure 3.7** ('Gods' was replaced by "Faith' in Turkey).

In response to the question 'If your house would be severely damaged by an earthquake, what would be the causes for the weakness of the house?', the majority in Philippines, Pakistan, Nepal, and Fiji answered 'poor construction materials/work' while respondents in Indonesia tended to answer 'built without design/supervision of engineers' and the respondents in Turkey tended to answer 'cost cut' as

shown in **Figure 3.8**.

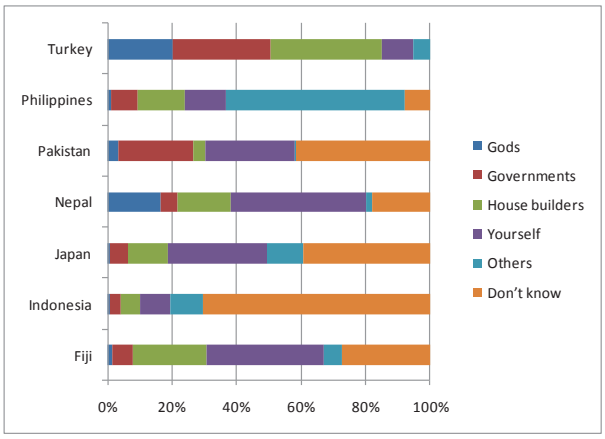

Figure 3.7. If your house would collapse and kill some of your family due to a big earthquake, whom would you blame?

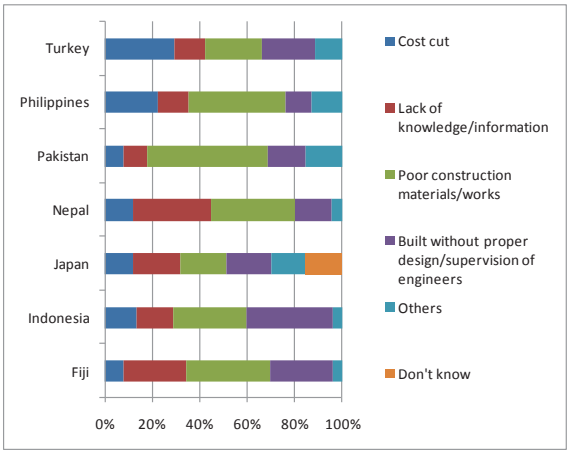

Figure 3.8. If your house would be severely damaged by an earthquake, what would be the causes for the weak house?

3.2.6. Willingness to pay for safer housing

With regard to willingness to pay for safer housing, the respondents were asked two similar questions: 'How much could you spend to protect your house/property from a big earthquake?' and 'How much could you spend to protect your family members from a big earthquake?' The difference between the two questions is whether the concern is house/property or the life of family members. Regarding the question on protecting the house/property (**Figure 3.9**), the majority in Indonesia (45%) and Pakistan (82%) answered 'more than 5 years' household income'. In contrast, the majority in Turkey (38%) and Philippines (53%) answered 'less than 1 month's income'. Similar questions were asked to house renters. In Indonesia, Nepal, and Philippines, the majority answered 'less than a 5% increase in my rental fee would be acceptable', while the majority in Turkey and Fiji answered 'an increase in my rental fee would not be acceptable'.

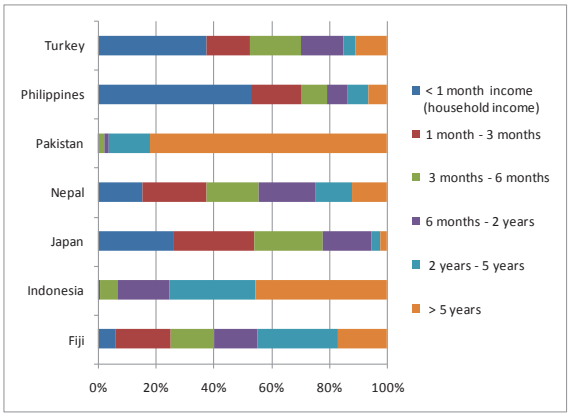

Figure 3.9. How much can you spend to protect your house/property from a big earthquake?

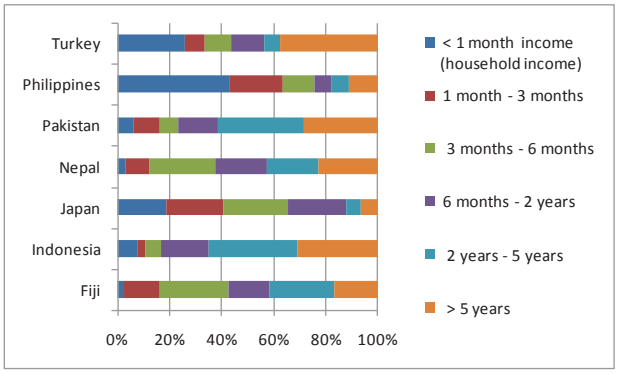

Figure 3.10. How much can you spend to protect your family members from a big earthquake?

In answering the question on protecting the family, the majority in Indonesia (34%) and Pakistan (33%) answered '2–5 years' income', as shown in **Figure 3.10**. Compared with the former question, the amount decreased, meaning that they would pay less to protect their family than their house/property. On the contrary, the majority in Nepal answered '3–6 months' income' and the respondents who answered 'more than 5 years' income' doubled. In Turkey, the majority (38%)

answered ‘more than 5 years’ income’. Compared with the former question, the amount increased, meaning that they would pay more to protect their family than their house/property.

3.2.7. Community issues

Several questions were asked concerning the risk of the communities. In response to the question ‘What facilities do you think should be protected with high priority?”, the majority in all the countries answered ‘schools’, ‘hospitals’, and water supply’ followed by ‘electricity’. The other facilities such as ‘government offices’, ‘religious places’, and telephone’ did not have high priority in the all countries. In response to the question ‘Are any community based associations or organizations working for disaster risk reduction in this area?’, many people (though less than half) answered ‘yes’ in Philippines, Pakistan, and Indonesia, and Fiji. In response to the question ‘Have you ever participated in any initiatives/activities for disaster risk reduction?’, the majority in the all countries did not participated in any initiatives. Comparatively many people participated in Philippines, Pakistan, and Indonesia.

4. RISK PERCEPTION OF HOUSE BUILDERS/MASONS

4.1. Safety of the house

We asked the mode of service to the house builders / masons. With regard to ‘What is mode of service you provide in building construction?’, the majority in Nepal (92%), Indonesia (72%), and India (42%) answered ‘Labor contract’ while the majority in Philippines (54%), Pakistan (54%) answered ‘Labor and material contract’ as shown in **Figure 4.1**. In response to the question ‘How do you think a big earthquake will affect the houses you constructed?’, the majority in Turkey and India answered ‘No (or little) damage’, and the majority in Philippines, Pakistan, and Indonesia answered ‘Light damage’, while the majority in Nepal and Fiji answered ‘Heavy damage’ or “Collapse” as shown in **Figure 4.2**.

In response to the question ‘Do you know about the details of the building code / housing guidelines developed by government?’, the majority in Turkey, Pakistan, Nepal, and Indonesia answered ‘Have not heard’ or ‘heard but don’t know the details’, while the majority in Philippines, India answered ‘Have been applying its provision’ as shown in **Figure 4.3**.

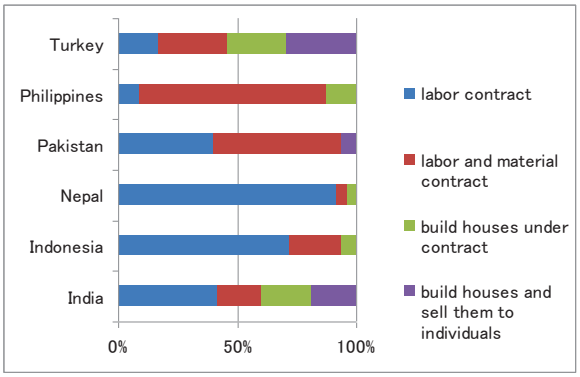

Figure 4.1. What is mode of service you provide in building construction?

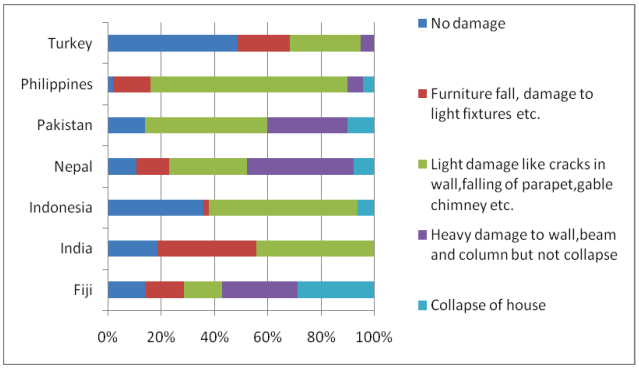

Figure 4.2. How do you think a big earthquake will affect the houses you constructed ?

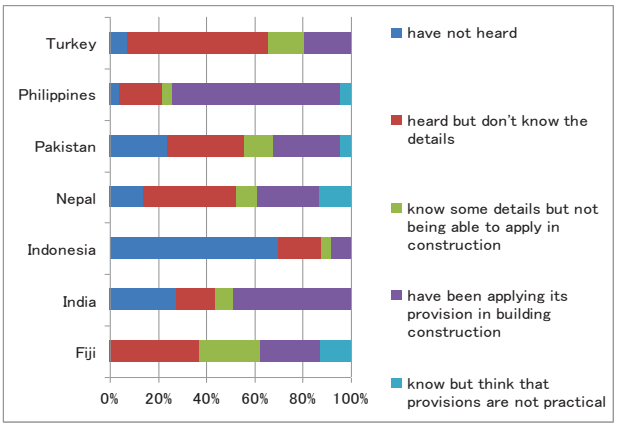

Figure 4.3. Do you know about the details of the building code / housing guidelines developed by government?

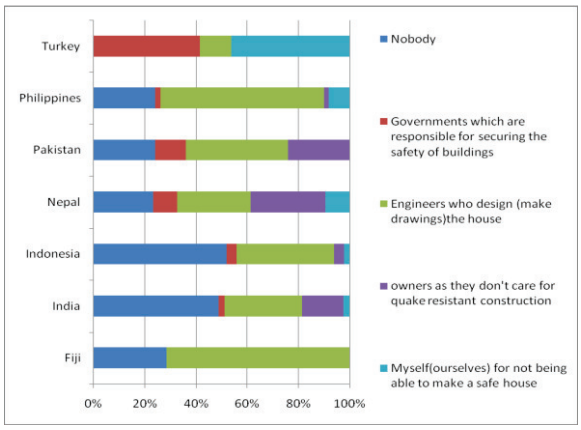

Figure 4.4. If the building you constructed collapse in a big earthquake, who should be blamed the most ?

4.2. Responsibility for housing safety

In response to the question 'If the building you constructed collapse in a big earthquake, who should be blamed the most?', the majority in India (49%) and Indonesia (52%) answered 'Nobody', and the majority in Philippines (64%), Pakistan (40%), and Fiji (71%) answered 'Engineers', while the majority in Turkey (46%) answered 'Myself' as shown in **Figure 4.4**.

5. RISK PERCEPTION OF GOVERNMENT OFFICERS

5.1. Issues of the government

In response to the question 'What do you think is the biggest problem in your city in terms of urgency and importance?', the majority in Pakistan, India, and Fiji answered 'Lack of infrastructure (water supply, transportation, traffic, etc.)', and the majority in Nepal and Indonesia answered 'Environmental problems'. The issue of 'Natural Disaster' is particularly minor in Pakistan and Indonesia. In response to the question 'What is the most difficult issue in enforcing building code effectively?', the majority in all the countries answered 'Unwillingness of general public to abide the code', rather than 'Low number of building control staff', 'Lack of financial resources to implement the code', or 'Low level of professional skill of engineers in the city' as shown in **Figure 5.1.**

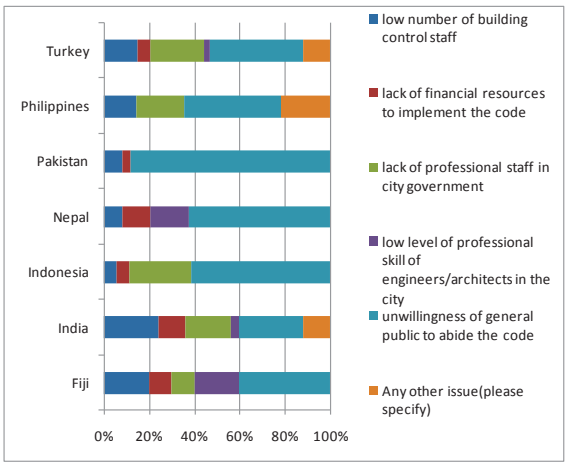

Figure 5.1. What is the most difficult issue in enforcing building code effectively?

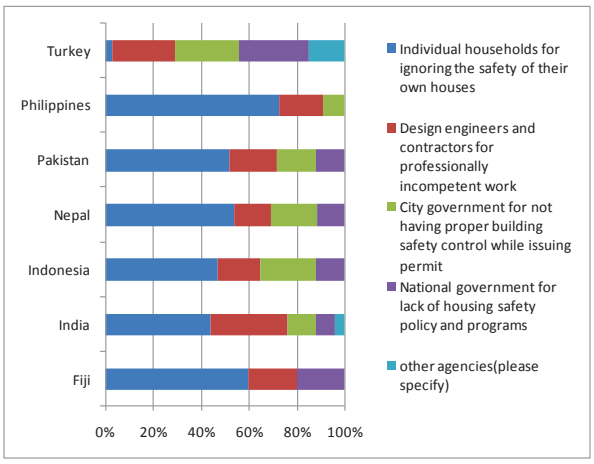

Figure 5.2. Who do you think would be considered most responsible for damage of buildings and loss of lives due to future earthquakes?

5.2. Responsibility for housing safety

We asked a question 'Who do you think would be considered most responsible for damage of buildings and loss of lives due to future earthquakes?', which is similar to the question asked to the residents and the house builders/masons. The majority in all the countries answered 'Individual household for ignoring the safety of their own houses' except Turkey where the majority answered 'Government officers (national and local)' as shown in **Figure 5.2**. The result is quite different from the result of the residents or the house builders/masons. In response to the question 'Which stakeholders or members/group can contribute most towards improvement of building safety in your city?', the majority in Turkey (33%) and Nepal (54%) answered 'City and national government' while the majority in Philippines (60%) and India (46%) answered 'Design engineers and architect', and the majority in Pakistan (40%) and Indonesia (53%) answered 'Builders, petty contractors, and masons'.

6. CONCLUSION

This study on the residents revealed that seismic risk perception differed from country to country, and from community to community. The findings of this study are summarized as follows.

- Most people in Turkey and Philippines think their house is strong enough to withstand a big earthquake, while the majority in Indonesia, Pakistan, Nepal, and Fiji do not think so.
- People tend to rely more on engineers for housing safety in Indonesia, Nepal, Japan, and Turkey while people tend to rely more on masons and governments in Pakistan, and people in Indonesia and Nepal rely less on the government.
- If family members would be killed by collapse of their house in earthquakes, the majority in Indonesia, Pakistan, and Japan would not blame anybody, while the majority in Nepal and Fiji would blame themselves, and the majority in Turkey would blame the house builders and the governments.
- People in Indonesia and Pakistan tend to pay more to protect house property than family members, while people in Nepal and Turkey tend to pay more to protect their family than house property.
- In most countries, house builders/masons are confident about the safety of the houses which they constructed although most of masons/builders do not know the building codes.
- In most countries, house builders/masons do not think that they are responsible for the vulnerability or collapse of the houses they constructed.
- For many government officers, disaster risk reduction is not the highest priority, compared with the development of infrastructure or environmental issues.
- The government officers tend to think that the individuals or house owners are responsible for noncompliance with the building codes and the damage or collapse of the houses in case of earthquakes.

Those findings will be useful for the governments to develop disaster reduction policies and initiatives, and for NGOs to develop effective strategies that would raise awareness and disseminate technologies for safer housing at community level, and would convince people to invest in housing safety against earthquakes.

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