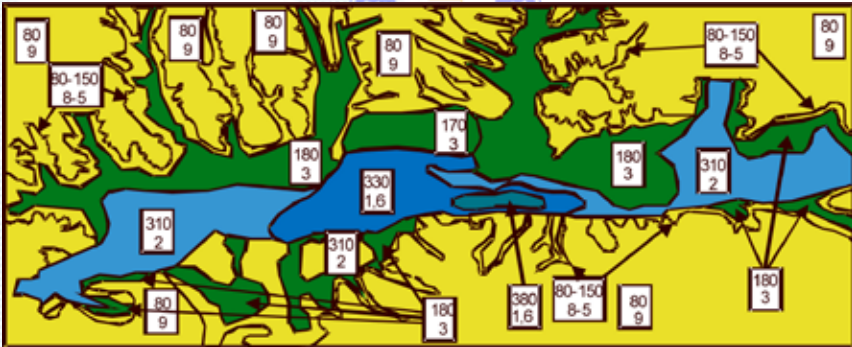


source zones and signal propagation paths. The shaking probability at this stage is predicted from the recurrence curve of certain energy-class earthquakes for the area of Ulaanbaatar town.



**Fig. 4. Schematic seismic risk of the area of Ulaanbaatar town. Top values are peak accelerations, cm/s<sup>2</sup>; bottom values are dominating frequencies of unconsolidated ground motions to solid rocks, Hz.**

The proposed technique for assessment of seismic effects with regard to probabilistic approach in detailing the initial data can be used for large-scale (1:25000 or 1:10000) mapping of seismic risk of the area of Ulaanbaatar town.

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## Sustainable Natural Disaster Management in Asia

Sciences Council of Asia

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### **Abstracts**

*In this report, the author aims to examine the status quo of people's perception or coping toward earthquakes, and the effects of risk experience and risk information to promote risk management. The relationship between people's anxiety and trust in the social risk management system is also examined. Social surveys using questionnaires were carried out before and after the Sichuan Earthquake in China, and the same survey was also conducted in Japan and the U. S. The survey results clarified that the respondents in China show lower levels of anxiety and higher self-evaluation of risk coping than do the Japanese respondents. The effect of risk experience was observed, as the awareness and countermeasures with respect to earthquakes improved especially among Chengdu residents after the Sichuan Earthquake. Significant effects from obtaining information on actual risk management action and life evaluation were also observed. The level of system trust was the highest for the Chinese respondents, before and after the Sichuan Earthquake. These findings indicate that a high level of trust in the risk management system is related to lower levels of anxiety about everyday life risks. The higher levels of anxiety shown by the Japanese respondents apparently reflect their feeling that the risk management system is either insufficient or untrustworthy.*

**Keywords:** citizen, risk management, earthquake, anxiety, risk experience, risk information, trust, education for disaster prevention

### **1. Introduction**

It has been argued that today is an era of risks. This report focuses on earthquakes, among the various types of risks for citizens. Earthquakes threaten the safety and security of our daily life. A great earthquake occurs,

with the result that ordinary people suffer from serious damage; perish, be injured, lose family and property. In fact, earthquakes have killed more than one million people during the past 25 years worldwide, and in Asia-Pacific region, China, Japan, Iran, India, Pakistan, Afghanistan, and Turkey have suffered greatly from earthquake disasters. These earthquake-prone countries are situated in regions where plate tectonic activity continues to generate earthquakes.

For the sustainable natural disaster management, it is essential to strengthening not only the hard wear including infrastructures but also soft-wear including risk management systems of organizations and individuals. There are several kinds of risk management subjects; governmental risk management, business risk management, community risk management, and individual (family) risk management. Our everyday environment is full of various risks; the necessity for citizens to introduce risk management process into their daily life has been increasing.

In this report, I aim to examine the significance of risk experience and risk information by examining people's conditions of risk perception and coping toward earthquakes. Furthermore, the differences in the levels of anxiety about everyday risks and the effect of the perception of the social risk management system on the levels of anxiety are clarified.

A social survey using a questionnaire was carried out to obtain quantitative data in China, Japan, and the U. S. By analyzing the quantitative data, the following five points are examined here: (1) differences in perception of anxiety toward risk among citizens of China, Japan, and the U. S.; (2) the actual conditions and self-evaluation of risk coping among people; (3) the effect of risk experience in promoting people's risk management toward earthquakes, by grasping the change in perception and coping toward earthquakes before and after the Sichuan Earthquake; (4) the effect of information in promoting Chinese people's risk management; and (5) the effect of the perception of the social risk management system on the levels of anxiety.

## **2 Framework of this study**

This report addresses the following five viewpoints: (1) uncertainty avoidance and risk perception, (2) relative deprivation and risk coping, (3) risk experience and risk management, (4) the effect of obtaining information on risk management, and (5) trust of government and science/scientists and the level of anxiety. The complete framework of this study is shown in Fig. 1.

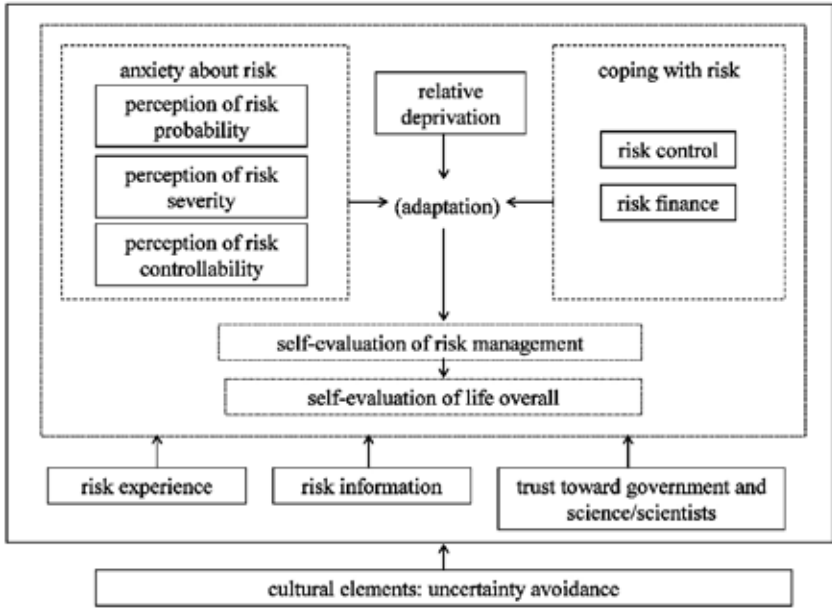


Fig. 1. Complete analytical framework of this study

### 3. Method

#### 3.1 Surveys

Two kinds of social surveys were conducted. One was carried out in China, Japan, and the U.S. before the Sichuan Earthquake (Survey A); the other was a follow-up survey in China after the Sichuan Earthquake (Survey B). Survey B was designed to examine how the levels of risk anxiety and risk management were changed by such a huge disaster.

#### Survey A

This survey was carried out with the following framework for China [C], Japan [J], and the U.S. [US]. (1) Population and subjects: [C], [J], & [US] male and female, 20-69 years old; [J] & [US] nationwide; [C] Beijing, Shanghai, Chengdu, Luoyang, and Guangzhou. (2) Method: [J] & [US] send and return by mail; [C] computer-assisted telephone interview. (3) Sampling ledger: [C] random digit dialing, [J] NOS list, & [US] GfK list. In all three countries, the subjects were randomly sampled on the basis of gender, age, and population percentage. (4) Number of usable samples: [C] 1000, [J] 1050, & [US] 509. (5) Survey period: [C] 2008 Feb 18-Mar

6, [J] 2008 Feb 13-29, & [US] 2008 Feb 23-Mar 28. (6) Investigation implementation organization: [C] Chinese Academy of Social Sciences, [J] Nippon Research Center, & [US] GfK Custom Research North America.

The basic attributes of the respondents were as follows. Gender: [C] female 50.0% and male 50.0%, [J] 54.6% and 45.4% & [US] 50.9% and 49.1%. Age: [C] (average 39.55 years old): 20-29, 24.0%; 30-39, 30.0%; 40-49, 23.0%; 50-59, 16.0%; 60-69, 7.0%; [J] (average 45.65 years old): 20-29, 14.1%; 30-39, 23.5%; 40-49, 21.1%; 50-59, 20.3%; 60-69, 20.9%; & [US] (average 42.65 years old): 20-29, 22.6%; 30-39, 22.2%; 40-49, 22.0%; 50-59, 18.6%; 60-69, 14.7%.

### **Survey B**

This survey was carried out with the following framework for China [C]. (1) Population and subjects: same as for survey A and new respondents (male and female, 20-69 years old, stricken areas). (2) Method: computer-assisted telephone interview. (3) Sampling ledger: random digit dialing. Subjects were randomly sampled on the basis of gender, age, and population percentage. (4) Number of usable samples: 1220 (720 repeat respondents; 500 new respondents). (5) Survey period: 2008 July 21-31. (6) Investigation implementation organization: Chinese Academy of Social Sciences.

The basic attributes of the respondents were as follows. Gender: female 49.8% and male 50.2%. Age (average 39.80 years old): 20-29, 23.4%; 30-39, 29.9%; 40-49, 22.5%; 50-59, 16.2%; 60-69, 8.0%.

### **3.2 Indexing of variables**

The indexes of the main variables are shown below.

#### **Items of risk**

Nineteen risks in everyday life were presented to the respondents: (a) earthquakes, (b) traffic accidents, (c) fire, (d) cancer, (e) contaminated food, (f) crime, (g) illness and injury, (h) decreased income, (i) decreased assets, (j) financial difficulties after retirement, (k) global warming, (l) health hazards from genetically modified food, (m) side effects of drugs, (n) nuclear accidents, (o) Internet scams, (p) leaks of personal information on the Internet, (q) defamation on the Internet, (r) Internet sex victimization, and (s) computer viruses.

#### **Perception of anxiety about risks**

The level of anxiety about each risk was obtained by asking,

“In your daily life, how anxious do you feel about the risks listed below? Use a number from 1 to 6, where 6 means ‘very anxious’ and 1 means ‘not anxious at all’.”

### **Action of disaster prevention**

To grasp the actual conditions of people’s risk management (risk control and risk finance) with respect to earthquakes, the following question was presented:

How much do you do the following things in your household? ‘Know evacuation sites and evacuation routes in times of disaster’, ‘Store water and food for emergencies’, ‘Have family discussions on disaster prevention’, ‘Have discussions on disaster prevention with neighbors or people from my local community’, ‘Save money for unexpected expenses in the future’, ‘Have life insurance’, ‘Have damage/disaster insurance’. The answer ranged from “very much” to “not at all”.

### **Evaluation of risk management and life**

To examine people’s evaluation of their own risk management, the following question was given:

How effective do you think it is for your household to prepare and take measures against unexpected events, including crime and disasters? Use a number from 1 to 10, where 10 means “very effective” and 0 means “not effective at all”. To examine people’s evaluation of their life overall, the following question was given: How satisfied are you with your present life in general? Use a number from 1 to 10, where 10 means “very satisfied” and 0 means “not satisfied at all”.

### **Trust toward government and science/scientists**

The tendency to trust government (both the state and municipal levels) for five items of risk (earthquakes, crime, side effects of drugs, financial difficulties after retirement, and leaks of personal information on the Internet) was evaluated by asking,

“How reliable do you think your state government would be regarding prevention and recovery related to these risks?” “How reliable do you think your municipal government would be regarding prevention and recovery related to these risks?” The answers ranged from “very reliable” to “very unreliable.” The tendency to trust science and scientists was evaluated by asking,

“How much do you agree with the following statements? ‘Scientific developments give more of a positive effect to people than a negative

one'; 'Statements by scientists and professionals are credible.' The answers ranged from "strongly agree" to "strongly disagree."

## 4 Results

### 4.1 Differences in anxiety about risks among three countries

Among the three countries investigated, the Japanese most strongly feared the effects of the 19 life risks in Survey A. The results are shown in Table 1.

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Table 1. Anxiety scores for 19 risks and ANOVA results for 3 countries (Survey A)

	Earthquakes	Traffic accidents	Fire	Cancer	Contaminated food	Crime	Illness and injury
Japan	5.07	4.89	4.59	4.70	4.70	4.52	4.92
U. S.	1.98	3.71	3.42	3.71	2.99	3.41	4.01
China	4.21	4.35	4.36	4.34	4.21	4.02	4.37
F value	926.60***	156.95***	137.62***	87.99***	287.92***	114.05***	110.25***
multiple comparisons (Tukey HSD)	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***
(China: After Sichuan Earthquake: Survey B)	(4.25)	(4.49)	(4.36)	(4.37)	(4.25)	(3.99)	(4.49)

	Decreased income	Decreased assets	Financial difficulties after retirement	Global warming	Health hazards from genetically modified food	Side effects of drugs
Japan	4.84	4.52	4.78	4.80	4.29	4.44
U. S.	4.08	3.79	3.80	3.11	3.13	3.56
China	4.27	4.03	3.99	3.59	3.90	4.14
F value	76.82***	58.79***	123.79***	361.19***	122.96***	75.77***
multiple comparisons (Tukey HSD)	J-U*** J-C*** C-U*	J-U*** J-C*** C-U*	J-U*** J-C*** C-U*	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***
(China: After Sichuan Earthquake: Survey B)	(4.37)	(4.18)	(4.16)	(3.88)	(3.94)	(4.15)

	Nuclear accidents	Internet scams	Leaks of personal information on the Internet	Defamation on the Internet	Internet sex victimization	Computer viruses
Japan	4.35	3.94	4.23	3.85	3.56	3.94
U. S.	2.70	3.40	4.01	3.04	2.72	3.83
China	3.62	3.22	3.31	3.12	3.12	3.18
F value	221.49***	55.63***	88.22***	67.65***	46.44***	63.44***
multiple comparisons (Tukey HSD)	J-U*** J-C*** C-U***	J-U*** J-C*** C-U ns	J-U* J-C*** C-U***	J-U*** J-C*** C-U ns	J-U*** J-C*** C-U***	J-U ns J-C*** C-U***
(China: After Sichuan Earthquake: Survey B)	(3.58)	(3.18)	(3.15)	(3.06)	(3.09)	(3.24)

\*\*\* p < .001, \*\* p < .01, \* p < .05

It has been stated by other researchers (e.g., Hofstede 1991; Mizushima 2002) that Japan is a society in which people tend to feel more anxious. Hofstede observed that “uncertainty avoidance” is a characteristic reflecting nationality. Hofstede’s investigation (among 50 countries in 3 regions, Japan ranked 7th in his survey.) On the other hand, the U.S. is characterized as a society where the uncertainty avoidance tendency is weak (46th out of 50). Given these perspectives, I can expect the level of anxiety about everyday life risks to be lower in China and the U.S. than in Japan, and this was confirmed by the results of this empirically in this study.

The tendencies for perception of probability and severity of risk were (1) Japan > U.S. > China (Wilks I2 = .334 ;  $p < .001$ ) for the probability of risk and (2) Japan > U.S. > China (Wilks I2 = .547;  $p < .001$ ) for the severity of risk. With regard to substantial risk, the Japanese respondents estimated a higher probability and severity for all 19 items of risk. For the controllability of risks, the tendencies were China > U.S. > Japan (non-Internet risks) and U.S. > China > Japan (Internet risks) (Wilks I2 = .655;  $p < .001$ ).

#### **4.2 Actual conditions and self-evaluation of risk coping**

The present survey examined the status quo of risk finance (saving money for unexpected expenses in the future, having life insurance, have damage/disaster insurance, etc.) and risk control (knowing evacuation sites and evacuation routes in times of disaster, storing water and food for emergencies, having discussions on disaster prevention with neighbors or people from the local community, etc.). In the results, Japanese people scored especially well for risk finance. The results show, however, that Japanese self-evaluation of risk management is lower than in the U. S. and China. The results show, however, that Japanese self-evaluation of risk management is lower than in the U. S. and China. The average score of self-evaluation is 4.38 in Japan, which is significantly lower than in the U. S. (5.00) and China (7.11).

#### **4.3 Effect of risk experience: change in perception and coping toward earthquakes among Chinese people before and after the Sichuan Earthquake**

In this section, the change in perception and coping toward earthquakes before and after the Sichuan Earthquake among Chinese respondents is discussed.



**Change in risk perception**

The results for Chinese respondents' change in risk perception is shown in Table 3. After the Sichuan Earthquake, the respondents throughout China felt the probability of big earthquakes occurring was higher than they did before; however, significant changes were not observed in other elements, such as the anxiety and knowledge of a person. Focusing on Chengdu residents, more remarkable changes were found. After the Sichuan Earthquake, the levels of anxiety and the probability of earthquakes became higher. It can be said that experiencing a certain risk improves the awareness and consideration of that risk.

Table 3. Risk perception toward earthquakes before and after the Sichuan Earthquake (Surveys A and B)

		Anxiety	Clarification by specialists	Personal knowledge	Probability	Severity	Control-lability
throughout China (n=720)	Before the Sichuan Earthquake	4.18	4.14	3.68	3.11	4.90	3.08
	After the Sichuan Earthquake	4.25	4.17	3.73	3.28	4.83	3.07
	t value	-.952 ns	-.545 ns	-.639 ns	-2.504 *	1.051 ns	.125 ns
Chengdu residents (n=141)	Before the Sichuan Earthquake	3.99	3.93	3.55	3.25	4.69	3.07
	After the Sichuan Earthquake	4.37	3.86	4.05	3.59	4.64	3.09
	t value	-2.444 *	.497 ns	-4.059 ***	-2.392 *	.348 ns	-.128 ns

\* p< .05 \*\*\*p< .001

**Change in risk coping**

The results for the change in coping toward earthquakes before and after the Sichuan Earthquake are presented in Table 4. It was observed that the levels of action rose for all items. The change for each disaster-prevention item is statistically significant.

Table 4. Actions for disaster prevention toward earthquakes before and after the Sichuan Earthquake (Survey B)

	Before the Sichuan Earthquake	After the Sichuan Earthquake
Prepare fire extinguisher and water bucket	14.3	43.9
Secure furniture and refrigerator	14.9	47.0
Check dangerous structures such as block walls surrounding homes	13.6	51.3
Strengthen level of earthquake-proofing	7.8	32.5
Store water and food for emergencies	18.4	53.1
Prepare portable radio or flashlight	22.5	60.9
Prepare valuables for evacuation	19.5	59.4
Arrange communication network with friends or relatives	24.5	65.9
Know evacuation sites and evacuation routes in times of disaster	7.4	50.4

#### 4.4 Relationships among information, risk management, and evaluation of life

In order to examine the relationships among Chinese people's tendency to obtain information, tendency to obtain disaster information, action for disaster prevention, and evaluation of risk management and life overall, a path analysis was conducted, giving the result shown in Fig. 2. The dependent variable here is the evaluation of life overall, with the variable of the household income also added in this model. The effect of risk management evaluation is significant at .362 ( $p < .001$ ). The result suggests the importance of information for evaluating both risk management and life overall.

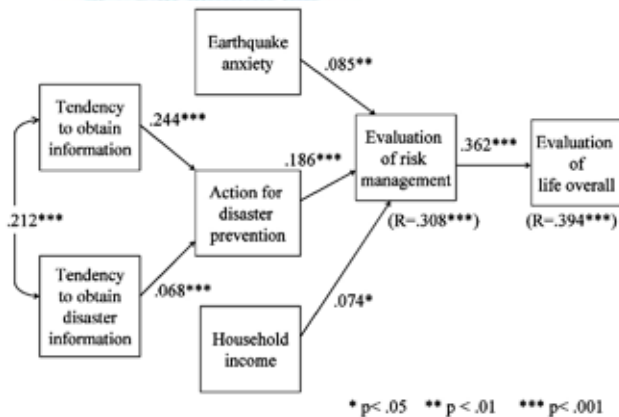


Fig. 2 Result of path analysis

**4.5 Trust of government and science/scientists**

Tables 5 shows the scores for trust in state governments related to five items of risk . The Japanese respondents scored low for all items. Same tendencies were observed as for the trust of municipal government and scientists. These results indicate that a low level of trust in the social risk management system is related to higher levels of anxiety about everyday life risks.

Table 5. Anxiety scores related to trust of state government for five risks and ANOVA results for three countries (Survey A)

	State government				
	Earthquakes	Crime	Side effects of drugs	Financial difficulties after retirement	Leaks of personal information on the Internet
Japan	2.44	1.99	1.89	1.61	1.62
U. S.	2.58	2.42	2.31	1.93	2.02
China	3.40	3.03	2.93	3.04	2.53
F value	443.277***	456.448***	460.893***	985.801***	293.952***
multiple comparisons (Tukey HSD)	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***	J-U*** J-C*** C-U***
China: After Sichuan Earthquake (Survey B, n=720)	3.40	3.00	2.80	3.00	2.40

p< .001

**5 Conclusion and future work**

Living is inevitably accompanied by risks, and the environment surrounding the life system in present day society is constantly changing. It is important for the ordinary people to improve their acknowledgment and risk management with respect to earthquakes.

By analyzing quantitative data, the following were evaluated. Differences among three countries in perception concerning anxiety toward risk were observed; the anxiety in this case is triggered by uncertainty. It is interesting to note that respondents in both China and the U. S. tend to better accept the impact of uncertainty. After the Sichuan Earthquake, people’s perception of probability and coping toward earthquakes has been strengthened in China. The tendency was especially remarkable among Chengdu citizens, who experienced the earthquake near the epicenter. Significant effects of information designed as part of a risk management action plan and of living sufficiency safeguards are observed. The analysis also revealed the levels of trust in the specialists/

agencies responsible for risk management. A higher level of trust in the social risk management system results in a lower level of anxiety.

On the afternoon of March 11, 2011, an earthquake measuring 9.0 on the Richter scale hit Tohoku area in Japan. It was reported that more than 23,000 people were killed or missing. As for my future work, I recognize the following two tasks should be achieved: 1) Carrying out another follow-up survey in Japan and China after the Tohoku Earthquake. I have obtained the concrete plan and subsidy to conduct it in March 2012; it will be examined how the conditions of people's risk perception and management would be changed by such a huge disaster. 2) Organizing the interdisciplinary research project team for supporting the disaster stricken area of Tohoku. Actually some researchers of natural sciences and social sciences, i.e., information science, engineering, agriculture, sociology, and economics - join to research and support residents of a certain area of Tohoku. The condition of victims move on, therefore it seems an important mission for researchers to obtain the quantitative and qualitative data reflecting the reality of victims in appropriate timing. Such data could be a significant clue to realize the effective risk management, and safe/secured living for ordinary people.

### Acknowledgement

This study was supported by the Japan Society for the Promotion of Science (JSPS), through a Grant-in-Aid for Scientific Research (B).

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