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SOCIAL RESPONSES TO THE
TANGSHAN EARTHQUAKE

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Abstract

A successful earthquake prediction would be of great benefit to reduce social and economic losses in seismically threatened communities. However, the impact of an earthquake prediction itself upon a community may be great; therefore, research on the social consequences of earthquake prediction is vitally important. The Tangshan earthquake of July 28, 1976 was not predicted by a short-term or imminent prediction which resulted in enormous loss of life and property damage occurred. However, a mid-term prediction had been issued. Using data from the social and economic survey on the Tangshan earthquake, public responses in Tianjin and Tangshan to this mid-term earthquake prediction will be investigated in this paper.

I. Introduction

On February 4, 1975, a major earthquake measuring 7.3 on the Richter scale struck Haicheng, a highly populated area in the northeastern part of China. An imminent earthquake warning had been issued before the event which was heralded as the first successful attempt in human history to forecast a major earthquake.

In contrast to that event, the Tangshan earthquake of July, 1976, was not preceded by an imminent prediction. That earthquake resulted in approximately 240,000 deaths and 160,000 injuries. All members of an estimated 7,000 households were killed. The earthquake leveled the entire city of Tangshan, partially destroyed Tianjin, and affected Beijing. Direct social and economic losses were estimated conservatively at 9.6 billion (RMB) yuan. The Chinese Central Government allocated 600 million yuan for direct disaster relief; and 2.5 billion yuan for Tangshan's reconstruction. Additionally, in order to recover and rebuild Tangshan, the Chinese Central Government exempted the city of Tangshan from its responsibility to contribute revenue to the Central Government from 1979 through 1983.

Although the Tangshan event occurred without a short-term prediction, a mid-term prediction had been issued in early 1974. At that time, the Chinese State Council identified the existence of a risk zone around Tianjin, Beijing and North Bohai (Figure 1) in which an earthquake of magnitude 5-6 would possibly occur in 1 to 2 years. The document was issued to local governments, the armies, and other government agencies in order to stimulate increased earthquake preparedness and prevention activities. Additionally, at the beginning of 1976, the State Seismological Bureau held a

meeting in Beijing on the general level of earthquake risk following the Haicheng earthquake. The conclusion of that meeting was that earthquake activity in northeastern China was still high and that increased activity would continue for the next two years. All participants agreed that there was a high probability that a major earthquake of magnitude 7 or higher would strike the area. However, the definite timing of the earthquake was not determined.

During this period, the Tangshan-Chaoyang area and the Beijing-Tianjin area were put under an intense watch, and the regions were combined to form a larger cooperative earthquake watch area. More seismographic stations were set up to monitor earthquake activity, and the communication network with Beijing was improved. At the same time, programs to educate and train people in earthquake emergencies were expanded, and mass participation in monitoring earthquake precursors was encouraged. Old houses were surveyed and retrofit preparation plans made. The Seismological Office of Tangshan city (the present Tangshan Seismological Bureau) used slides and exhibits of popular seismology science and earthquake preparedness to educate the public. They also distributed various pamphlets to improve public knowledge about earthquakes, preparedness, and prevention. In related efforts, monitoring sites were set up in factories, mines and schools to make observations of earthquake precursors. In the countryside, peasants and students in middle and primary schools were organized to monitor the anomalous phenomena of ground water and animal behavior. During the period before the Tangshan earthquake, observation stations in the Tangshan area, staffed by amateur groups, increased from about 65 to over 90. However, no short-term or imminent precursory anomalies were detected by either experts or amateur groups. Thus, despite efforts by both seismologists and members of the public, the attempt to formulate an imminent prediction failed.

II. Dissemination of Earthquake Information

To clarify how earthquake information is disseminated in China, it is necessary to briefly discuss the Chinese regulations concerning earthquake predictions. In China, there are four types of earthquake predictions: long-term; medium-term; short-term; and imminent. Long-term prediction refers to forecasts in which the predicted range is large and no definite occurrence time is specified. Long-term predictions give a probability estimation from years to tens of years, and they are not issued to the public. Medium-term predictions are slightly more urgent. Their predicted range is comparatively shorter. Although still indefinite, their duration is generally one to three years. Medium-term predictions are not issued to the public; but the local government is informed, and increased attention of seismological departments takes place. Short-term predictions are more definite, with a period which is shortened to several months. The earthquake risk is considered very high, and the prediction is generally communicated to the local government. However, it is

still not issued to the public. Finally, the imminent or most urgent prediction is issued to the public typically with occurrence times of 3 to 15 days (See Figure 2).

Because of the above-mentioned policies related to medium-term earthquake predictions, the issuance of the Tangshan prediction was restricted to the local governments and other relevant government organizations (e. g., locally stationed armies). Although all the earthquake information was not officially conveyed directly to the public, it was more or less disseminated in the society, since the local governments' increased earthquake preparedness and prevention and many seismologists and amateur groups undertook intense and wide-range monitoring the earthquake precursors. In this case, though, the prediction may have been mainly referred to as an "internal document" circulating among the local governments. Only in this way could the information be said to have been disseminated indirectly to the society through word of mouth.

III. A Survey of Public Response to Earthquake Information

In 1987, a large-scale retrospective survey on the Tangshan earthquake was conducted in the communities of Tianjin and Tangshan by the Section of Seismosociological Study (SOSS) of the Institute of Geophysics within the State Seismological Bureau (SSB) and the Department of Sociology at Nankai University. Although the study focuses primarily on socio-economic losses and social problems caused by the earthquake, the study of social responses to earthquake prediction was also part of the survey. In this study, 3552 questionnaires were randomly distributed to residents in Tangshan and Tianjin. Except those that did not conform to the definition of "legitimate" questionnaires (i.e., no answers or no effective answers to the questionnaire), the response rate of 85% (N=3035) was achieved. This study focuses on a number of topics: the extent to which information about the earthquake hazard had been disseminated in the affected areas prior to the 1976 Tangshan earthquake; the extent to which respondents believed and acted on the information they received; and the nature of respondents' beliefs concerning the science of earthquake prediction.

The survey scope was conducted within Tangshan city (involving five districts which were Lunan, Dongkuan, Xinqu, Kaiping and Lubei) and a severely effected part of Tianjin (involving four districts and one suburban county which were Heping, Hexi, Tanggu and Hangu, and Ninghe county). Four types of sampling techniques were used: stratification, systematic sampling, clustering, and random sampling were used (Figure 3). Considering the problem that there might be some questions without answers on the questionnaire and some refusals, before distributing questionnaires, the percentage of respondents who would refuse to answer was estimated. This estimation was based on the investigators' research experiences, the survey's contents, and the respondents' possible condition, so as to guarantee the number of effectively answered questionnaires.

During the survey, the respondent's situation was very important in order for the investigator to get back a completed questionnaire. Since the Tangshan survey was carried out 10 years after the Tangshan earthquake, most of the respondents experienced the terrible great earthquake and had miserable suffering. When a few of them looked at the questionnaire, they felt very sad and grieved or even angry no matter how the investigator explained to them how important the survey was. Certainly, many refused to answer or could not manage themselves to answer.

In addition, 10 years after the Tangshan earthquake, social mobility also created a problem for the survey. For example, when the sample included a person who had moved to Tianjin or Tangshan after the earthquake, it was not "legitimate." According to the survey requirements, for the respondents should be those who had experienced the Tangshan earthquake. Therefore, it was estimated that 15 percent of the respondents would not answer or would not be able to answer the questionnaire. According to the sampling principles shown in Figure 3, in Tangshan residents among the sampled 10-household groups were sample units which were randomly selected. In Tianjin, households were sample units which were randomly selected. In fact, 1500 samples in each of the two cities had been enough to meet the demands of statistical confidence interval (99.5%). Therefore, the extra distributing number of the samples should be: $3000 / 15\% = 450$, so that distributing 3500 questionnaires would be very satisfactory. Actually, 3552 questionnaires were distributed.

FINDINGS

Earthquake Knowledge. In the survey, 1455 respondents in Tianjin and 1539 respondents in Tangshan were asked whether they had heard that an earthquake might possibly occur in their communities. About two-thirds of the residents of Tianjin and just under one-half of the residents of Tangshan reported that they had not heard about the possibility of an earthquake in their area (Table 1). However, it is interesting to note that 29 percent of the residents of Tianjin and 50 percent of the residents of Tangshan did recall hearing something about the possibility of an earthquake prior to the earthquake, a significant proportion of the population had received some form of earthquake prediction information prior to the July event, especially in Tangshan.

Channels Through Which Information Was Obtained. Respondents were also asked to indicate the sources where they heard this earthquake prediction information. Included among the questionnaire items were various formal and informal sources of communication: radio and television; newspapers and magazines; public earthquake displays; and conversations with relatives and friends.

Among individuals responding to these items, the most frequently reported source of earthquake information was relatives and friends, particularly true in Tangshan where approximately one-half of the respondents indicated they had used this source.

In our survey, 386 respondents in Tianjin and 728 in Tangshan answered the question (Table 2). Fifty-one percent in Tianjin and 46 percent in Tangshan said that they obtained the earthquake information mainly through "talk with relatives and friends." In contrast with this item, reliance on the work unit as a source of information varies considerably between the two cities.

In 1989, Profs. Zou Qijia, Su Tuo and Ge Zhizhou developed a dissemination model for the Tangshan earthquake prediction information. They maintain that when the government and some departments were undertaking arrangements of earthquake preparedness and propaganda education, it enabled part of the people to obtain the earthquake information, and then those who had obtained the information were targeted as a core to radiate to the surrounding by talking with their relatives and friends (See Figure 4).

Levels of Concern. Respondents who had received information about the possibility of an earthquake were asked to indicate how much concern they felt as a result of that knowledge. As shown in Table 3, 35 percent in Tianjin and 38 percent in Tangshan were "very concerned" following the receipt of the information. Approximately the same proportion indicated they were "fairly concerned." Altogether, 73 percent of respondents in Tianjin and 71 percent of respondents in Tangshan reported elevated levels of concern as a result of receiving the information.

Respect for Science and Scientists. It was hypothesized that people would more often take earthquake prediction and warnings seriously if these warnings were attributed to scientists than to other sources since the scientific findings might be seen as more legitimate or credible information which the people would have available in deciding whether to take protective action or to go on with life as usual (Turner, Nigg and Paz, 1986). For that reason, public respect for scientists was explored.

The extent of public belief in earthquake information was found for different sources of earthquake information. Responses were overwhelmingly favorable toward scientists; 60 percent of Tangshan respondents and 52 percent of Tianjin respondents reported that scientists were the most believable source of earthquake information (Table 4). The next most credible source was the government (43% and 33%, respectively).

In addition, opinions about the belief in scientific prediction were investigated by asking respondents whether they believed scientists could predict earthquakes with accuracy (Table

5). Over half of the respondents in each city said that they believed earthquake scientists can predict earthquakes "quite" or "fairly accurately." Compared with scientists' more modest claims, these findings indicate fairly widespread overconfidence in current scientific capabilities in earthquake prediction. As Turner, Nigg and Paz (1986) suggest, belief in science may contain elements of exaggerated confidence.

This positive image of earthquake scientists and their predictions may also reflect the view that scientists know a great deal that they are not permitted to tell the public. Indeed, in the People's Republic of China, the State Seismological Bureau (SSB), is technically responsible for earthquake prediction. However, official government channels (e.g., the Chinese State Council, provincial or municipal governments and local governments) are responsible for issuing predictions. The practice is to withhold any announcement of an earthquake warning from the public until signs indicate that the earthquake is imminent.

Interestingly, Table 4 denotes that there is only a small difference in the perceived credibility of earthquake scientists and government departments. Apparently, belief in scientific prediction/warning is almost equal to belief in official prediction/warning. There is a paternalistic system of government-and-scientist management which has been established to protect the public from potentially unsettling news; that is to say, the earthquake scientists and government equally support controlling the flow of earthquake information. However, in some cases, this view arouses a widespread disposition among the public to believe in a stream of secret information to which the public is not privy. Beliefs in this sort of information constitute fertile ground for the rapid growth and spread of earthquake rumor.

Public Responses to Official Prediction. Several hypothetical questions were included in the questionnaire to further study likely responses to future predictions for the Tangshan and Tianjin areas.

Whether they get the information from the government or other sources, the assumption is that people will react in some manner by taking one or more hazard-reduction measures. Respondents in these two large cities were asked several questions about possible responses to an earthquake. Of particular interest were comparisons between people's responses to the information received through informal channels and their responses to the official predictions. As shown in Table 6, 48 percent of the respondents in Tianjin and 54 percent of the respondents in Tangshan would immediately take measures if they get earthquake information from their relatives and friends.

When asked whether they would take protective measures if the government were to issue a prediction, 93 percent of the

respondents in Tianjin and 95 percent of the respondents in Tangshan answered "Yes." Clearly, information disseminated by the government is seen as much more credible than information received through informal channels. Therefore, when earthquake prediction is officially issued by the government, the people are likely to have positive responses.

Most people in the study communities evidently feel that the government symbolizes authority. Thus, to the public, they consider that a prediction from the government is much more reliable than information received from relatives and friends. When the government issues a prediction, they think that they have obligation to take some actions.

Next, respondents were asked what actions they could take if a major earthquake were expected to occur in the place where they live. A majority of the people responding (59 percent in both cities) indicated they would "check the information with neighbors." This finding indicates that the people are not satisfied with the information received from one or a small number of others in their networks; they are in a state of half doubt and half belief. In this condition, the people would continue to check the information with others.

The next most common answer (41% in both cities) was to "tell the information to close colleagues to make preparation," indicating that respondents consider the "information" believable enough to disseminate. Of course, if the information is really reliable, it is beneficial to those who received it. However, in most cases, the information from relatives or friends is probably less reliable than that from scientific or government sources. Respondents who discussed evacuation with family members about refuge are also quite a large number.

What if the government predicts a major earthquake? Survey respondents were given a list of countermeasures they could take and were asked to indicate which ones they would take in the event of an official government prediction.

The survey results suggest that, if people were to receive an official earthquake warning, they would undertake a range of actions. sixty-eight percent in both cities indicated they would "get ready to protect themselves from earthquake before going to bed." Perhaps this response was the most common because the great Tangshan earthquake struck Tangshan and Tianjin at 3:42 a.m. The next most common response was to set up an earthquake-proof shelter for refuge (which is recommended as a response to earthquake prediction in China); 66 percent in Tianjin and 75 percent in Tangshan of respondents indicated they would take this action.

Next, 48 percent of Tianjin respondents and 52 percent of Tangshan respondents would attempt to observe earthquake precursors. Monitoring precursors is one of the main elements in mass monitoring and mass prevention principles in China (i. e., by amateur groups), which once brought a lot of benefits for earthquake preparedness and prevention. Forty-four percent of persons in Tianjin and 39 percent in Tangshan would buy food and daily use articles. By contrast, purchasing a large quantity of food and daily use articles could cause market supplies to fall in short of demand. It is also believed in China that this kind of mass purchasing could produce a lot of "induced behavior" such as crowds and riots, even if it promotes people to take actions relevant to earthquake preparedness.

Finally, respondents were asked about what disposition they would have if there is a definite issuance of a major earthquake prediction by the government. The survey results show that most of the people would have a strong reliance upon the government (Table 9). 66 percent in Tianjin and 70 percent in Tangshan indicated they would "follow the arrangements of the government and of your work unit" in the event of a prediction. In this case, far more people have confidence in government preparedness than their own or in general public preparedness. This is one of the main characteristics of earthquake preparedness and prevention in China. The successful preparedness for the Haicheng earthquake prediction in 1975 was based on this reliance on government. On one hand, such dependence doubtless increases the work load of the governmental departments; but on the other hand, it provides opportunities for government departments to strengthen their earthquake preparedness and mitigation work.

IV. Conclusion

According to the above study of social responses to the Tangshan earthquake prediction, it can be concluded that the public obtained the information of the mid-term Tangshan earthquake prediction mostly through talk with relatives or friends. Although the prediction was not issued to the public, the governmental arrangement of earthquake preparedness and prevention at various levels enabled people to disseminate the information in the society. The public had a strong desire to know the information. When the people heard that earthquake information, most of them expressed concern about it. They have a good faith in sciences and respect for scientists, leading to a strong belief in scientific prediction and official prediction/warning. If they were to receive information from their relatives and friends that a major earthquake is going to occur in the place where they live, nearly two-thirds of the people would check the information with other informal sources (their neighbors); whereas if they were to receive information from official government prediction, most of the people will take measures of earthquake preparedness and follow the government arrangements. In absolute terms, the confidence in the government

preparation for an earthquake is very impressive. People consider the government to be a symbol of authority. Therefore, the earthquake information issued from the government is more likely to be acted on than information issued by other sources.

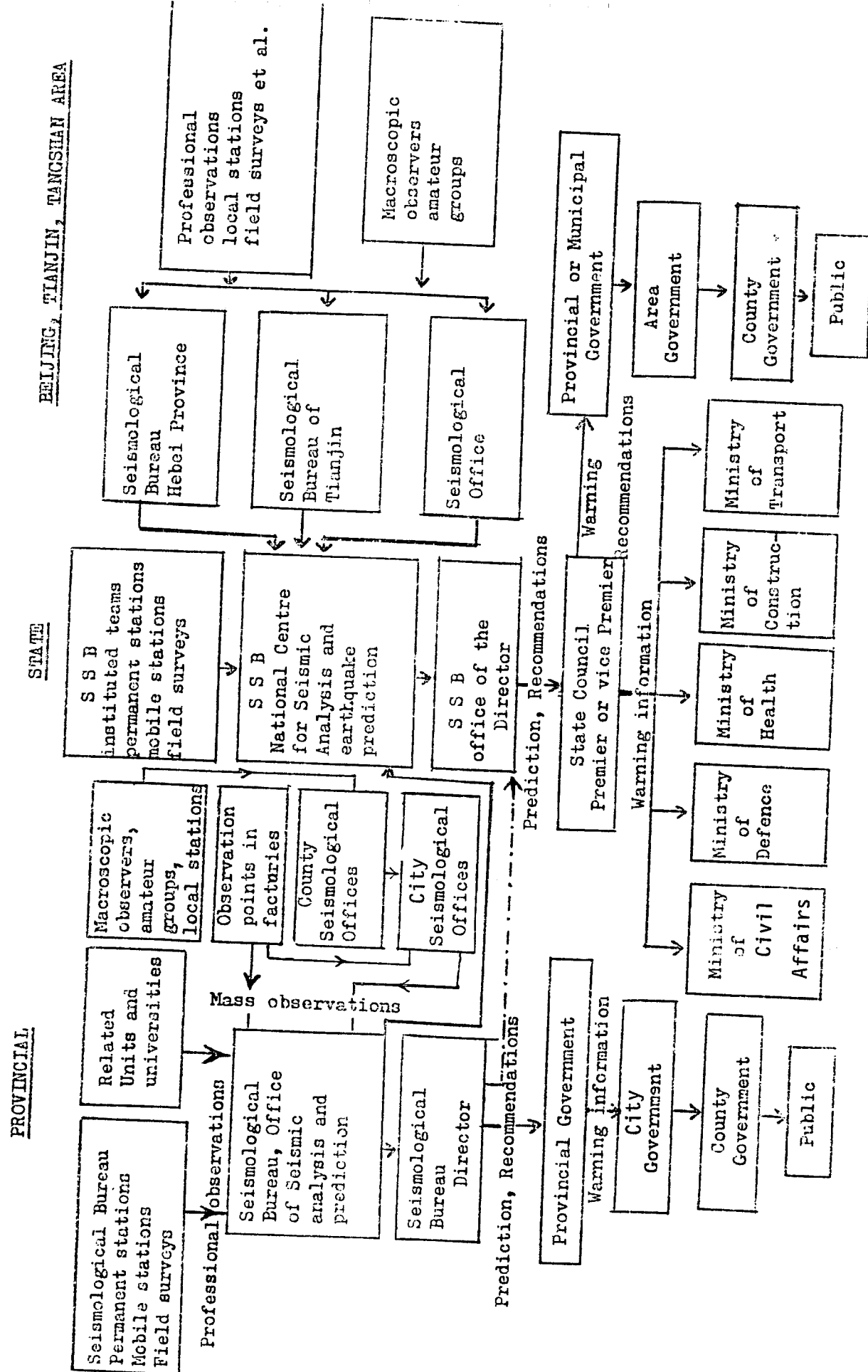
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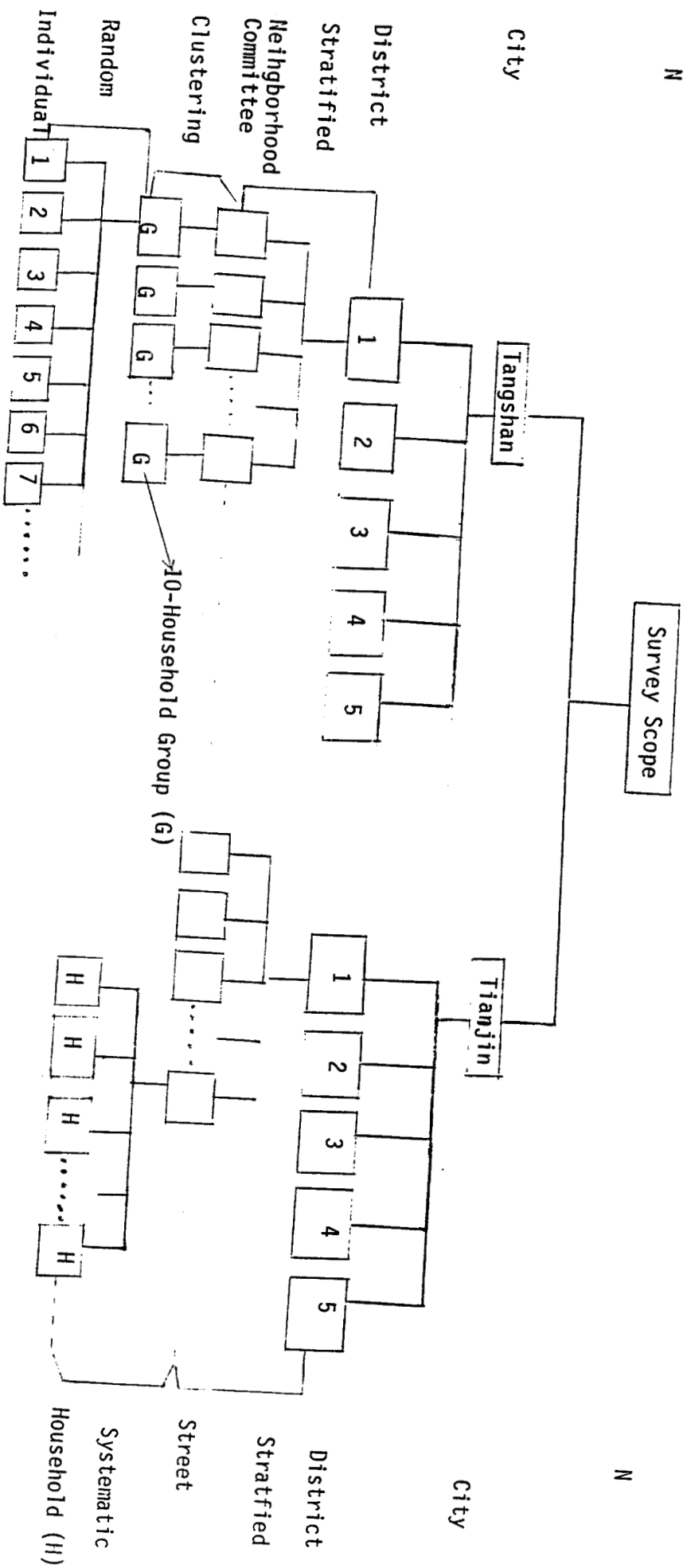
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Figure 2 Chart for seismic hazard assessment and issuance of earthquake prediction in China (Zhu Chuanzhen, 1983).



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Figure 3 Pattern of the Questionnaire survey in Tangshang and Tianjin.



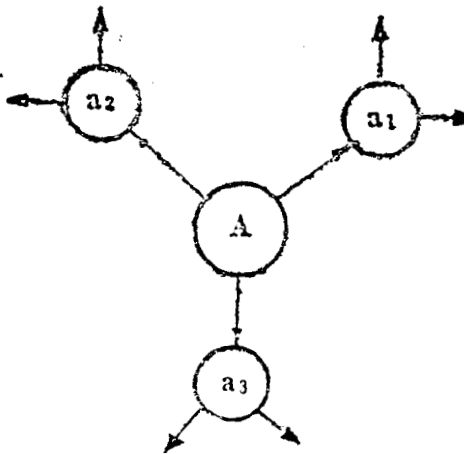


Figure 4 A: People who knew the information
 $a_1 \dots a_n$: people who obtained the information
 through various channels and continued to disseminate
 (Zou, Su and Ge et al., 1989)

Table 1 Residents Remembering Hearing that an Earthquake Might Occur in their Communities Prior to Tangshan Earthquake

	Tianjin		Tangshan	
	Frequency	Percent	Frequency	Percent
Heard	429	29%	775	50%
Didn't hear	882	61	643	42
Unclear	<u>144</u>	<u>10</u>	<u>118</u>	<u>8</u>
Total	1455	100%	1539	100%

Table 2 Which Channels Did You Get the Earthquake Prediction Information Before the Tangshan Earthquake?

	Tianjin		Tangshan	
	Frequency	Percent	Frequency	Percent
Radio and TV	79	21%	92	13%
Newspapers and magazines	64	17	85	12
Earthquake display	17	4	57	8
Work unit information	17	4	250	34
Talk with relatives and Friends	189	51	335	46
Other	<u>40</u>	<u>13</u>	<u>127</u>	<u>17</u>
Total	386	110%*	728	130%*

* Since a respondent is allowed to choose one more answers, the total percentage is more than 100%.

Table 3 Public concern

	Tianjin		Tangshan	
	Frequency	Percent	Frequency	percent
Very concerned	151	35%	299	38%
Fairly concerned	161	38	254	33
Not very concerned	102	24	197	25
Not concerned at all	<u>15</u>	<u>4</u>	<u>17</u>	<u>4</u>
Total	429	101%*	775	100%

* Total percent does not equal 100% due to rounding.

Table 4 Public belief in different sources of earthquake prediction

	Tianjin		Tangshan	
	Frequency	Percent	Frequency	Percent
Government departments	613	43%	503	33%
Earthquake scientists	743	52	900	60
Foreign newspapers and radio	19	1	19	1
People who experienced earthquakes	54	4	84	6
Senior citizens	10	1	16	1
Fortune-teller	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	1440	101%*	1522	101%*

* Total percent does not equal 100% due to rounding.

Table 5 How accurately earthquake scientists can predict earthquakes at present

	Tianjin		Tangshan	
	Frequency	Percent	Frequency	Percent
Quite accurately	63	4%	88	6%
Fairly accurately	809	55	798	52
Not too accurately	441	30	403	26
Very unaccurately	31	2	39	3
Don't know	<u>118</u>	<u>8</u>	<u>217</u>	<u>14</u>
Total	1462	99%*	1545	101%*

* Total percent does not equal 100% due to rounding.

Table 6 Willingness to take self-protective measures, by
prediction information sources

Action if information from:	Tianjin	Tangshan
<hr/>		
Relatives and friends		
Yes	48%	54%
No	<u>52</u>	<u>46</u>
Total %	100%	100%
Total N	1460	1541
Government		
Yes	93%	95%
No	<u>7</u>	<u>5</u>
Total %	100%	100%
Total N	1457	1531
<hr/>		

Table 7 If your relatives or friends tell you a major earthquake will occur in the place where you live in the coming few days, what would you do?

	Tianjin		Tangshan	
	Frequency	Percent	Frequency	Percent
Tell the information to the close colleagues to make preparation	317	41%	368	41%
Discuss with family members about refuge	294	38	343	39
Check the information with neighbors	452	59	522	59
Other	<u>44</u>	<u>6</u>	<u>12</u>	<u>1</u>
Total	766	144%*	890	140%*

* A respondent is allowed to give one answers, thus, the total percent is greater than 100%.

Table 8 What measures would you take if the government predicts that a major earthquake will possibly occur in the place where you live in the coming few days?

	Tianjin		Tangshan	
	Frequency	Percent	Frequency	Percent
Buy food and daily use articles	587	44%	574	39%
Set up earthproof shelter for refuge	884	66	1107	75
Ask family to move to another place	247	18	304	21
Withdraw money from bank or extort money someone owes you	46	3	25	2
Collect valuables	276	21	216	15
Observe precursors	647	48	708	52
Get ready to protect yourself from earthquake before going to bed	920	68	1011	68
Other	<u>32</u>	<u>2</u>	<u>40</u>	<u>3</u>
Total	1349	270%	1485	275%*

* Since a respondent was allowed up to three answers, the total percentage exceeds 100%.

Table 9 What action would you take if the government assures that a major earthquake will occur in the place where you live at a particular time? (%)

	Tianjin		Tangshan	
	Frequency	Percent	Frequency	Percent
Continue to stay where you live	49	3%	36	2%
Try to leave where you live as far away as possible	134	9	94	6
Try to find a shelter in the earthquake-coming area	297	20	287	19
Follow the arrangements of the government and of your work unit	955	66	1091	70
Don't care for the matter and live as usual	14	1	24	2
Others	<u>9</u>	<u>1</u>	<u>12</u>	<u>1</u>
Total	1458	100%	1544	100%