Natural Disasters and Local Resilience:
Analysis of Factors Affecting China's Community Resilience

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Abstract

China is a country at high risk of disasters; building resilience is a collective imperative. In the past 20 years, China has improved its disaster response capacity through continuous improvement of disaster reduction systems. The integrated disaster reduction model community is an essential indicator for China to enhance community resilience. Through the analysis of 6530 valid questionnaires of 31 municipalities directly under the Central Government, the integrated disaster model formed through community construction has a positive impact on community resilience. At the same time, the institutional arrangements for community disaster reduction have the characteristics of overcoming urban-rural and ethnic differences. However, due to the lack of public understanding of disaster prevention and mitigation, the promotion of relevant disaster reduction systems needs to be further deepened.

Keywords: Integrated disaster reduction model community, community resilience, assessment, institutional factor

Introduction

In 2018, the Ministry of Emergency Management (MEM) was established. Its establishment marked a significant institutional change in China's disaster management. It is part of China's institutional reform that adapts to the overall security concept of the country. The MEM has integrated 13 responsibilities of 11 departments to transform the management of sub-disasters into an integrated disaster prevention and mitigation.[i] The MEM integrates disaster management responsibilities and the headquarters duties. The primary purpose of the establishment of the emergency management department is to strengthen comprehensive coordination.[1]

In April 2019, the MEM, the National Development and Reform Commission (NDRC) and the Ministry of Finance led the establishment of inter-ministerial joint meeting system for natural disaster prevention and controlled jointly. The joint conference system marks that China has not abandoned the coordination of disaster reduction resources through the department after the establishment of the emergency management department. At the same time, as institutional reforms, China also proposed to implement significant projects for disaster reduction projects. Enhanced disaster prevention capabilities through a combination of institutional reforms and engineering measures, are consistent with the investment in disaster risk reduction goal proposed by the Sendai Framework for Disaster Reduction resilience.[2]

The institutional change in 2018 marked the transformation of disaster management in China from disaster classification to comprehensive risk management. On October 11,

2016, the "Opinions on Promoting the Reform of Disaster Prevention and Mitigation and Disaster Relief System and Mechanism" proposed to improve the legalization, standardization, and modernization level of disaster prevention, mitigation and relief work, and enhance the comprehensive defense ability of the whole society below the natural hazard. The concept of disaster reduction has shifted from focusing on disaster relief and emergency response to risk reduction before disasters and improving resilience. Since the 1980s, the impact of the United Nations disaster reduction has begun to promote community disaster reduction activities. Community disaster reduction (CDR) is an important indicator to enhance local resilience. How is disaster reduction in the Chinese community carried out?

Is CDR useful for enhancing local resilience? What are the factors that affect the enhancement of local resilience? This study will highlight the CDR in China and analyze the factors affecting local resilience. It first reviews the changes in China's natural disaster management system and the characteristics of natural disasters in the background section. In the second section, we will define the concept of resilience and community resilience assessment. Then we will introduce the specific measures and effects of China's disaster reduction and resilience community. The third section analyzes the influencing factors of community resilience through 6350 community resilience questionnaires in the municipalities directly under the central government of 31 provinces and autonomous regions. In the fourth section, relevant improvement suggestions are proposed based on the assessment results of community disaster reduction and resilience.

Ⅰ. Background

A. *Changes in China's Natural Disaster Management System*

China's natural disaster management has improved over the past four decades with the development of Chinese society. In The 1970s, departments and research institutes were established to handle the government's daily management and related work on drought, weather, ocean, earthquake, geology and agriculture, forestry, and flood damage. China's disaster prevention system developed according to the type of disaster. In the 1990s, China introduced laws on disaster reduction like the Water and Soil Holding Act (1991), the Anti-Drop Act (1997), Earthquake disaster reduction law (1997), the Fire Service Act (1998) and the Meteorological Act (1999).

The SARS in 2003 prompted China to promote disaster reduction reforms, which named emergency management that characterized by preplans. The representative of the legal development is the "National Emergency Response Act" published in August 2007. Under the National Sudden Public Incident Response Act, emergency management includes three phases: prevention, response, and recovery. Disasters and accidents divide into four types as natural disasters, accident disasters, public health, and social safety incidents. Emergency management is divided into four levels according to the severity of the disaster or accident, and different countermeasures are taken according to the severity.[3]

China's disaster management adapted to domestic economic development and social changes and the impacts from the UN's disaster reduction. The 1989 United Nations disaster reduction activities promoted the development of China's disaster reduction system. One is the establishment of an inter-departmental coordination organization at the intermediate level, and the other is the creation and publication of China's first national-level disaster management plan. Specifically, in 1989, the "China International Commission on Disaster Mitigation" was established under the State Council of China as a provincial-level coordination mechanism. Its main activities are the preparation of disaster prevention plans and the establishment of essential mitigation policies and the exchange of information on disaster mitigation activities among departments. Also, the China International Commission on Disaster Reduction 10 Years is an organization that conducts foreign communication and transactions in the field of disaster prevention.[4]

After the 2008 Wenchuan earthquake, NGOs participated in post-disaster relief, and disaster reduction became the norm.[5] However, disaster management in China focused on emergency response; preparation for disaster reduction has been inadequate. After 2016, China began to advocate integrated disaster reduction, which should highlight both emergency rescues after disasters and pre-disaster prevention. The disaster management system of disaster-related accidents has been unable to adapt to the needs of disaster management in China. From the perspective of total national security, understanding risks, and managing risks is a new concept of disaster management in China.

Therefore China's disaster reduction system has shifted from disaster-based management to integrated disaster reduction. The disaster management concept has also changed to risk management with a focus on prevention and as part of the total security of the country. The next section will explore the characteristics of natural disasters in China.

B. *Characteristics of natural disasters in China*

There are many types of natural disasters in China. Floods affect more than 60% of the mainland and Typhoons, and storm surge mainly affect the vast southeastern developed areas. Drought and sandstorms threaten the three northern regions. In recent years, significant droughts have occurred frequently in the south, especially in the southwest. In areas such as North China, Southwest China, Northwest China, and Taiwan, geological disasters such as collapsing, landslides, and debris flows frequently occur in mountains, hills, and plateaus that account for more than 60% of the country's land area. Storm surges and red tides are more common in the sea, and forest and grassland fires are prone to occur in the uplands.[6]

Natural disasters put China's prosperity at risk. Disaster risks covered over 70% of cities and 50% of the population. Among all counties, 98% of them, which summed up to 2800, were impacted by various natural disasters. Over 70% of them suffered more than twice every, and nearly 40% experienced more than fourth. Flood with subsequent geological hazards and typhoons caused severe damage from 2011–2015, which accounted

for 50%–90% of the total death toll and homeless people. Collapsed buildings and direct economic losses are much higher than those caused by other natural disasters.[7]

China is one of the countries with the most severe earthquake disasters in the world. On average, there are about 20 earthquakes of magnitude 5 or higher in China's mainland, and about four earthquakes of magnitude 6 or above. Since the beginning of the 20th century, an earthquake of magnitude 7.5 or higher has occurred every five years, and an earthquake of magnitude 8 occurred every ten years. On the land of 7% of the total land area of the world, earthquakes of more than 75% of the continent occurred in 35% of the world. China's 58% of the country's land area, more than 50% of the city, 70% of the population of more than one million large and medium-sized cities, are located in the high-intensity area of the earthquake of VII or above. It is one of the primary national conditions of China that there are many earthquakes, wide distribution, high intensity, shallow source, and massive disasters.[8]

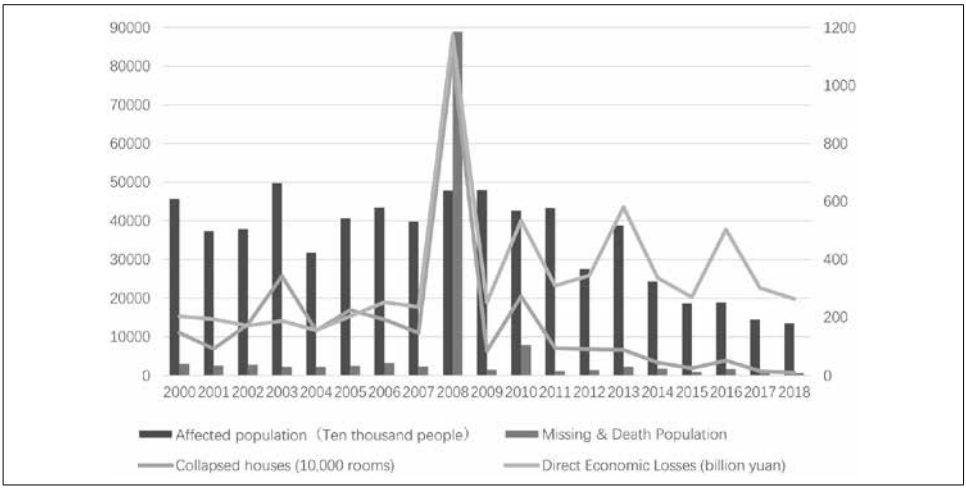

Figure 1 : Disaster Loss Trend from 2000 to 2018[9]

In the past two decades, China's economy has grown rapidly and it has also become rapidly urbanized. In 2012, China's urbanization level reached 52.57% and will still be in a stage of rapid development in the next 20 years. According to the World Bank's forecast, China's urbanization level will reach 68% by 2030.[10] In different periods, the state has different focus on urbanization, and there are many defects in urbanization planning and guiding policies.[11] Studies have shown that disorderly and rapid urbanization leads to poor land management, and China's population and economic development are increasingly approaching large fault zones.[12]

The annual data released by the Ministry of Civil Affairs shows that except in 2008, from 2000 to 2018, the number of people affected or the number of deaths or disappearances due to disasters and the collapsed houses is on a downward trend. Though the

base of the affected population is still significant, the number of people affected has decreased, which was 450 million in 2000 that was reduced to 130 million in 2018. In contrast, the economic losses caused by natural disasters are on the rise. China's disaster reduction governance is effective in reducing building collapse and reducing personnel losses. However, China still faces high risks of disasters. Strengthening disaster risk management and improving China's disaster reduction resilience remains an issue for China.

Ⅱ. From community disaster reduction to local resilience

A. *community resilience and resilience assessment*

The resilience in this study refers to the definition of UNISDR (UN office for Disaster Risk Reduction), which is the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.[13] The quantitative assessment of disaster resilience is particularly critical. Only through quantitative assessment can the main impact factor set of disaster resilience be extracted, thus providing a scientific basis for government risk management and disaster reduction decision-making.[14]

First, a community vulnerability assessment is developed based on the Kobe framework and definition of urban resilience. The evaluation method was developed by organizations such as GEM, CEDIM, SAI, and USAID, and used in the Participatory Evaluation of Earthquake Risk and Resilience in Lalitpur Sub-metropolitan city. The assessment includes six elements: legal, institutional arrangements, social capital, critical services and public infrastructure, emergency preparedness response and recovery, planning regulation and mainstreaming risk mitigation, and awareness and advocacy.[15]

A more representative example of the development of indicators that focuses on social vulnerability is the assessment of urban vulnerability in Boston. The study is based on an analysis of the social factors in the existing literature and develops the social determinants of the vulnerability framework. The framework consists of seven interrelated social factors, and children, the disabled, the elderly, chronic and acute diseases, social isolation, low-income, and colorless people are considered to contribute to the development of vulnerability. Quantitative analysis of these social factors based on Boston city data confirms many of the relationships between social factors of vulnerability and the importance of social isolation.[16]

ANDRI[17] uses a top-down approach that uses indicators derived from secondary data covered by the country. ANDRI is a layered design based on coping and adaptability that represents the potential for disaster recovery. Responsiveness is how people or organizations can use existing resources, skills, and opportunities to address the adverse consequences of a disaster. Adaptability is the arrangement and process of achieving adjustment through income, adaptation, and transformation. Responsiveness

divides into social characteristics, economic capital, infrastructure and planning, emergency services, community capital, and information, and participation. Adaptability divides into governance themes, policy and leadership, and social and community involvement.[18, 19]

Social science scholars propose physical, institutional, economic, and social factors for community resilience indicators.[20] Domestic scholars have studied the usability of the Chinese version of the Community Stress Resilience Assessment (CART) in China. The Chinese version of the Community Resilience Evaluation Form (CART) derived from the indicators determined by the University of Oklahoma's Pfefferbaum et al. The Chinese version of the CART indicators include contact and care, resources owned, the potential for change, management of disasters and information communication in five dimensions, 26 entries. The Chinese version of the CART evaluation not only focuses on the translation of the original CART indicators but also adds information and communication dimensions to the unique signs according to the Chinese situation.[20]

B. *Community and community disaster reduction in China*

In 2000, "the Ministry of Civil Affairs on the promotion of community building in general" defined "community as a collective composed of people living in a certain geographical area".[21] Academically community is part of the third sector other than the government and market. The "community" is a community within a geographical range, and has two aspects: positioning as an organization that plays an administrative management role and autonomy role. Among the community, the "district resident committee" in the urban area and the "rural resident committee" in the rural areas are the ones who play the role of the former.

Since the 1990s, criticism of disaster response by government agencies is a common phenomenon in developing and developed countries, and that "dissatisfaction with public disaster management organizations has increased"[22] in the background. In China, the concepts of community disaster reduction (CDR) and resilience affect all disaster reduction activities.

"National Integrated Disaster Reduction Model Communities (NIDRMC)" has been in practice since the beginning of 2000. While CDR is regarded as necessary in China to respond to requests of disaster preventions, its background as a concept emerged from that of social governance parallel with the transition of the Chinese society. As a saying that "one thousand threads are in one needle," community is an essential leader in social integration in China, and it is also a terminal organization implementing policies of different departments. Although CDR is almost limited to the local community, a large number of governments, companies, residents, volunteer organizations are also involved.

The first mention of the implementation of the NIDRMC policy is the "National Integrated Reduction Eleventh five-year Plan".[23] In the National Reduction Plan, community mitigation capacity is mentioned with the goal of among others, constructing 1,000 NI-

DRMC across China such that 85% of the communities will have a disaster relief team, and more than 95% communities will have one disaster information staff (National Council Office, 2007). Furthermore, with the "National Integrated Disaster Mitigation Regulations (2011 • 4-5)" published in 2011, the number of NIDRMC increased from 1000 to 5000.

The Ministry of Civil Affairs (MCA) promoted integrated disaster reduction model community. There are different departments in charge of disaster management according to the type of disasters; thus, different departments promote different CDR. Moreover, the "Earthquake Safety Model community" led by the China Earthquake Administration (CEA). In 2008, CEA requested "promoting a model project for earthquake safety community in urban areas," and stated "earthquake safety model community (ESMC)." The "National Earthquake Mitigation Regulations (2006-2020)" announced the goal of ESMC. In September 2011, China Housing and Castle Town Construction Department (HCTCD) announced "Twelfth Five-Year City Township Construction Disaster Prevention and Disaster Mitigation Plan." The plan pointed out that "communities and villages need to reorganize land for earthquake disaster prevention."

As mentioned above, the disaster prevention related departments set their own goals for community mitigation. As a concrete promotion measure, the MCA released the "National Disaster Reduction Model Community Standard" in September 2007, and the National Disaster Mitigation Committee published the "National Integrated Disaster Reduction Model Community Standard" in May 2009. Moreover, in 2013, these standards have been revised. Also, in May 2012, the CEA published "Earthquake Safety Community Management Temporary Provision". Thus, as a result of the implementation of multi-sectoral community disaster prevention policy, in September 2007, the National Security Production Control and Management Administration recognized 21 communities as "National Safety Community" throughout China.

Also, at the end of 2018, a total of 14,025 communities were commended as "National Integrated Disaster Reduction Community," and it can be said that the national disaster reduction goal has been achieved. Furthermore, by January 16, 2014, the CEA commended the 1,549 National Earthquake Safety Model community. Also, depending on the region, there is at least one example of a "model CDR" at the province or city level according to the national standard.

The evaluation criteria for disaster prevention communities in China are often in line with Community-Based Disaster Risk Management (CBDRM). Both the MCA and the CEA have developed their model community evaluation criteria. The MCA is a demonstration community for disaster reduction, and the CEA is a demonstration community for earthquake prevention and disaster reduction. The evaluation criteria of the general NIDRMC of the MCA are stricter than the evaluation criteria of the CEA, and the criteria of CDR include one of the primary conditions that the satisfaction level of community residents as a NIDRMC. In other words, there have been no major acci-

dents due to disasters for three consecutive years, and emergency response manuals and disaster drills were conducted according to the characteristics of the area. If the community does not meet the criteria of CDR, the community could not apply for the NIDRMC. Furthermore, MCA standards are more detailed than CEA.

Although a model DCR is an honorary title, a community, which is potential to become model DCR applies to the local civil administration and earthquake stations, respectively and based on the application materials. The MCA and the CEA focus on their evaluation criteria, and when a community meets the evaluation criteria, the community will commence as a "model community." Both the MCA and the CEA set out a policy for the model DCR, but the local government is responsible for securing the expenses. The construction of the model DCR relies more on the local government's awareness of disaster reduction and work enthusiasm. Essentially, the model DCR is honorific, and there is no capital investment from the central government.

As the number of NIDRMC is the largest, the data from the NIDRMC will be used to illustrate the effectiveness of China's model DCR. Figure 2 shows the distribution of NIDRMC. It shows that even in the same province, the NIDRMC can also have unequal distribution. In economically developed regions, e.g., the top four provinces in China in terms of domestic GDP such as Guangdong (1,216), Zhejiang, (1,040), Jiangsu (814) and Shandong (805). There are more NIDRMCs Hainan (84) and Tibet (38) have the least number, The number of NIDRMC in these two provinces is not over 100.

According to the number of comprehensive disaster reduction demonstration communities, 31 provinces can be divided into four groups, namely, the four provinces with the largest number of disaster reduction demonstration communities in Guangdong and the other six provinces, including Beijing, which have more disaster reduction demonstration communities, and Hainan Tibet as the least group. Other provinces such as Jilin Province are the provinces with small number of disaster relief demonstration communities.

After the establishment of the Emergency Management Department in 2018, this divide-and-go disaster management model was terminated. Moreover, from 2008 to 2018, the NIDRMC has been facing a transformation. Some cities have begun to explore the strengthening of local resilience from city levels and establish model cities. Local resilience is expanding from the community level to the city level. Resilience in city-level means the emergency management that focuses on post-disaster emergency and rescue changed to pre-disaster prevention. The goal of city-level resilience is an upgraded version of the integrated disaster reduction model community.

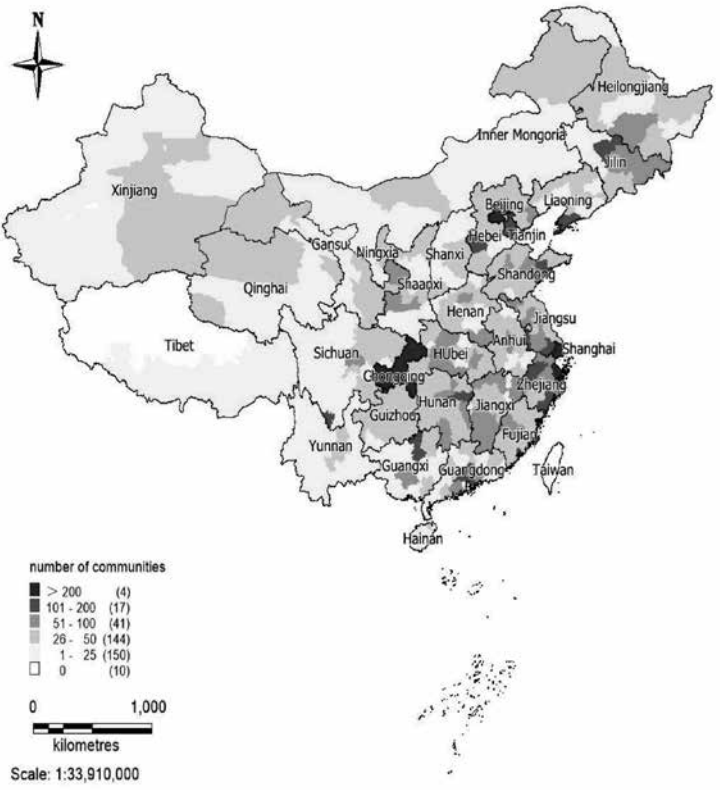

Figure 2 : Distribution of NIDRMC

Although the NIDRMC has the characteristics of uneven geographical distribution, its purpose is to demonstrate to set an example and promote the general community learning through excellent examples. So how does the public evaluate local resilience? This study will use community resilience as an indicator of community mitigation capacity. The next section will use national public survey data to examine the public's assessment of local resilience.

Ⅲ. Community resilience assessment

A. *Method*

From 2017 to September 2018, the community resilience assessment survey conducted in 31 provinces across the country. The questionnaire covered 337 counties and cities in 31 provinces. The survey conducted using an online questionnaire survey, and a total of 95,388 emails have been sent, 10499 were responded, among them 81 samples were unqualified for clearing, 6530 samples were successful. The investigation recovery rate was 6530/(10499－81)=62.68%.

B. *Dependent variable*

Community resilience is a dependent variable. Based on CART assessment results, the

Cronbach alpha coefficient of Contact and Care (0.888) is lower than the community resources (0.911) change potential (0.952), disaster management (0.935), and information and communication (0.916), this study uses community resources and transformative potential, disaster management, information and communication. The CART indicators in this study use 21 items in four dimensions of resources, the potential for change, disaster management, and information and communication. Moreover, it consists of four dimensions, namely community resources, the potential for change, disaster management, information, and communication.

There are four to eight questions in each dimension, forming a self-rating scale with 21 entries, all using the Likert Rating divided into 5 levels. 5 points is the community status that is very consistent with the description of the item; 1 point is very non-conformance. 5 points to 1 point, the swings range from status quo to the degree of description reduced. Four dimensions, including 21 self-assessments, all scores are summing up the results of the community resilience self-assessment score.

Table 1 : The Composition of Community Resilience Self-assessment Variable

Community resources	Community/village activities for caring for children and the elderly
	Community/village has resources to solve community/village issues
	Residents know where to solve the problems they encounter
	Community/village has a strong leader
	Community/village residents can get the services they need
The potential for change	Community/village can work with external organizations to solve problems
	Community/village residents can communicate with community leaders
	Residents have a common sense of solving community/village issues
	Residents discuss together to improve community/village issues
	Community/village residents work together to improve the community
	Community/village can sum up past lessons
	Community/village can find resources to solve problems
	Community/village has plans for the future and sets goals
Disaster management	The community strives to prevent disasters from happening
	The community is ready for possible disasters
	Community/village can provide emergency services when disaster strikes
	After the disaster, there are various services to help the residents.
Information and communication	Residents can learn about their own interests
	Community/village provides information on how to respond to disasters
	Residents have received helpful information from the community/village
	Residents trust community/village staff

Source: 19

Independent variable

The independent variables include physical factors, social factors, economic factors, and institutional factors. Physical factors **from the location of the housing** (hlocation1), housing structure (hstruc_1), length of housing (lghouse_y), personal safety assessment of the natural disasters of their homes (hsafty0) and the region.

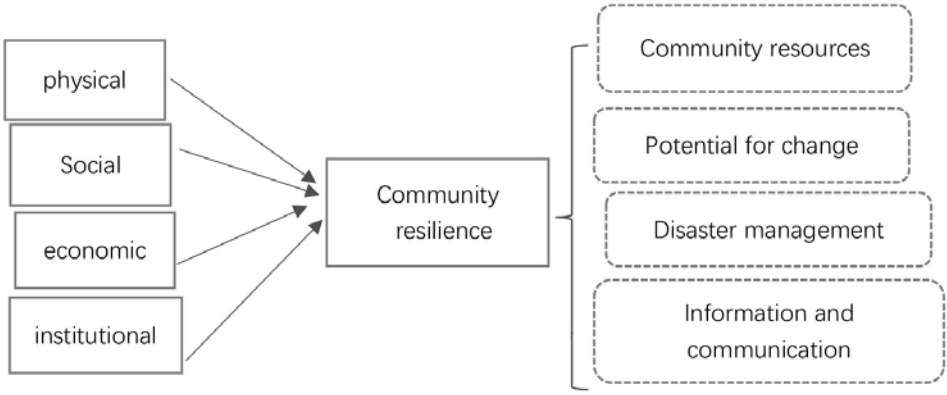

Figure 3 : Research Framework

In the models, the houses located in plains is "1", other locations are "0"; reinforced concrete is "1", brick-concrete or brick and wood structure or adobe house is "0" . In the regression model used the logarithm of the years of the housing is houseing year? Regarding the safety assessment of one's home (whether your home is safe after a natural disaster), there are three categories: safe (answer "very safe" and "safer"), "general", and unsafe (answer "not safe" and "is very unsafe"). These are recorded "1", "2" and "3" in the models.

According to the statistics of the NIDRMC, the Region variable divides 31 provinces /autonomous regions/ municipalities into four groups, namely, the regions with the most NIDRMC in Guangdong, Zhejiang, Jiangsu, and Shandong (region 1), Sichuan, Hunan, Hubei, Henan, Liaoning, and Beijing have more regions (region 2), Hainan and Tibet are the least regions (region 4), and other provinces are general regions with NIDRMC (region 3). Social factors include gender, ethnicity, population under three years of age, population over 60 years of age, subsistence allowance, and physical disability. When calculating the data, the male is "0". The female is "1". The Han ethnic is "0", the other ethnic groups are "1"; the under three years old, over 60 years old, the subsistence allowance or the disabled coded as "1".

There are significant urban-rural differences in China, so the economic factor measured by urban-rural variable (your main living area is urban or rural). Also, the self class evaluation (according to 2017 income, which class do you feel yourself at the local) is the other economic variable. The long-term residence is marked "1" for the city and

"0" for the rural area.

The institutional factors are composed of the following 6 items: whether the village group has written family member contingency plans (preplan_1); whether the community/village has publicity materials for safety preparedness (popus0); whether the village/community organizes emergency drill training (emertr_1); and whether the community/village has emergency response for flood control and landslides rescue cleaning equipment (emeritem0) and public facilities such as health centers in the community/village (pubserv_1). Not as 0, entries will have as 1. Medical level (premed) (in your own community/village, if you need to take medicine for a long time if you are sick, easy to get conventional medicines), it is divided into three types of medical treatments: "easy to get" is "easy", "general" is "not accessible" and "not easy" is "It's not easy".

C. *The result*

60% of respondents are male, of which 77.3% are college education or above, 92.9% are Han, and 85.8% are in cities. There are 20.5% of infants with young children under the age of three in the family, 24.6% of the population are over 60 years old, and 2.8% of the population are enjoying the minimum living allowance. 2.4% of respondents have disabled people at home.

Table 2 : Variable Description

	N (%)		N(%)
gender		**housing year**	10.92 (8.98)
male	3915 (60.0%)	**house location**	
female	2615 (40.0%)	flat land	5730 (87.7%)
education		hills	406 (6.2%)
Elementary school and below	41 (0.6%)	mountain	254 (3.9%)
junior high school	1441 (22.1%)	Riverine	140 (2.1%)
College and above	5048 (77.3%)	**house construct**	
ethnic		concrete	5600 (85.8%)
han	6064 (92.9%)	tile	759 (11.6%)
others	466 (7.1%)	Brick wood	157 (2.4%)
rural or urban		Adobe	14 (0.2%)
urban	5600 (85.8%)	**The safety of housing after a natural disaster**	
rural	930 (14.2%)	very safe	1052 (16.1%)
under 3		safe	3893 (59.6%)
haven't	5193 (79.5%)	general	1257 (19.2%)
have	1337 (20.5%)	unsafe	260 (4.0%)
up 60		very unsafe	68 (1.0%)
haven't	4923 (75.4%)	**Written family emergency plan**	
have	1607 (24.6%)	haven't	1814 (27.8%)

low security		have	4716 (72.2%)
haven't	6345 (97.2%)	**Community/village has publicity materials on safety preparedness**	
have	185 (2.8%)	haven't	925 (14.2%)
Persons with disabilities (referred to as being rated)		have	5605 (85.8%)
haven't	6376 (97.6%)	**Village/community emergency drill training**	
have	154 (2.4%)	rare or no	2547 (39.0%)
		frequently	3983 (61.0%)
publicity materials for safety preparedness		**Public service facilities such as health centers**	
haven't	925 (14.2%)	haven't	699 (10.7%)
have	5605 (85.8%)	have	5831 (89.3%)
			Total (N = 6533)

The mean years of housing are 10.92 years, 87.7% of the respondents' housing was in the plains, 6.2% of the respondents are in the hills, 3.9% of the respondents are in the mountains, and 2.1% are in the valley. 85.8% of the houses are reinforced concrete structures, with a brick-concrete structure of 11.6% and a brick-wood structure of 2.4%. Another 0.2% of the houses are adobe houses. 16.1% of respondents think their own homes are "very safe" after a natural disaster, and 59.6% answered "safe".

Since the proportion of respondents living in the city is relatively high (85.8%), which is much higher than the urbanization rate in China, the structure of the adobe house will be higher in the actual situation. 72.2% of the respondents answered that they had a family emergency plan in the community or village where they lived, 85.8% of the communities or villages had emergency preparedness, and 61.1% of the communities/villages often held emergency drills. 89.3% of the communities/villages have public facilities such as health centers.

Table 3 : Public Evaluation of Community Resilience（mean）

province	mean	sd	N
Beijing	55.83	16.62	212
Tianjing	50.32	16.88	207
Hebei	49.48	16.10	203
Shanxi	50.56	14.05	200
Neimenggu	41.42	10.55	200
Liaoning	45.91	14.36	207
Jilin	44.68	9.91	205
Heilongjiang	46.57	15.71	200
shanghai	52.16	15.06	217

Jiangsu	47.16	15.17	212
Zhejiang	45.23	14.77	207
Anhui	45.26	11.28	213
Fujian	48.59	13.75	208
Jiangxi	46.45	13.02	303
Shandong	49.89	13.20	210
Henan	48.26	14.28	205
Hubei	47.97	13.35	200
Hunan	47.32	12.74	200
Guangdong	49.17	13.68	217
Guangxi	43.05	13.73	200
Hainan	39.43	8.71	200
Chongqing	45.77	15.42	203
Sichuan	47.34	14.85	200
Huizhou	47.59	14.32	200
Yunnan	39.18	11.04	300
Tibet	38.63	8.21	201
Shanxi sheng	46.36	11.98	200
Gansu	43.55	12.05	200
Qinghai	39.66	10.19	200
Ningxia	43.60	12.20	200
Xinjiang	41.97	11.48	200
Total	46.03	13.90	6530

There are significant regional differences in community resilience assessment scores. The highest scores of community self-assessment were Beijing (55.83), Shanghai (52.16), Tianjin (50.32) and Shanxi (50.56). Secondly, Shandong (49.89), Hebei (49.48) and Guangdong (49.17). The lowest scores are Qinghai (39.66), Hainan (39.43), Yunnan (39.18), Tibet (38.63). The above provinces concentrated in the western region. The comparison of Guangdong (1216) and Shandong (805) scores with the most significant NIDRMC, the second most Zhejiang (1040) scored 45.23, and the third largest demonstration community in Jiangsu (814) scored 47.16.

Through the continuous investment in the model, the research discussed the factors affecting the resilience of the community. In Model 1, “region” invested as a physical variable in examining the impact of the NIDRMC on community resilience. Model 2 continues to invest in economic factors (living in the city or not, based on 2017 income

to evaluate the local class). Model 3 is the housing factor (housing logarithm), housing location (in the plain), housing structure (reinforced concrete), and safety assessment of the housing (safe after natural disasters). Model 4 invests in social factors, namely whether ethnic (ethnic), female (female), whether there are infants under the age of three (under3), older adults over 60 (up60), disabled (disable), and whether there is a minimum living allowance at home. Personnel (lowsecu). Model 5 inputs institutional factors. After making a collinearity test and a heteroscedasticity test on model 5, the modified model of model 5 recorded as Model 6.

Table 4 : Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)
	m1	m2	m3	m4	m5	robust
Variable	comdisd	comdisd	comdisd	comdisd	Comdisd	comdisd
2.region	1.388*	1.508*	1.574**	1.728**	1.021+	1.021+
	(0.673)	(0.640)	(0.609)	(0.606)	(0.527)	(0.554)
3.region	−1.752**	−1.192*	−0.869	−0.512	0.413	0.413
	(0.586)	(0.558)	(0.532)	(0.532)	(0.463)	(0.476)
4.region	−8.409***	−8.159***	−7.568***	−6.616***	−3.997***	−3.997***
	(0.877)	(0.835)	(0.799)	(0.815)	(0.713)	(0.598)
urban		−1.526**	−0.079	0.140	0.197	0.197
		(0.477)	(0.493)	(0.493)	(0.430)	(0.493)
2.class		−2.650+	−2.072	−1.607	−2.669*	−2.669
		(1.482)	(1.429)	(1.424)	(1.238)	(1.699)
3.class		−0.423	−0.830	−0.339	−1.048	−1.048
		(1.448)	(1.400)	(1.395)	(1.211)	(1.685)
4.class		6.427***	4.255**	4.691***	1.554	1.554
		(1.472)	(1.428)	(1.423)	(1.238)	(1.709)
5.class		15.323***	9.927***	10.272***	3.997**	3.997*
		(1.675)	(1.633)	(1.628)	(1.421)	(1.970)
lghouse_y			0.643***	0.624**	−0.785***	−0.785***
			(0.194)	(0.194)	(0.173)	(0.183)
Plain			1.247*	1.508**	0.972*	0.972*
			(0.502)	(0.503)	(0.438)	(0.459)
concrete			−1.353**	−1.140*	−1.267**	−1.267**
			(0.495)	(0.494)	(0.430)	(0.485)
2.hsafty0			6.737***	6.701***	3.132***	3.132***
			(0.407)	(0.405)	(0.364)	(0.376)

3.hsafty0			15.160***	14.961***	8.027***	8.027***
			(0.743)	(0.740)	(0.664)	(0.811)
ethnic1				−1.894**	−0.210	−0.210
				(0.619)	(0.543)	(0.597)
female				−0.887**	−0.969***	−0.969***
				(0.314)	(0.273)	(0.273)
under3				1.754***	2.228***	2.228***
				(0.385)	(0.335)	(0.368)
up60				2.103***	1.208***	1.208***
				(0.367)	(0.320)	(0.351)
disable				1.808+	1.560+	1.560
				(1.076)	(0.936)	(1.139)
lowsecu				−0.546	0.431	0.431
				(0.997)	(0.867)	(1.022)
preplan_1					−4.458***	−4.458***
					(0.390)	(0.398)
2.popus1					2.104***	2.104***
					(0.304)	(0.290)
3.popus1					6.134***	6.134***
					(0.546)	(0.600)
emertr_1					−2.890***	−2.890***
					(0.352)	(0.350)
emeritem0					−5.579***	−5.579***
					(0.440)	(0.475)
pubserv_1					−4.400***	−4.400***
					(0.470)	(0.552)
premed					−1.350***	−1.350***
					(0.324)	(0.319)
Constant	47.434***	47.077***	43.012***	41.273***	58.952***	58.952***
	(0.547)	(1.573)	(1.602)	(1.625)	(1.549)	(1.984)
Observations	6,530	6,530	6,512	6,512	6,484	6,484
R-squared	0.025	0.121	0.203	0.212	0.408	0.408

Standard errors in parentheses
***p<0.001, **p<0.01, *p<0.05, + p<0.1

There are regional differences in community resilience. After controlling for other variables, the regions with more NIDRMC have a positive impact on community resilience compared with the regions that have most NIDRMC. The least affected areas of NIDRMC have a more significant negative impact on community resilience, and the general NIDRMC region sees no relations with community resilience. The less NIDRMC, the worse the community resilience is. In other words, the NIDRMC has a promoting significance to community resilience. The impact of economic factors on community resilience is only seen at the lowest level.

After controlling for other variables, the city has no effect on community resilience. Compared with the top layer, the lowest level of hierarchy and community resilience is positively related, and there is no correlation between other levels and community resilience.

Housing affects community resilience. After controlling for other variables, the number of years of housing negatively correlated with community resilience. That is, the longer the housing year, the less favorable the resilience of the community is. The geographical location of the housing will affect the resilience of the community. The housing in the plains has a positive impact on the resilience of the community. However, housing and community toughness of reinforced concrete structures are inversely related. The evaluation of self-housing safety after controlling for other variables is generally related to community resilience compared with the evaluation of safety.

Social factors have a partial impact on community resilience assessment. After controlling for other variables, female negatively correlated with community resilience, and those with population under three years of age or over 60 positively correlated with resilience. Minorities, families with disabilities, and low-income groups are not related to community resilience.

Institutional factors have the most significant impact on the self-assessment model of community resilience. After controlling for other variables, minority groups negatively correlated with community resilience (model 4). However, the negative correlation between minority and community resilience disappeared after investing in institutional factors. In other words, the institutional investment in community disaster reduction can overcome ethnic differences. In Model 5, controlling for other variables, institutional factors are negatively correlated with community resilience assessments. That is to say, the more emergency drills and material reserves, the less resilience it is for communities that carry out emergency drills, emergency relief supplies, public health facilities such as health centers, and access to medicines, or collectively for communities with wel-set or 'tough' public health conditions.

D. *Discussions*

First, local differences in disaster-reduction communities are related to the level of economic development in different regions and are also related to the NIDRMC itself. The

NIDRMC is not a mandatory measure. After obtaining the honorific title of NIDRMC, it carries a life of its own but is oftentimes not supported by funds (coming from the central government). The creation of disaster reduction demonstration community relies more on the local leadership's awareness and resource mobilization ability.

The four provinces with the most significant NIDRMC are also China's major GDP provinces, and the least provinces are also the regions with relatively backward economies in the western region. At the same time, the creation of NIDRMC allows local characteristics at the level of measures.[23] These ultimately led to local resilience building through the disaster-reduction model community, which in turn led to regional differences.

Second, the NIDRMC has played a role in overcoming urban-rural differences and ethnic differences. From 2008 to December 2016, there were 9958 NIDRMC, including 6,190 urban communities and 3,378 rural communities.[24] Rural communities account for 35%. At the same time, China's tilting policies on ethnic areas have also played a role in overcoming the differences caused by the nation.

Finally, the negative correlation between institutional factors and community resilience may stem from more understanding and less reliable risk perception laws. At the lower level, the assessment of community resilience is high, which may not be a fact but is related to cognition. In 2011 Yuxi City issued an emergency rescue package leading to earthquake rumors, and many people evacuated Yuxi.[25] This incident has a specific effect on understanding the negative correlation between institutional input and community resilience. The Chinese public may need a more scientific understanding of resilience and disaster reduction. Housing and community resilience of reinforced concrete structures are also negatively correlated, which means that our disaster reduction propaganda requires more communication to the public.

Conclusion

China's disaster reduction system has changed from disaster management to risk management, and the transformation of the system has been the transformation of the concept of disaster reduction. The transformation of this concept of disaster reduction has both residential and economic development, changes in demand, and international influence. However, changes in the concept of disaster reduction at the government level cannot be said to permeate well at the public level. There is a bias in the public's understanding of disaster reduction behaviors, and the public is encouraged to accept new disaster reduction concepts. More work is needed. Improving public understanding of community disaster reduction is a topic for the future.

Although the construction of the integrated disaster reduction demonstration community is guided by the central government, local government-based disaster reduction matters. However, the model community has played a demonstrative role in enhancing regional resilience. Institutional construction can improve urban-rural differences and

ethnic differences. The main purpose of the demonstration community policy is to mobilize resources of all parties and promote the development of grassroots disaster reduction. In this sense, China's attempt to promote local resilience through demonstration communities is effective. However, due to the diversity of natural disasters in China, the diversity of economic and social conditions, more efforts are needed to strengthen local resilience.

Acknowledgements: This paper was supported by Special Fund of the Geophysical Institute China Earthquake Administration, "Community Earthquake Risk Vulnerability Assessment and Policy Countermeasure Research" (Grand No. DQJB709) and the China Earthquake Administration's earthquake prevention and disaster reduction policy and regulation key research tasks. Disaster Reduction and Poverty Alleviation in Vulnerable Communities Funding Research. The statistics of the national comprehensive disaster prevention and mitigation demonstration community have helped by the National Disaster Reduction Center (former) Wang Dongming and Professor Yang Nihong of Beijing Normal University.

Note

i Four integrated organization is National Disaster Reduction Committee, National Flood Control and Drought Relief Headquarters, National Earthquake Relief Headquarters, National Forest Fire Prevention Command.

References

1 Zhong Kaibin 2018, The evolution and strategic integration of the national security concept in China, Chinese Soft Science, 10: 23–30.
2 Sendai Framework for Disaster Risk Reduction, 18 March 2015,A/CONF.224/CRP.1.
3 Wu Guochun, Sociological Research on Disaster Relief: A Comparative Study on Indonesia, China and Japan, Beijing University Press, 2014: 57–61.
4 Fan Baojun ed. The Record of China International Disaster Reduction Ten Years, Modern China Press, 2000: 123.
5 Wu Guochun, Development and issues of disaster NGOs in China, Nagoya University Sociological Review, 2017.
6 Shi Peijun,Wang Jiwei, et.al, Research review and prospects of natural disasters regionalization in China, Geographical 2017, Research, 36(8): 1401–1414.
7 Office of the National Disaster Reduction Committee, Department of Disaster Relief MCA, National Disaster Reduction Center MCA, 2001–2015 Atlas of natural disaster in China, China Map Publishing Press, 2017: 4–11.
8 Gao Mengtan edit, GB18306–2015《China ground motion parameter zoning map》Publicity material, China Quality Inspection Press / China Standard Press, 2015: 7.
9 Liu Nanjiang, Fei Wei, Analysis of the basic situation of natural disasters in 2018, China Disaster Reduction, 2019.March: 14–17.
10 Research Group of the Development Research Center of the State Council, China's new urbanization roads, models and policies, China Development Press, 2014: 253–257.
11 Research Group of the Development Research Center of the State Council, China's new urbanization roads, models and policies, China Development Press, 2014: 271.
12 Gao Mengtan edit, GB18306–2015《China ground motion parameter zoning map》Publicity material, China Quality Inspection Press / China Standard Press, 2015: 4.
13 United Nations Office for Disaster Risk Reduction (UNISDR), "2009 UNISDR Terminology on

Disaster Risk Reduction", Geneva, May 2009 (http://www.unisdr.org/we/inform/terminology).
14 Liu Jin, Shi PeiJun et. al, 2006 The review of disaster research, Advances in Earth Science, 21(2): 211-218.
15 Global Earthquake Model, S. A. I., Heidelberg University, Center for Disasster Management and Risk Reduction Technology, & USAID, N. S. f. E. T.-N. N. a. (2014). Participatory Evaluation of Earthquake Risk and Resilience in Lalitpur Sub-Metropolitan City. 34.
16 Martin, S. A. (2015). A framework to understand the relationship between social factors that reduce resilience in cities: Application to the City of Boston. International Journal of Disaster Risk Reduction, 12, 53-80. doi:10.1016/j.ijdrr.2014.12.001
17 Melissa Parsons, 2018 Top-down assessment of disaster resilience: A conceptual framework using coping and adaptive capacity.
18 Parsons, M., Glavac, S., Hastings, P., Marshall, G., McGregor, J., McNeill, J.,... Stayner, R. (2016). Top-down assessment of disaster resilience: A conceptual framework using coping and adaptive capacities. International Journal of Disaster Risk Reduction, 19, 1-11. doi:10.1016/j.ijdrr.2016.07.005
19 Hu Man, Hao Yanhua, Ning Ning, et.al, Reliability and validity of the communities and Advanced Resilience Toolkit (CART) Chinese version, Chin J Public Health, May 2017 Vol. 33 No. 5: 707-710.
20 Zhu Huagui, A discussion of community resistibility in a Risky society, Journal of Nanjing University, 2012, No. 5: 47-53+159.
21 Wang Xiujie edit. Research on China's Disaster Reduction Strategy for Addressing Climate Change, Chinese Social Press, 2019: 301.
22 James K. Mitchell, The Crucibles of Hazard: Mega-cities and Disasters in Transition, The United Nations University Press. 1999 = 2006: 38.
23 Feng xijin, Wang Dongming, Analysis of community disaster reduction policy, Beijing University Press 2014: 28.
24 Wang Xiujie edit. Research on China's Disaster Reduction Strategy for Addressing Climate Change, Chinese Social Press, 2019: 342.
25 Yunnan Yuxi issued an emergency rescue package leading to an earthquake rumors, http://news.sina.com.cn/c/2011-11-24/224823520876.shtml

※ Editorial Note: The format used in this chapter is the authors'. Owing much to the time constrain, the editor has little choice but to leave the style of writing of this chapter as it is originally submitted especially in regard to footnoting and the list of references.