

# Paradigm shift and prospects of China's earthquake emergency management policies: Analysis of historical institutionalism

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## Abstract

China's earthquake emergency management policies have experienced a total of four types of paradigms: the paradigm focusing on disaster relief from 1949–1966, the paradigm focusing on earthquake prevention from 1966–1989, the paradigm focusing on earthquake mitigation from 1989–2016, and the paradigm integrating disaster prevention, mitigation, and relief from 2016 to present. Path dependence can be found in China's earthquake emergency management policies, which have accumulated to implement comprehensive disaster mitigation based on a pure focus on disaster relief. In addition, earthquake emergency management policies also have a change logic in which subjects are increasingly diversified, policy tools are continuously developed and influenced by the economic system, and policy paradigm changes are influenced by the international environment, national strategies, and emergencies. In the future, earthquake emergency management policies should start from organizational change, digital change and rule of law construction to promote the modernization of China's earthquake emergency governance system and capacity.

**Citation:** Cui X. 2022. Paradigm shift and prospects of China's earthquake emergency management policies: Analysis of historical institutionalism. *Emergency Management Science and Technology* 2:14 <https://doi.org/10.48130/EMST-2022-0014>

## INTRODUCTION

Since the founding of the country, the Xingtai earthquake, Tangshan earthquake, Wenchuan earthquake and other big earthquakes, as well as frequent small and medium-sized earthquakes, have caused a great amount of damage in China. In order to mitigate the damage caused by earthquakes, China has been actively promoting the development and reform of earthquake emergency management policies and continuously adjusting earthquake work guidelines. The original earthquake work guideline in 1972 is 'under the monolithic leadership of the Communist Party of China, prevention should be the main focus, combining specialization with the masses, combining domestic and foreign technologies, developing mass movements, and relying on the masses for good prediction and prevention'. After the 18<sup>th</sup> National Congress of the Communist Party of China, the government has emphasized the prevention of disasters and the combination of disaster prevention, mitigation and relief, and to comprehensively enhance the disaster prevention capabilities to provide a solid guarantee for the safety of people's lives and property.

From simple 'prevention-oriented' to 'prevention-oriented, disaster prevention, mitigation and relief combined', China's earthquake emergency management policies have undergone major adjustments since the founding of the country. Are these adjustments made in an action? How many stages have they gone through? Where should the future direction go? Analyzing the process of earthquake emergency management policy changes in China from the theoretical perspective of historical institutionalism allows us to analyze the different characteristics of different stages of earthquake emergency management

policies, analyze the logic of their changes, and provide suggestions for the change of earthquake emergency management policies and its developmental direction. Previous studies tend to classify the phases based on the number of policies through the analysis of earthquake emergency management policy texts, which to some extent neglects the exploration of the characteristics of different policy stages and the change logic of earthquake emergency management policies. The research purpose of this paper is to explore China's earthquake policy paradigm stages, the policy characteristics of different paradigm stages, the internal logic of the policy shift in the perspective of historical institutionalism, and provide an outlook on the development of earthquake emergency management policy in China.

## LITERATURE REVIEW AND ANALYTICAL FRAMEWORK

### Literature review on paradigm shifts in earthquake emergency management policy

The basic theory for the study of policy paradigm shift is Peter Hall's theory<sup>[1]</sup>. According to Hall, the policy formulation process involves three variables: the basic objectives of the policy, the policy instruments, and the specific application of these policy instruments. Different learning processes can be classified according to different changes in the three variables. A change in all three of these variables is a policy paradigm shift<sup>[1]</sup>. Many studies have combined punctuated equilibrium theory, multiple streams theory, and advocacy coalition framework with policy paradigm shift theory to explore policy

change<sup>[2]</sup>. In analyzing policy paradigm shift, punctuated equilibrium theory tends to describe the process of public policy development by dividing it into punctuation periods, which are associated with unintended consequences, and equilibrium periods, which are associated with path dependence. In addition, related studies tend to explore the causes of policy paradigm shift by analyzing changes in policy issues, policy subsystems, policy images, and places of policy agreement during intermittent periods<sup>[3]</sup>. The multiple streams theory points out that the establishment of government agendas is influenced by three streams: political stream, policy stream, and issue stream, as well as the activities of policy entrepreneurs. It considers policy paradigm shift as an interactive process involving actors, institutional structures and policy contexts, and emphasizes the influence of policy agendas, policy entrepreneurs and policy issues on the opening of policy window and policy paradigm shift<sup>[4–6]</sup>. Analysis of policy paradigm change with the advocacy coalition framework usually analyzes the causes of policy change, such as the interaction of different initiative coalitions within and outside the policy subsystem and changes in external non-cognitive factors<sup>[7]</sup>. The advocacy coalition framework overemphasizes the game of coalitions within the policy subsystem at the expense of the importance of the macro system for policy change.

Regarding the paradigm shift of earthquake emergency management policy, some scholars have discussed the process of earthquake policy change. Zhang et al., who used Nvivo analysis software to classify China's earthquake policy into three periods: blank stage (1949–1976), budding stage (1977–2007) and development stage (2008–2018)<sup>[8]</sup>. Some other scholars have discussed the reasons that caused the paradigm shift in earthquake policy<sup>[9–11]</sup>. Koshimura & Shuto argued that the 311 earthquake in Japan in 2011 had exposed the inadequate preparedness of coastal dikes and promoted a paradigm shift in mitigation measures<sup>[10]</sup>. In addition, there are other factors that drive policy paradigm change. Li & Yao argued that the media can promote policy paradigm shift from the bottom up by capturing government attention through coverage of abnormal events<sup>[11]</sup>. Wood concluded that three types of policy entrepreneurs, elected politicians, top executive leadership, and interest groups, play an important role in driving seismic change by analyzing data from building department officials in 292 cities and counties in California<sup>[12]</sup>.

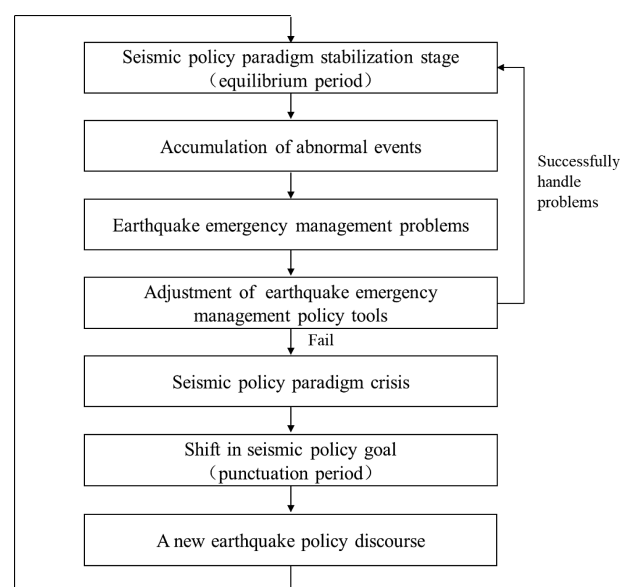
Studies tend to divide earthquake policies based on the number of policies. The number-based approach can not provide a deep analysis of the characteristics of each earthquake policy stage and can not explore the logic and historical context that drive the changes in earthquake policy. In addition, most studies have focused on the analysis of the role of a certain factor which promotes the earthquake policy change, while few studies have described the complex historical background and various reasons for the change of China's earthquake emergency management policy. In conclusion, it is necessary to use policy goals rather than the number of policies as the basis for dividing policy stages and explore the features and background of China's earthquake emergency management policies from a historical perspective.

### Analytical framework building for historical institutionalism

There is a problem of focusing too much on the role of micro-individuals at the expense of the influence of

institutional environment on actors, or too much on analyzing the causes of institutional change at the expense of describing the process of institutional change. Historical institutionalism emphasizes the importance of history and institutions, analyzing them at the meso-level of interactions between individuals and institutions, between institutions, and between institutions and policy outputs<sup>[13]</sup>. In public policy paradigm shift, historical institutionalism usually takes institutions as dependent variables and examines the causes that give rise to institutional paradigm shift<sup>[14,15]</sup>. Sometimes, historical institutionalism also uses past institutions as independent variables in the analysis of policy change and analyzes the role of 'path dependence'<sup>[16]</sup>. Analyzing earthquake policy with historical institutionalism not only describes the different stages of China's earthquake policy and elucidates the era in which different policy goals and policy tools are formed, but also analyzes the abnormal events that lead to changes in the policy system and explores the reasons for the paradigm shift in earthquake policy. Based on Hall's theory of policy paradigm shift, this paper used the analytical framework of historical institutionalism and incorporated punctuated equilibrium framework to explore the process of earthquake emergency management policy formulation and the logic of change in the context of the times<sup>[1]</sup>. This paper analyzed the earthquake emergency management policy paradigm from the perspectives of policy goals, policy problems, policy tools, policy discourse, and difference between punctuation and equilibrium periods (as shown in Fig. 1).

The framework shown in Fig. 1 takes institutional inertia as the logical starting point for analysis. Being influenced by the increasing returns, China's earthquake emergency management policy maintains a path dependence. Abnormal events can expose problems with earthquake emergency management policies. Initially, policy makers solve policy problems by modifying the specific settings of policy instruments or the types of policy instruments. If the policy problems are successfully solved, the paradigm is stable and this is the equilibrium period of the policy. If modifying the policy instruments fails to solve the policy problem, the policy maker will adjust the policy



**Fig. 1** A historical institutionalism framework for paradigm shift in earthquake emergency management policies.

China's earthquake emergency management policies

goal, at which point there is a shift in the earthquake emergency management policy paradigm, the policy enters a punctuation, and a new type of policy discourse is formed.

This paper first used the research method of textual analysis and the analytical framework of historical institutionalism to collect and organize public policies such as laws and administrative regulations related to this earthquake emergency management, and to delineate the policy paradigms in earthquake emergency management. This paper analyzed the policy problems, policy goals, policy tools, and specific settings of policy tools under different paradigms in the background of the times. Second, this paper concluded the logic and motivation of the change of China's earthquake emergency management policies from the perspective of institutional structure. Finally, this paper adopted a comparative research method to compare and sort out the policy paradigms in earthquake emergency management in different periods, summarized the problems of the current earthquake emergency management policies in China, and provided suggestions on the direction of future policy changes.

**Selection and analysis of earthquake emergency management policies**

This paper retrieved a total of 606 policy texts at the central level, including laws, administrative regulations and

departmental rules, using the China law search system and the official websites of the Ministry of Emergency Management and other earthquake emergency management departments as channels, and using 'earthquake', 'emergency management' and 'earthquake emergency' as keywords. After getting rid of policies that were not highly relevant to earthquake emergency management, such as appointments, dismissals, and notices of rewards and punishments, a total of 472 policy texts were obtained, covering the period from August 1971 to December 2021 (as shown in Fig. 2).

Our research extracted the earthquake emergency management policy goals by analyzing the texts of earthquake emergency management policies, which were based on the earthquake work guidelines and earthquake emergency management policies formulated at the national level (as shown in Table 1). This paper combined the classical classification of policy instrument types into four types: organizational, information, regulatory and economic, using resources as the basis for classification. The organizational policy tools are related to the institutional setup and personnel adjustment of the earthquake emergency management department. Information policy tools are related to earthquake emergency management information monitoring, forecasting, communication and disclosure. Regulatory policy tools are related to earthquake emergency management laws, regulations and standard restrictions. The

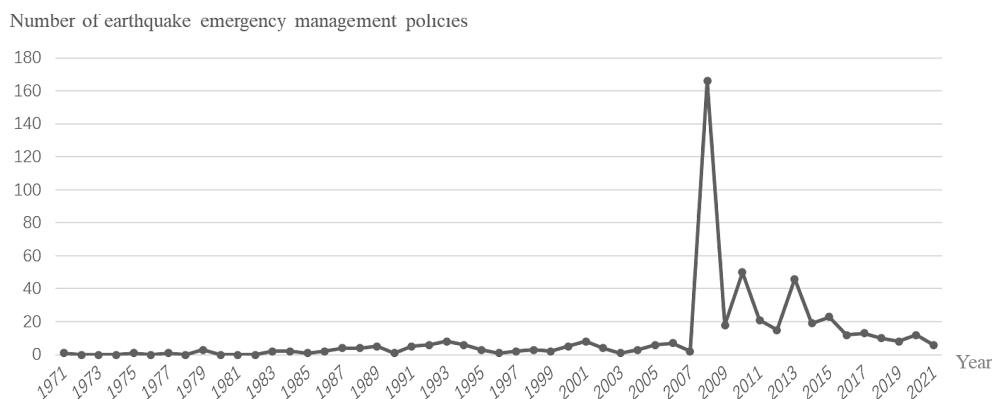


Fig. 2 The history of changes in China's earthquake emergency management policies.

Table 1. Extraction of key words from China's earthquake emergency management policy goals.

Policy goal keyword extraction	Example of policy text content	Policy examples
Disaster relief	Local governments and civil affairs departments carry out research on earthquake relief countermeasures, not only....., but also for future scientific guidance of our disaster relief work.	<i>Proceedings of the Symposium on Earthquake Disaster Response Research</i> (No.21 Document of Ministry of Civil Affairs[1987])
Disaster prevention	Must effectively strengthen the monitoring and forecasting work of the seven key surveillance areas, and suggest that the local people's government take practical measures as early as possible to strengthen and implement disaster prevention work in these areas.	<i>Earthquake Administration, Ministry of Construction, Ministry of Civil Affairs on Strengthening Earthquake Disaster Prevention in Key Earthquake Surveillance Areas</i> (No.113 Document of State Earthquake Administration [89])
Disaster mitigation	Incorporate the knowledge of earthquake prevention and disaster reduction into the national quality education system, ....., and persistently publicize the knowledge of earthquake prevention and disaster reduction to make it known to every household and everyone.	<i>Notice from China Earthquake Administration, Ministry of Science and Technology on Strengthening the Popularization of Earthquake Disaster Prevention and Mitigation Science</i> (No.20 Document of China Earthquake Administration[2014])
Combination of disaster prevention, mitigation and relief	Firmly establish the concept of disaster risk management,.....,disaster prevention, mitigation and relief into the overall planning of national economic and social development at all levels, as an important element of the construction of the national public security system.	<i>The CPC Central Committee and State Council on promoting disaster prevention, mitigation and disaster relief institutional reform views</i> (No.35 Document of CPC Central Committee [2016])

economic policy tools are related to earthquake financial management (as shown in Table 2).

## THE FORMATION AND CONTINUOUS EVOLUTION OF THE EARTHQUAKE EMERGENCY MANAGEMENT POLICY PARADIGM

### The relief-oriented earthquake emergency management policy paradigm (1949–1966)

Since ancient times, China has been a country prone to earthquake disasters. China developed an earthquake policy paradigm that focused on disaster relief in ancient times, because good disaster relief could maintain the stability of society and rules. At the beginning of the founding of the country, China formulated a catch-up development strategy out of the need to maintain the new regime and to quickly restore the national economy and attached importance to independence of development. The catch-up development strategy took catching up with the United Kingdom and surpassing the United States as the core goals, and focused national resources on the central and economic construction areas through national political mobilization, ignoring earthquake emergency management policy making. The earthquake policy paradigm from the early founding of China to the Xingtai earthquake (1966) was influenced by institutional inertia, following the old paradigm with disaster relief as the main focus (as shown in Table 3).

The construction of earthquake emergency management in the early years of the foundation gave way to a development strategy to catch up with the United Kingdom and surpass the United States. The earthquake emergency management paradigm inherited the earlier paradigm of disaster relief. Because of the policy of 'relying on one's own efforts', China rarely accepted foreign aid when the earthquake occurred. The earthquake emergency management was dominated by the Central Committee of the Communist Party of China, the central government, the Ministry of the Interior, the Central Disaster Relief Committee and the Chinese Academy of Sciences. Except for the Earthquake Working Committee under the Chinese Academy of Sciences, China had no full-time earthquake emergency management agency. In addition, influenced by the planned economy and the unified fiscal system, earthquake emergency management policy tools focused on central control, such as stopping the blind exodus of people from the disaster area. Other policy tools such as organizational policy tools, information policy tools and economic policy tools were in their infancy. In terms of policy language, the earthquake policy at this time was dominated by mobilizing language, mobilizing the masses to develop production and fight against natural disasters. Overall, China did not pay attention to earthquake emergency management in the early years of the country, and the policy tools were relatively simple, which sowed hidden dangers for later earthquake disposal.

**Table 2.** Types of policy tools for earthquake emergency management in China.

Types of policy instruments	Key words	Policy examples
Organizational policy tools	Establishment, abolition, earthquake working group, earthquake bureau, earthquake working agency, earthquake management system	<i>Notice of the State Council on Strengthening the Central Earthquake Working Group and Establishing the National Earthquake Bureau</i> (No.56 Document of State Council)
Information policy tools	Forecast, communication, notification, science and technology, publicity, education, information sharing	<i>Seismic Information Network Management Interim Regulations</i> (No.140 Document of China Earthquake Administration[2008])
Regulatory policy tools	Work system, management methods, standardization, administration according to law, serious discipline, clean up and regulate	<i>China Earthquake Administration on the comprehensive promotion of administrative implementation of the law</i> (No.122 Document of China Earthquake Administration[2007])
Economic policy tools	Payroll, allowances, insurance, budget management, auditing, bidding and procurement	<i>Management of special reserve for earthquake catastrophe insurance for urban and rural residential buildings</i> ( No.38 Document of the Ministry of Finance[2017])

**Table 3.** Seismic policy paradigm before the Xingtai earthquake.

Policy paradigm	Focusing on disaster relief
Policy problem	Focused on economic development (ignored the earthquake problems)
Policy goal	'Catch up with the United Kingdom and surpass the United States'. 'Rely on one's own efforts'. 'Develop the economy'. 'Work with stamina and diligence'
Subjects of responsibility	Central Committee of the CPC, the central government, the Ministry of the Interior, Central Disaster Relief Committee, Chinese Academy of Sciences
Policy tools	<ul style="list-style-type: none"> <li>• Organizational policy tools</li> <li>Established the Central Disaster Relief Committee</li> <li>Established the Earthquake Working Committee</li> <li>• Information policy tools</li> <li>Established the seismic network</li> <li>• Regulatory policy tools</li> <li>Stopped the blind exodus of people from disaster areas</li> <li>• Economic policy tools</li> <li>Reduced taxes for the affected areas</li> <li>Developed agricultural production</li> <li>Disbursed loans and handouts</li> </ul>
Policy discourse	Mobilizing language 'Mobilize and relocate the production of people in the disaster area' 'Mobilize and organize the masses to fight against natural disasters'

**The earthquake emergency management policy paradigm focused on prevention (1966–1989)**

From March 8 to 29, 1966, five consecutive earthquakes of magnitude 6 or greater occurred in the Xingtai City area of Hebei Province within 21 days, resulting in heavy damage and casualties<sup>[17]</sup>. After the failure of the original relief-oriented earthquake emergency management paradigm in the Xingtai earthquake, leaders gradually became aware of the importance of disaster prevention (as shown in Table 4). In 1972, the State Earthquake Administration put forward the policy of 'under the monolithic leadership of the Communist Party of China, prevention should be the main focus, combining specialization with the masses, combining domestic and foreign technologies, developing mass movements, and relying on the masses for good prediction and prevention' in the National Conference on Earthquake Work.

After the Xingtai earthquake, under the new earthquake emergency management policy paradigm, the Chinese government began to build earthquake disaster prevention capacity in two major aspects: organizational and technical. Regarding organizational policy tools, China started to build a dedicated earthquake emergency management agency including the Central Earthquake Working Group, the National Earthquake Administration and other organizations, and used economic-type policy tools to address the issue of allowances for employees in the earthquake sector. Besides, influenced by the weak earthquake science and a tradition of centralization, China carried out earthquake prevention and prediction through extensive mobilization of the masses. Mass mobilization in earthquakes refers to the activities of earthquake monitoring and earthquake disaster prevention conducted by citizens and social organizations without seismic systems in accordance with the law. By 1979, there were 1,344 local and county earthquake offices, tens of thousands of public survey stations, and hundreds of thousands of amateur survey workers<sup>[18]</sup>. The public predicted earthquakes through simple microscopic precursors, some of which have no scientific basis, such as observing the behavior of animals. In 1975, people's own observations of precursory phenomena successfully predicted the Haicheng earthquake and showed the positive effect of mass prevention and measurement<sup>[19]</sup>.

**Table 4.** The seismic policy paradigm from the Xingtai earthquake to the Tangshan earthquake.

Policy paradigm	Focusing on earthquake prevention
Policy problem	Earthquake prevention and prediction
Policy goal	'Focus on prevention'
Subjects of responsibility	Central Committee of the CPC, the Revolutionary Committee, Seismological Bureau, seismic group, seismic crew, Earthquake Relief Headquarter
Policy tools	<ul style="list-style-type: none"> <li>• Organizational policy tools</li> <li>Organized the central Earthquake team</li> <li>Established the national Seismological Bureau</li> <li>• Information policy tools</li> <li>Improved the seismic network</li> <li>• Regulatory policy tools</li> <li>Stopped the blind exodus of people from disaster areas</li> <li>• Economic policy tools</li> <li>Increased the issue of subsidies for earthquake workers</li> </ul>
Policy discourse	Mobilizing language 'Uphold the unified leadership of the Party' 'Lead people's war'

Technologically, China strengthened earthquake monitoring and communication technology with political mobilization, which freed seismic stations from the need to be manned, allowing for centralized implementation of recording earthquake information, rapid determination of earthquake parameters, and rapid earthquake reporting<sup>[20]</sup>. During this period, China's earthquake emergency management policy made some progress. However, influenced by the planned economy, earthquake emergency management was strongly colored by revolutionary and political mobilization and was dominated by central orders and plans, with single policy tools.

The Tangshan earthquake in 1976, the change of party and state leaders, and the reform and opening up (1978) have promoted the further strengthening of the policy paradigm of seismic disaster prevention, which is mainly reflected in the scientification of earthquake prevention (as shown in Table 5). Organizationally, after the abolition of revolutionary committees at all levels, China made adjustments to its earthquake organizations. Emergency management was the responsibility of party organizations at all levels, the governments at all levels and the earthquake bureaus and other agencies. In addition, during this period, China took the principle of professional division of labor to rectify the earthquake work institutions and management system, such as earthquake research institutes, earthquake stations, and group prevention and measurement management agencies, to clarify the institutions, responsibilities and steps of earthquake forecast management as well as earthquake business plans, and to improve the level of emergency management. In terms of information policy tools, China actively promoted the construction of earthquake prediction and prevention communication network and earthquake analysis to improve earthquake observation and forecasting capabilities, and earthquake digitalization and standardization. In addition, China strengthened the propagation of earthquake prevention and seismic knowledge, promoted the graded management of scientific and technological achievements and the graded management of confidentiality, and carried out international exchanges and cooperation related to earthquake science. In terms of legal construction, China promulgated the Regulations on the Administration of Seismic Analysis and Forecasting Work of the State Seismological Bureau, and the Regulations on the Issuance of Earthquake Forecasts, to strengthen the management of earthquake monitoring and forecasting work and to minimize earthquake disasters. In terms of economic-type policy instruments, influenced by the complete financial responsibility system, the central government shifted its financial and administrative powers downward, so the revenue and management authority of local governments increased, and the local governments' authority to manage earthquake emergencies has also increased. In addition, China reformed the salary system for staff in seismic institutions during this period, stipulating that the job salary of seismic institution staff is a structural salary system and strengthening the management of allowances for hardship seismic stations.

In summary, the pre-earthquake emergency management policy paradigm (before 1976) focusing on earthquake prevention was influenced by the Cultural Revolution (1966–1976) and the planned economic system (1956–1992), and the language of earthquake emergency management policy was dominated by mobilizing language, such as the use of mass

**Table 5.** The seismic policy paradigm from the Tangshan earthquake to the establishment of the China National Committee of the International Decade for Natural Disaster Reduction.

Policy paradigm	Focusing on earthquake prevention
Policy problem	Used seismological science to strengthen earthquake prediction and monitoring and reduced earthquake disasters
Policy goal	'Focus on prevention'
Subjects of responsibility	CPC, governments, Seismological organizations such as the Seismological Bureau, the Seismological Monitoring and Research Center and the Seismological Office, Earthquake Relief Headquarters, Leading Group for earthquake relief work
Policy tools	<ul style="list-style-type: none"> <li>• Organizational policy tools</li> </ul> Adjusted the earthquake organization and improved the earthquake management system; Adjusted the seismological scientific research institutions; Organized professional earthquake teams and mass survey and prevention teams <ul style="list-style-type: none"> <li>• Information policy tools</li> </ul> Strengthened the education and training of earthquake personnel; Conducted academic exchanges and international cooperation; Block some news; Publicized knowledge of earthquake prevention and aseismic resistance; Paid attention to science and technology management and science and technology achievements management; <ul style="list-style-type: none"> <li>• Regulatory policy tools</li> </ul> Stopped the blind exodus of people from disaster areas; Promulgated the 'Regulations on the Administration of Earthquake Analysis and Forecast of the State Earthquake Administration'; Promulgated the 'Regulations on the Release of Earthquake Forecasts' <ul style="list-style-type: none"> <li>• Economic policy tools</li> </ul> Set up funds for local earthquake projects; Reformed the wage and subsidy system for personnel working in earthquake institutions; Awarded seismological achievements <ul style="list-style-type: none"> <li>• Other policy tools</li> </ul> Took earthquake fortification and reinforcement measures
Policy discourse	Managerial language 'Strengthen earthquake prediction and engineering earthquake research', 'Promote the modernization of earthquake science and technology', 'Promote the modernization of earthquake science and technology', 'Give play to the role of earthquake science in national economic construction and social progress'

mobilization in earthquake prevention and prediction. In the later period (after 1976), influenced by the Tangshan earthquake and the reform and opening up, the policy language of earthquake emergency management changed to managerial language, the variety of policy tools was enriched, and certain adjustments were made to the policy tool settings. However, the economic system after the reform and opening up was a commodity economy, so it was still in the transition period from planning to market, and there was an alternation of old and new policy tools. For example, in order to stabilize the masses and ensure production and living conditions, the State Council imposed an embargo on earthquake news. The earthquake emergency management policy paradigm still needed further development and innovation.

**The earthquake emergency management policy paradigm focused on prevention and mitigation (1989–2016)**

In 1987, the United Nations designated the period from 1990 to 2000 as the International Decade for Natural Disaster Reduction, which sought to address the lack of capacity of developing countries to respond to disasters. In response to the call of the United Nations, China established the China National Committee of the International Decade for Natural Disaster Reduction in April 1989, and the policy paradigm of earthquake emergency management in China changed from earthquake prevention to earthquake disaster prevention and mitigation. After the Wenchuan earthquake in 2008, China revised and adopted the 'Earthquake Disaster Prevention and Mitigation Law' on December 27, 2008. In addition, since 2009, in order to enhance national awareness of disaster prevention and mitigation, the State Council has set May 12 as National Disaster Prevention and Mitigation Day. The revision of the 'Earthquake Disaster Prevention and Mitigation Law' after the Wenchuan earthquake and the establishment of the National Disaster Prevention and Mitigation Day implied the continuous strengthening of the earthquake emergency management

policy paradigm for prevention and mitigation (as shown in Table 6)<sup>[21]</sup>.

The organizational, information, regulatory and economic policy tools of earthquake emergency management were adjusted following the shift in the policy objectives of earthquake emergency management. In terms of organizational policy tools, China established a block-based emergency management system after SARS, and since then the capacity of local and grassroots emergency management has been improved. In addition, China enhanced the cooperation and coordination mechanism of various departments through the establishment of additional coordinating non-permanent bodies such as the National Committee for Natural Disaster Reduction, Emergency Management Committee and Emergency Management Office, as well as the establishment of a joint conference system for earthquake disaster prevention and reduction. Regarding information policy tools, China continued its previous development tendency of focusing on prediction and forecasting, strengthening publicity and education and international exchange and cooperation, as well as focusing on earthquake announcement and public opinion control management, and strengthening earthquake scientific research. Regulatory policy tools had a considerable change. Along with the strategy of 'rule by law', the State Council issued the 'Regulations on Destructive Earthquake Response', 'Regulations on Seismic Safety Evaluation' and other departmental regulations, and the National People's Congress issued the 'Law of the People's Republic of China on Earthquake Disaster Prevention and Reduction', 'Law of the People's Republic of China on Response to Emergencies' and other emergency management laws. As a result, the number of earthquake emergency management laws and regulations in China increased, the content became enriched, and the construction of 'rule by law' strengthened. Regarding the economic policy tools, influenced by the gradual formation and improvement of the market economy system, government departments strengthened the financial management of the earthquake business during this period, and the

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**Table 6.** The seismic policy paradigm from the establishment of the China National Committee of the International Decade for Natural Disaster Reduction to the reform of disaster prevention, mitigation and relief system.

Policy paradigm	Focusing on earthquake prevention and mitigation
Policy problem	Strengthened disaster prevention, resistance, relief and comprehensive disaster reduction
Policy goal	'Prevention, taking into account the needs of peacetime and earthquake, constant readiness', 'Putting prevention first, combining prevention and rescue efforts, and comprehensively reducing disaster', 'To prevent and mitigate earthquake disasters, protect people's lives and property, and promote sustainable economic and social development'
Subjects of responsibility	CPC, governments, China Earthquake Administration, China National Committee of the International Decade for Natural Disaster Reduction (National Disaster Reduction Commission), Emergency Committees, Emergency Offices, Earthquake Relief Headquarters, Leading Group for earthquake relief work
Policy tools	<ul style="list-style-type: none"> <li>• Organizational policy tools</li> </ul> Established China National Committee for Natural Disaster Reduction; Adjusted the earthquake organization and improved the earthquake management system; Clarified the work of relevant organizations on disaster prevention and mitigation; Strengthened earthquake preparedness and disaster mitigation at the city, county and community level <ul style="list-style-type: none"> <li>• Information policy tools</li> </ul> Strengthened earthquake prediction and improved earthquake communication systems; Formulated China's seismic intensity zoning map; Strengthened earthquake investigation and judgment, information communication, information disclosure and public opinion control and management; Strengthened education of earthquake knowledge; Strengthened seismological research; Promoted international exchanges and cooperation; <ul style="list-style-type: none"> <li>• Regulatory policy tools</li> </ul> Stopped the blind exodus of people from disaster areas; Established an earthquake emergency inspection system; Strengthened the construction of earthquake emergency under the rule of law; Comprehensively promoted law-based administration of the earthquake system; Introduced comprehensive emergency management laws; <ul style="list-style-type: none"> <li>• Economic policy tools</li> </ul> Strengthened financial management of earthquake departments; Strengthened the management of the companies belonging to the seismic system; Strengthened the assessment of earthquake losses; Mobilized units and the general public to participate in earthquake insurance and standardized enterprise insurance; Standardized the management of seismic safety assessment fees
Policy discourse	Managerial language 'The work of earthquake prevention and mitigation shall be managed in a unified manner', 'Comprehensively strengthen earthquake emergency management', 'Promote coordinated, orderly and efficient earthquake emergency response', 'Ensure and promote the comprehensive, coordinated and sustainable development of earthquake preparedness and disaster reduction'

economic policy tools became more refined. In order to strengthen budget management, the Earthquake Bureau specified the source, use, and review of special funds and materials for earthquake prevention and resistance, as well as the management system and budget composition, preparation, execution, and adjustment of the Earthquake Bureau's earthquake budget. In addition, the state required and mobilized enterprises, institutions and people to participate in insurance to improve the resilience of each unit and the public.

Influenced by the reform and opening up and the UN's International Decade for Natural Disaster Reduction, the policy paradigm of earthquake emergency management in China changed from focusing on earthquake prevention to earthquake prevention and mitigation during this period. The policy language in this period was management language such as 'The work of earthquake prevention and mitigation shall be managed in a unified manner', 'Ensure and promote the comprehensive, coordinated and sustainable development of earthquake preparedness and disaster reduction'. Influenced by the socialist market economy system, the types and contents of earthquake emergency management policy tools became much various. However, the earthquake emergency management policy at this stage also had problems such as confused earthquake emergency management functions, lack of a unified leading organization, uninitiated catastrophe insurance system and insufficient economic policy tools.

**A policy paradigm for earthquake emergency management combining disaster prevention, mitigation, and relief (2016–present)**

In 2013, the Third Session of the Eighteenth Central Committee of the CPC (the Communist Party of China) put forward the goal of promoting the modernization of China's

system and capacity for governance. The modernization of governance for earthquake emergency management required to promote the construction of earthquake emergency management system, mechanism and legal system, to improve the level of rule by law, to carry forward the standardization and modernization of earthquake prevention and mitigation as well as disaster relief work, and to comprehensively enhance the comprehensive prevention capacity of the whole society to resist natural disasters. On December 19, 2016, the State Council issued 'Opinions on Promoting the Reform of the Institutional Mechanism for Disaster Prevention, Mitigation and Relief', which required adhering to the unification of normal disaster mitigation and extraordinary disaster relief, changing from focusing on post-disaster relief to focusing on pre-disaster prevention, changing from dealing with a single disaster to comprehensive disaster mitigation, and changing from reducing disaster losses to mitigating disaster risks. As a result, the earthquake emergency management paradigm of earthquake prevention and mitigation transformed into an earthquake emergency management paradigm that combines disaster prevention, mitigation and relief (as shown in Table 7).

The original earthquake emergency management organization system had the disadvantages of multiple leadership and confused earthquake emergency management functions. In 2018, China adjusted the disaster prevention, mitigation and relief system by establishing the Ministry of Emergency Management and transferring the emergency management functions of the China Earthquake Administration and other earthquake departments to the Ministry of Emergency Management, thereby pooling resources and strengthening the overall coordination of emergency management. In addition, under the new paradigm of earthquake emergency manage-

**Table 7.** The seismic policy paradigm of combining disaster prevention, reduction and relief after the reform of disaster prevention and relief system.

Policy paradigm	Focusing on integrating disaster prevention, mitigation and relief
Policy problem	Enhanced risk awareness and focused on disaster prevention, resistance, relief and comprehensive disaster reduction
Policy goal	'Focus on prevention, and combine disaster prevention and relief', 'Integrate normal disaster mitigation with abnormal disaster relief, shift focus from post-disaster relief to pre-disaster prevention, from responding to a single type of disaster to comprehensive disaster reduction, and from reducing disaster losses to mitigating disaster risks'
Subjects of responsibility	CPC, governments, the Ministry of Emergency Management, China Earthquake Administration, National Disaster Reduction Commission, Earthquake Relief Headquarters, Leading Group for earthquake relief work
Policy tools	<ul style="list-style-type: none"> <li>• Organizational policy tools</li> </ul> Established the Ministry of Emergency Management; Advanced the reform of disaster prevention, mitigation and relief systems; Formulated plans for earthquake prevention and disaster reduction; Standardized the evaluation of professional and technical titles <ul style="list-style-type: none"> <li>• Information policy tools</li> </ul> Strengthened science popularization in earthquake preparedness and disaster mitigation; Promoted the commercialization of scientific and technological achievements in earthquake; Strengthened the building of information sharing mechanisms; Strengthened the building of information sharing mechanisms <ul style="list-style-type: none"> <li>• Regulatory policy tools</li> </ul> Standardized the seismic safety evaluation; Promulgated the 'Administrative Measures for the standardization of earthquakes'; Promulgated the 'Rules for the Administration of the institution and revision of seismic standard System' <ul style="list-style-type: none"> <li>• Economic policy tools</li> </ul> Established an earthquake catastrophe insurance system for urban and rural residential buildings; Strengthened budget management and performance evaluation of the Seismological Bureau; Standardized the tendering and procurement work of the seismological Bureau
Policy discourse	Governance language 'Advocate extensive participation of social forces and market mechanisms'; 'Vigorously promoting the modernization of earthquake disaster prevention and mitigation in the new era'; 'Comprehensively improving the emergency rescue capacity and comprehensive disaster prevention capacity of earthquake disasters'; 'Improving the rule of law, standardization and modernization of disaster prevention, mitigation and relief work'

ment, China has actively involved multiple subjects in emergency management and has proposed a disaster prevention and mitigation mechanism that adheres to 'leadership of the CPC and government, and extensive participation of social forces and market mechanisms'. The information-based tools in this period are similar to those in the previous period, and continue to focus on propaganda and education on earthquake prevention and mitigation knowledge, scientific and technological research and development, promoting the construction of earthquake information sharing mechanisms, and improving the quality of earthquake monitoring. In addition, greater progress has been made in the digitalization of earthquake emergency management. With regard to regulatory policy tools, China has adjusted administrative regulations as well as departmental regulations related to earthquakes. Firstly, in order to implement the requirements of the State Council's decentralization reform, the Seismological Bureau withdraws administrative licenses such as the approval of practice qualifications for seismic safety evaluators and strengthens the supervision of seismic safety evaluation in and after the event<sup>[22]</sup>. Secondly, the country has promoted earthquake standardization through the development of regulations such as the 'Seismic Standardization Management Measures'. The market-determined social market economy has driven the development and improvement of economic policy tools for earthquakes, which include budgets, insurance, performance evaluation, bidding and procurement, and many other types of economic tools in this period. The China Earthquake Administration (CEA) has standardized the budget management system as well as the bidding and procurement process by formulating the 'CEA Budget Management Measures', 'CEA Bidding and Procurement Management Measures', and 'CEA Project Expenditure Performance Evaluation Management Measures', thereby strengthening the management of earthquake funds. During this period, China also carries out the construction of catastrophe insurance system by issuing the

Implementation Plan for the Establishment of Earthquake Catastrophe Insurance System for Urban and Rural Residents, and promotes the catastrophe insurance system from initiative to practice.

The Third Session of the Eighteenth Central Committee of the CPC put forward the goal of promoting the modernization of China's system and capacity for governance, and has clarified the decisive role of the market in resource allocation, thus triggering all-round changes in various fields. During this period, the earthquake emergency management policy has been influenced by China's comprehensive deepening reform, and the policy discourse gradually transfers from management language to governance language, emphasizing 'vigorously promoting the modernization of earthquake disaster prevention and mitigation in the new era', 'comprehensively improving the emergency rescue capacity and comprehensive disaster prevention capacity of earthquake disasters', and 'improving the rule of law, standardization and modernization of disaster prevention, mitigation and relief work'. Various policies adapted to the governance policy language have promoted the modernization of the earthquake emergency management system and emergency management capabilities. However, market and social forces in this period are mainly involved in earthquake emergency management matters through the guidance of government departments, and there are problems of lack of autonomy and insufficient participation capacity, as well as insufficient cooperation between the government and other forces. In addition, the digital construction of earthquake emergency management in China is difficult to adapt to the development needs of high-speed information flow, and there is a problem of low level of earthquake emergency digitalization. There are also problems of late updating of earthquake emergency management laws and regulations, inadequate earthquake financial management and disaster loss compensation mechanisms, and inadequate development of economic policy tools.



## THE CHANGING LOGIC OF EARTHQUAKE EMERGENCY MANAGEMENT POLICY PARADIGM

### Path dependence in earthquake emergency management policy paradigm

Institutions in historical institutionalism are characterized by path dependence. Path dependence can be understood through 'increasing returns', where a system is adopted because it yields greater benefits, and once it is fixed, it becomes increasingly costly to change it, so that the previous system constrains the subsequent one<sup>[23]</sup>. The path-dependent period is the policy equilibrium period in punctuated equilibrium theory. Due to inertia, public policies are not easy to change, and the period of policy equilibrium is relatively long. The path dependence of China's earthquake emergency management policy is first reflected in the long policy equilibrium period. After 1949, the policy paradigm went through three change nodes, 1966, 1989, and 2016, with a policy equilibrium period of 17, 23, and 27 years. Second, influenced by path dependence, China's earthquake emergency management policy is characterized by gradual changes. Lindblom believes that government departments do not overhaul policies and that policy changes are achieved through incremental debugging over a considerable period of time<sup>[24]</sup>. The current policy paradigm of combining disaster prevention, mitigation and response in China has been developed through incremental changes. In the early stages of the country, China had no experience in responding to large earthquakes and had not yet begun to build an earthquake emergency management system, and the earthquake policy paradigm was based on pure disaster relief. When the Xingtai earthquake occurred in 1966, the Central Committee of the CPC and the Central Government set up a corresponding command for emergency disposal during the earthquake disposal process. After the disposal of the earthquake, China began to set up dedicated institutions for earthquake emergency management, such as the Earthquake Administration, and also began to build an earthquake prevention and forecasting system in an attempt to do a good job of earthquake prevention as well as forecasting. Since then, the paradigm of earthquake emergency management changed from focusing solely on disaster relief to focusing on earthquake prevention. In 1989, in response to the United Nations' call for disaster reduction, China established the China National Committee of the International Decade for Natural Disaster Reduction. Earthquake policy paradigm shifted from a focus on earthquake prevention to a focus on disaster prevention and mitigation. Affected by SARS, the One Case Three systems for earthquake emergency management began construction. In 2016, influenced by the comprehensive deepening of reform after the Third Session of the Eighteenth Central Committee of the CPC, China issued the Opinions on Promoting the Reform of the Institutional Mechanism for Disaster Prevention, Mitigation and Relief, thus promoting the reform of the institutional mechanism in the field of earthquake emergency management. The earthquake policy paradigm developed into a paradigm that combines disaster prevention, mitigation and relief. Under the new policy paradigm since 2016, China has comprehensively improved the earthquake disaster emergency response capacity and comprehensive disaster prevention capability by establishing the Ministry of

Emergency Management, standardizing earthquake monitoring, and establishing a catastrophe insurance system.

### Earthquake emergency management subjects are increasingly diversified

The plurality of subjects is first reflected in the increasing number of earthquake emergency management agencies within government departments. In the early years of the founding of China, under the relief-oriented policy paradigm, the Central Committee of the CPC and the Central Government were responsible for post-earthquake emergency management, and the Ministry of Interior and the Central Disaster Relief Committee were responsible for disaster relief. At that time, the responsibility for disaster relief was concentrated in the central government, and a full-time earthquake emergency management agency had not yet been established, with a single disaster relief force. The Tangshan earthquake exposed the drawbacks of relying too much on the central government for earthquake emergency management, and China began to focus on the role of local governments in earthquake emergency management. After 2003, the principle of local management was established and local governments became the main responsible body for earthquake emergency management. As the policy paradigm shifted, the government gradually set up permanent institutions such as the Earthquake Monitoring and Research Center and non-permanent institutions such as the China National Committee of the International Decade for Natural Disaster Reduction (now the National Disaster Reduction Committee), the Emergency Management Committee, the Emergency Management Office, the Leading Group for Earthquake Disaster Prevention and Reduction, and the Earthquake Disaster Relief Command to take charge of earthquake emergency management affairs. Coordination between the various earthquake emergency management departments was carried out through the deliberative and coordinating bodies and the inter-ministerial joint meeting system. After 2018, China established a new department, the Ministry of Emergency Management, and various localities set up emergency management departments and bureaus one after another. The diversity of earthquake emergency management subjects is also reflected in the fact that in addition to the increase of earthquake emergency management agencies, enterprises, non-profit organizations, and private citizens are also gradually participating in earthquake emergency management. For example, before 2008, the main subject of earthquake emergency management in China was mainly the government department. Non-profit organizations were involved in earthquake emergency management after the Wenchuan earthquake, and after the Ya'an earthquake in 2014, the participation of non-profit organizations became more standardized. Under the policy paradigm of combining disaster prevention, mitigation and relief for earthquake emergency management, China is now exploring the establishment of a catastrophe insurance system, which also requires the active participation of individual citizens as responsible subjects for earthquake emergency management.

### Economic systems have a large impact on earthquake emergency management policy tools

Economic systems can affect the richness and style of earthquake emergency management policy tools. For organizational policy instruments, the fiscal regime within the economic

system has an impact on the central-territorial relationship and thus on the seismic institutions and organizational settings. As in the early days of China's fiscal system of unified collection and support, local finances were handed over to the central government, and the main body of earthquake relief was the central government rather than local governments. After the implementation of the fiscal contracting system (1980–1993), as well as the tax-sharing fiscal system (1994–Present), local governments received financial revenues and gradually became the main body responsible for earthquake emergency management. For information-based policy tools, economic development has an impact on the level of seismic information technology. As the level of economic development increases, the country has more resources to advance earthquake science and technology development, thus improving earthquake emergency management capabilities. In addition, the level of economic development affects the degree of external communication and information disclosure of government departments. For example, after the reform and opening up in 1978, China gradually expanded the degree of foreign exchange and established the China National Committee of the International Decade for Natural Disaster Reduction under the initiative of the United Nations. For regulatory policy instruments, the economic system affects the degree of rule by law for earthquake emergency management policies. At the early stage of the country's founding, there were no laws and regulations specifically for earthquake emergency management in China. After the implementation of the commodity economy and the socialist market economy, social relations became more and more complex, requiring laws to regulate various types of behavior. Therefore, the strategy of following the rule by law was proposed, and regulations and policies such as the Regulations on Earthquake Administration and Law Enforcement and the Regulations on Procedures for Making Earthquake Administrative Regulations were promulgated to improve the tools of earthquake emergency management control. For economic policy instruments, the level of economic development is directly linked to the economic policy instruments for earthquake emergency management and affects the richness of the economic instruments for earthquake emergency management. For example, in the early stage, the economic policy tools for earthquake emergency management in China were mainly direct relief payments and subsidies, and in the later stage, economic policy tools such as earthquake insurance were gradually added.

### **A number of factors drive the paradigm shift in earthquake emergency management policies**

The change in policy targeting implies a shift in policy paradigm, and the motivation for the change in policy paradigm is the 'abnormal event' in the analytical framework. The summary of the previous section shows that abnormal events such as international environmental changes, national strategic adjustments, and unexpected events can drive changes in the earthquake policy paradigm.

A national strategy is a strategy for arranging national security and development within a certain period of time that is the responsibility at the national level and includes various political, economic, cultural, and social aspects<sup>[25]</sup>. National strategic reorientation involves a shift in the overall national development plan, implying a shift in the overall national

development goals and a redefinition of policy issues, often leading to policy changes as well as policy paradigm shifts<sup>[26]</sup>. At the early stage of the founding of the country, China pursued a catch-up development strategy, with all construction giving way to economic development, and national attention was not focused on the field of emergency management, so earthquake emergency management had not yet started, and the earthquake policy paradigm was based on disaster relief. After the Third Session of the Eleventh Central Committee of the CPC, the country shifted its attention from revolution to economic construction, implemented an economic growth-oriented development strategy, and actively promoted reform and opening up. In line with this, China's earthquake policy focused on research and cooperation in earthquake science and technology during this period, and the variety of policy tools was continuously enriched. After the 16<sup>th</sup> National Congress of CPC, China put forward the scientific outlook on development based on its conditions. The scientific outlook on development made the earthquake emergency management policy pay more attention to the balanced development of the earthquake cause. Therefore, the earthquake policy in this period focused on enhancing the emergency capacity building of local governments and grassroots, strengthening the publicity and education of earthquake disaster prevention and mitigation of knowledge in remote areas, and promoting the comprehensive, coordinated, and sustainable development of the earthquake disaster prevention and mitigation cause. Since the Third Session of the eighteenth Central Committee of the CPC in 2013, China has been actively promoting the modernization of the national governance system and capacity, and the policy network is increasingly open to the public. In the field of earthquake emergency management, China focuses on the participation of multiple subjects such as society, the market and the public, while strengthening the leadership of the CPC and exploring the establishment of a disaster prevention and mitigation mechanism led by the Party committee, led by the government, and widely participated in by social forces and market mechanisms.

In addition to domestic strategic adjustments and institutional changes, the development of emergency management policies in the international community will also have an impact on China's earthquake emergency management policies, and may even cause a paradigm shift in earthquake emergency management policies. Before the reform and opening up, China did not have close communication with foreign countries. Since the reform and opening up, in order to enhance its international image and influence, China has taken the initiative to integrate into the globalization process and actively strengthen international exchanges and cooperation in the field of earthquakes, while promptly announcing news to the international community and actively seeking international assistance when earthquakes occur. With China's deepening integration into globalization, China established the National Committee of the International Decade for Natural Disaster Reduction in 1989 under the influence of the UN, which led to a shift in China's earthquake policy paradigm from focusing on earthquake prevention to focusing on prevention and mitigation.

Under normalized management, the problems of earthquake emergency management policy are not easily revealed, while the original problems may be exposed and magnified when

## China's earthquake emergency management policies

emergencies occur, thus making emergencies such as earthquakes a booster for the continuous development and improvement of earthquake emergency management policies. For example, the Xingtai earthquake exposed the lack of a specialized agency for earthquake emergency management and the shortcomings of earthquake prediction capability in China, and promoted the establishment of earthquake departments, and the start of earthquake prevention and prediction work. The Tangshan earthquake exposed the shortcomings of over-reliance on the central government, untimely disclosure of information, ineffective use of earthquake prediction and forecasting facilities, refusal of international assistance, and less use of market and social forces. It promoted the participation of local governments, markets and social forces in earthquake emergency management, promoted the construction of seismic protection and earthquake monitoring and forecasting, prompted China to disclose relevant information and actively accept international assistance after the disaster, and prompted China to provide corresponding assistance to other affected countries and regions. The Wenchuan earthquake exposed the drawbacks of poor cooperation among all parties in government departments and chaotic participation of social forces in China's earthquake emergency management, and promoted the establishment of the Ministry of Emergency Management, the standardization of the order of emergency disposal by social forces, and the construction of infrastructure. In addition to earthquakes, other emergencies can affect the emergency management system and thus on earthquake policy development. For example, SARS exposed the shortcomings of China's emergency management system construction, prompted the construction of emergency management systems, mechanism and legal systems, and clarified the principles of hierarchical management and classification responsibility in earthquake emergency management.

## CONCLUSIONS

The policy paradigm of earthquake emergency management in China has experienced four policy paradigms focusing solely on disaster relief (1949–1966), to focusing on earthquake prevention after the Xingtai earthquake (1966–1989), to focusing on earthquake prevention and mitigation after the establishment of the National Disaster Reduction Committee (1989–2016), and to the current policy paradigm focusing on comprehensive disaster reduction combined with disaster prevention, mitigation and relief in the context of modernization of the governance system and governance capacity (2016–present). An analysis from a historical institutionalism perspective reveals that different policy paradigms reflect national and popular demands for earthquake emergency management in different times. There is path dependence in earthquake emergency management policies, while changes in economic systems, national strategic adjustments, international environmental changes, and emergencies can have an impact on policy paradigms and policy tools.

At present, China's earthquake emergency management policy paradigm still suffers from insufficient coordination, difficulties in monitoring and forecasting, inadequate construction of information interconnection, backward construction of rule of law in emergency management, and inadequate earthquake financial management and disaster loss compensation

mechanisms. To this end, government departments should seize the opportunities of the times of globalization, modernization of governance system and governance capacity, and construction of socialist market economy, and comply with the development requirements of comprehensive deepening reform to make improvements in the following aspects so as to realize further development of public policy on earthquake emergency management.

We should promote the organizational change of emergency management and promote the synergistic linkage of multiple subjects. First of all, we should promote organizational changes at the local level, refer to the central organizational structure, promote the local earthquake emergency management departments, and rationalize the bureaucratic relationship. A physical earthquake relief command office should also be set up to promote a combination of earthquake emergency management response and prevention. Secondly, government, business, society and other sectors should transform various elements from a disorderly state to a mutually synergistic self-organized state with certain rules and order, so as to respond collaboratively in the face of a crisis in order to deal with it effectively<sup>[27]</sup>. The collaboration in earthquake emergency management includes firstly the synergistic linkage during the response and preparation period, and should also focus on the linkage within the government at all levels, strengthen the synergistic linkage between government departments and society and market, strengthen the synergistic linkage between emergency rescue teams, actively promote military-local linkage and regional linkage<sup>[28]</sup>, and strengthen the exchange and cooperation with the international community.

Digital governance for emergency management should be strengthened and innovation in earthquake science and technology should be promoted. The digital construction of emergency management can be carried out in four areas: earthquake monitoring and early warning and rapid assessment, earthquake training and exercises, emergency management platform construction, and changes in the organizational system of emergency management. In terms of earthquake monitoring and early warning and assessment, we can use drones, remote sensing satellites, and other equipment to build an 'air-space integration' monitoring and surveillance network. When an earthquake occurs, a rapid early warning forecast and an automatic report on the basic situation of the disaster area and an auxiliary decision report can be generated to assist the relevant departments in disaster analysis<sup>[28]</sup>. In terms of earthquake training exercises, virtual reality technology can be used for earthquake emergency rescue simulation training to build a platform for earthquake emergency rescue exercises<sup>[29]</sup>. Or through information technology such as big data to broaden the channels of earthquake and disaster prevention knowledge dissemination and strengthen disaster prevention and mitigation knowledge education. In terms of emergency platform construction, an emergency command platform and public service platform containing multiple subjects can be built, involving emergency science and technology, disaster collection and reporting, auxiliary decision-making, emergency risk avoidance and rescue, and statistical data management to realize the exchange of disaster information<sup>[30]</sup>. Finally, the emergency platform should also be used to absorb multiple action subjects, such as society, enterprises, and individual citizens, to expand the organizational boundaries of

emergency management, to promote the flatness and flexibility of the earthquake emergency management system, and to promote the organizational reshaping of the earthquake sector<sup>[31]</sup>.

Emergency management laws and regulations should be improved to promote the rule by law in earthquakes. First of all, the content of the earthquake emergency management policy should be further refined, such as clarifying the minimum distance and penalties for earthquake monitoring and environmental protection, and unifying the penalty standards for all levels of governments. Secondly, the earthquake policy should be updated in a timely manner according to the development requirements of the time. For example, the national level should update the earthquake emergency management plan in a timely manner to ensure that the earthquake emergency management policy is compatible with the paradigm of combining disaster prevention, mitigation and relief. In addition, in the context of comprehensive deepening reform for the legal system, a good job should be done to connect the old and new systems. For example, after the abolition of the seismic safety evaluation system, it should be combined with the regional assessment system to establish a new type of regulatory system and appraisal system. In addition to legislation, it is necessary to comprehensively strengthen law enforcement, judicial and law-abiding work, and promote the process of rule by law in earthquake emergency management.

The construction of disaster compensation mechanisms should be improved and the financial management of the earthquake sector should be strengthened. In terms of disaster compensation mechanisms, the earthquake department should clarify its principles, subjects and procedures, and expand the scope of compensation from focusing on livelihood assistance to employment and production recovery. The supervision and management of donation work by various organizations should be strengthened, and the legal system of volunteering and public welfare donation should be promoted<sup>[32,33]</sup>. In addition, we should explore the establishment of a government-led catastrophe insurance mechanism with joint participation of the government and commercial insurance companies, and adopt a mandatory or semi-compulsory approach to promote people's participation in insurance<sup>[34]</sup>. In terms of earthquake financial management, relevant departments should promote the establishment of a scientific and reasonable financial management system with clear responsibilities. During the budget preparation, budget items should be refined, budget quota standards should be determined, and the budget should be reasonably divided to ensure the consistency of financial affairs and expenditure responsibilities<sup>[35]</sup>. In accounting, we should adapt to the new accounting system as soon as possible, clarify accounting, improve reimbursement procedures, and establish a sound financial reimbursement audit system. At the time of procurement, the procurement process and implementation details should be clarified, and government procurement information should be made public in a timely manner to widely accept public supervision. In addition, the supervision of financial management of government departments should be strengthened, regular inventories should be taken, procedures and methods for recording, reporting and disposing of assets should be improved, and supervision and management of assets should be strengthened<sup>[36]</sup>.

## ACKNOWLEDGMENTS

The writing of this manuscript was supported by the School of Political Science and Public Administration of Shandong University (Qingdao, China).

## Conflict of interest

The author declares that there is no conflict of interest.

## Dates

Received 5 September 2022; Accepted 20 December 2022;  
Published online 30 December 2022

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