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# Selection of Policies on Typhoon and Rainstorm Disasters in China: A Content Analysis Perspective

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**Abstract:** China is a country often subjected to severe meteorological disasters. Analyzing the evolution of policies concerning the prevention and reduction of disasters is of great practical significance for the management of such natural events. We focus on typhoons and rainstorms as disaster sources and examine policy documents from two dimensions: basic policy instruments and disaster chains. Results indicate that (1) two levels of government (central and local) focus on five policy instruments; namely, they are fund and material input, infrastructure construction and management, information sharing and support, goal programming, and regulations. Other policies, however, such as engineering construction of disaster prevention, or material reserves and international cooperation, are relatively few. (2) At present, both the Central and Local governments prefer both supply-oriented policies and environment-oriented policies to focusing on demand-oriented policies. (3) As for the disaster chains, the typhoon and rainstorm disaster policies are focused on disaster defense, disaster warning, and disaster relief, neglecting disaster evaluation and post-disaster reconstruction. Finally, we put forward suggestions for perfecting the policies of disaster evaluation and post-disaster reconstruction, and point out the importance of demand-oriented policies.

**Keywords:** policy instruments; meteorological disasters; disaster chain; content analysis

## 1. Introduction

In China, the occurrence rate of meteorological disasters is relatively high compared to those in many other regions of the world. Chinese disasters are marked not only by their wide variety but also by their extensive regional distribution and by their severity of losses. Typical natural disasters in China include typhoons and rainstorms. From 2001 to 2013, typhoons, on average, caused direct economic losses of 46.14 billion Yuan (RMB) per year, with direct economic losses peaking in 2013 at 126.03 billion Yuan (RMB). By August 2017, typhoons “Nesat” and “Haitang”, the 9th and 20th typhoons, respectively, had affected 817,000 people, to one extent or another, in 35 cities in 8 provinces including Beijing, Hebei, Fujian, and Jiangxi. Rainstorms, also considered a form of major natural disaster, often bring about flash floods, inundate farmland, and interrupt traffic and communication causing economic losses in the hundreds of millions of Yuan (RMB). In order to better manage typhoons and rainstorms, the State Council has jointly promulgated a series of policy documents with the Ministry of Civil Affairs, the Ministry of Finance, and other local governments.

As for the Central government, the State Council promulgated the National “11th-Five-Year” Plan of Integrated Disaster Mitigation in 2005, designing national plans for disaster monitoring and warning, disaster prevention and preparedness, emergency handling, disaster rescue, and post-disaster restoration along with reconstruction and division of duties among relevant departments, all with

an emphasis on mutual cooperation among departments. Since 2008, in the aftermath of the Wenchuan Earthquake and following a series of severe snowstorm disasters, the Ministry of Civil Affairs, the Ministry of Finance, the Bureau of Meteorology, and the Ministry of Housing and Urban–Rural Development successively enacted disaster prevention and mitigation policies.

As for the local governments, provinces, such as Guangdong, Zhejiang, and Liaoning, etc., had already taken the lead in promulgating local policies for disaster management before the State Council promulgated the 2011 National “12th-Five-Year” Plan of Integrated Disaster Reduction. Jiangsu and Fujian also developed policies on disaster prevention and mitigation in 2012. There were policies set forth in 17 provinces but the number of policies promulgated in just the four provinces of Guangdong, Fujian, Zhejiang, and Jiangsu was far greater than that in the other provinces, mainly because these four provinces, located on the southeastern coast, are more vulnerable to typhoons and rainstorms. The number of policies enacted by provinces more vulnerable to rainstorm and typhoon disasters is obviously greater than those of other provinces.

Although these policies have achieved much, gaps still remain. Due to the lack of quantitative statistics concerning policy instruments, we rarely know the reasons why some provinces are better able to prevent disasters than others. It is also often impossible to determine what kinds of policies are missing in those areas with frequent disasters and serious losses and this makes it more difficult to put forward targeted disaster relief policies. Moreover, there are a number of provinces in China, such as Jiangsu, Fujian, and Guangdong, that are easily affected by typhoons and rainstorms. Why have some provinces suffered small losses but others severe? What are the policy instrument differences among the provinces? To address these gaps, a thorough policy document analysis related to disaster prevention and mitigation is of great practical value. China has stressed the importance of sustainable development since the “Outlook on Scientific Development” was first proposed by former General Party Secretary Hu Jintao in 2004, and we have therefore collected policy documents at two levels of government, Central and Local, from 2004 to 2016.

## 2. Literature Review

Being a connection between policy goals and effects, policy instruments are employed as one approach used by governments to achieve good governance. While implementing policies, the types and the criteria used to evaluate the effectiveness of policy instruments may have a detrimental impact on a government’s ability to achieve its established policy objectives.

At present, a few studies concern the policy instruments related to typhoons and rainstorms. A considerable quantity of research analyzes natural disaster policy management from the point of view of disaster causes, disaster risk assessment, disaster insurance, disaster-reducing organization, and institutional design. Although many focus on other types of natural disasters instead of meteorological ones, their conclusions can still be used as a reference.

An understanding of the causes of disasters forms a basis for the reduction of the negative impacts of natural disasters. According to Gao [1], the acceleration of urbanization, economic development, and the continuous increase of population and plant facilities have caused a shift of high loss in natural disaster regions from northwestern to southeastern China. As infrastructure construction and urban planning are the foundations for urbanization, they highlight the policy instrument importance of infrastructure construction and management and goal programming. In the case of the Three-Gorge Reservoir Region, Xu et al. [2] pointed out that a build-up of savings and migrant income can considerably reduce any external risks to the vulnerability of poor farmers caused by disasters. Insurance is an important measure for disaster mitigation. By studying the Chinese Fujian Forest Disaster Insurance (FFDI) project, Dai et al. [3] found that the FFDI program had significantly increased family income (by 10%). Ye et al. [4] conducted a comparative analysis between Snow Index Insurance (SII) and Commercial Mortality Insurance (CMI) and revealed that the design of the former was relatively superior with regard to the benefit to potential users. The focus on insurance

verifies that fund input is a positive reinforcement for disaster prevention, and should be considered as a policy instrument.

Disaster risk evaluation or division also provides loss reduction with reference to decision-making. Zhang [5] evaluated the drought disaster risk of the Songliao Plain by establishing a risk model and divided the regional risk into four subregions: a high-risk region, middle-risk region, low-risk region, and slight-risk region. Considering the high frequency and magnitude of flash floods, China, in 2009, set up a comprehensive nonstructural measurement system in 103 pilot counties. This system looked at risk analysis and disaster evaluation which could offer guidance for warning systems, forecasts, regional planning, land utilization, and emergency response [6]. It should be noted that disaster risk evaluation not only includes the policy instruments of model and index establishment, but also data sharing, and education and training for the evaluation technique. However, the current studies pay close attention to the model and index establishment at the neglect of later policy instruments.

Urban or village planning, as an important measure of disaster reduction at the strategic level, has been the focus of attention for some scholars. By using the geological space database of the Yangtze River Delta in China, Kim and Rowe [7] pointed out that, although urbanization can reduce property losses due to earthquakes, flood, landslides, ground subsidence, and sea-level rise, it will tremendously restrict the urban development of those regions that face environmental dangers. Du et al. [8] evaluated the disaster-relief capacity of the Guizhou, Dalishi community in terms of three criteria: Individual Disaster Coping Capacity (IDCC), Actual Community Disaster Coping Capacity (ACDCC), and Potential Community Disaster Coping Capacity (PCDCC). As indicated by the conclusion, it is usually inconsistent to undertake fireproofing measures without a comprehensive fire risk reduction plan.

Organization or design mechanisms, on the other hand, provide disaster reduction with institutional guarantees. For example, Menefee [9] investigated the educational earthquake relief programs of international nongovernmental organizations, and the institutional work environment of such organizations. By analyzing the impact of extreme meteorological disasters on grain production in Jilin Province, China, Xu et al. [10] pointed out that, in order to ensure the safety of Chinese grain, the formulation of a long-acting agricultural disaster prevention mechanism and the innovation of agricultural risk management tools should also be incorporated into agricultural policies.

A few scholars have considered other policies relating to disaster reduction. For example, Innocenti and Albrito [11] argued that mitigating disaster risks involves a participative dialogue between scientific circles and decision-makers. As emphasized by Wu [12], responding to the multidimensional challenges of disasters involves the conversion of a hierarchical science and technology network into public earthquake disaster prevention action, a disaster reduction plan, and a management plan of action. Biran et al. [13] drew on the theory of black tourism and explored the motives and intentions of potential domestic tourists (from non-disaster-stricken regions) in visiting post-earthquake Sichuan province, thus providing the idea of industrial development to alleviate disasters. Lei et al. [14] suggested that adaptive governance was a feasible and cost-effective strategy in typhoon disaster governance in coastal regions.

The reduction of natural disasters is a systematic project which needs comprehensive policies. This is highlighted by some of the studies. Qin and Jiao [15] proposed countermeasures to be adopted in four phases (prevention, preparation, response, and restoration) of infectious disease disaster with the purpose of constructing a perfect urban risk management system. Liu et al. [16] introduced a system of disaster reduction into the disaster management plan of regions around the Three-Gorge Dam that were vulnerable to landslides. Based on communities, this system is supported by experts, police, The Red Cross Society, and other institutions and involves risk investigation, education and training, landslide monitoring, information analysis, warning systems, and emergency response. Fang et al. [17] examined the impact of time and space changes of coastal and marine disasters on the Chinese mainland. Their conclusions were that, due to social and economic development, climatic change, subsidence, and newly-emerging marine disasters, Chinese coastal regions still face ever

higher risks. Comprehensive solutions spanning social and economic development, reduction of disaster risks, and environmental protection should be implemented in coastal regions. Obviously, these studies argue that disaster prevention and mitigation require comprehensive policies. The main viewpoint differences are as follows: Fang et al. failed to consider the connection between policy and disaster chains. Liu et al. investigated policy tools, but neglected the Y dimension analysis of disaster chains. In contrast, Qin and Jiao were unable to categorize the policy tools while dividing the disaster chain into four stages.

To summarize, a number of scholars have already looked at the policies regarding natural disasters, but some gaps still remain: (1) Research into the specific policies concerning typhoon and rainstorm disasters is scant; (2) Few comparative analyses have been conducted looking at the disaster reduction policies of both the central and local governments. For these reasons, we will analyze statistics on policy information, and explain the meteorological disaster mitigation policies in a quasi-quantified and comparative manner.

### 3. Method

The content analysis was initiated by National Office of Overall Assessment of USA in 1983. The working procedure of this method is as follows: deciding whether this method should be adopted, determining which documents shall be included into content analysis, constructing policy dimensions, listing the coding catalog, and analyzing the results. The advantage of content analysis lies in extracting new opinions from the historical data to support document analysis. Compared with a qualitative approach, this method is more applicable to policy document analysis because of its foreseeability and ability to guide policy practice.

The basis for using content analysis is the selection of policy documents and the construction of policy dimensions. Policy dimensions are divided into two dimensions: X and Y. The X dimension refers to basic policy instrument, and the Y dimension is the disaster chain.

#### 3.1. X Dimension: The Basic Policy Instruments

The basic policy instruments of the X dimension are primary elements. Currently, academic circles have not yet reached consensus on the classification of basic policy instruments. According to Zhang's research, policy tools contain loans and services directly provided by the governmental departments, contract outsourcing, subsidies, coupons, concession operations, voluntary service, and market operation, etc. [18]. Chen classified policy tools into three categories: market tools, business technologies, and social measures [19]. We drew on the idea of Rothwell and Zegveld [20], and analyzed the policies of typhoon and rainstorm disasters from the perspective of two dimensions by classifying basic policy instruments into three types: supply-oriented, environment-oriented, and demand-oriented policies. Supply-oriented policies refer to fund and material input, infrastructure construction and management, and material reserves for disaster reduction and relief, etc. The reason for the classification of supply-oriented policies is that the funds expenditure for emergency relief and resettlement, facility construction and maintenance for roads, electricity, and disaster prevention engineering, and the relief materials reserved for quilts, rubber shoes, and medical first aid kits, are all disaster relief factors. Demand-oriented policies mean those that reduce the uncertainties of disaster prevention through governance procurement, transdepartmental cooperation, and international cooperation. The government procurement of disaster relief materials will improve the motivation of enterprises and mitigate market risks to a certain extent. As disaster relief requires not only accurate weather information, but also disease prevention and material provisions, there is a need for the government to develop policies for cooperation among the bureau of meteorology, bureau of hydrology, and the bureau of provincial water resources, the centers for disease control and prevention, and other departments. Domestic cooperation may not be sufficient to mitigate disaster, and, in some cases, international cooperation will be necessary because of the availability of abundant funds, materials, and advanced technology from foreign institutions. A case of international cooperation

occurred following the Wenchuan earthquake in 2008, when China rented large aircraft from abroad. Goal programming, regulation, and market participation mechanisms are environment-oriented policies. The government provides these policy instruments in favor of warning and prevention, disaster evaluation, and disaster relief. Plans for urban land use, disaster prevention space and facilities layout, and technology and talent support planning—all of these are goal programming. The safety standards for the buildings, facilities, and equipment; regulations on the administrative duty of disaster mitigation; and the emergency administrative regimes in the face of disasters all fall into the categories of regulation. The market participation mechanism mainly refers to tax preference, incentives, etc.

### 3.2. Y Dimension: Disaster Chain

The Y dimension implies that the central and local policies on typhoon and rainstorm disasters is analyzed from the vertical axis. The governance chain of typhoon and rainstorm disasters chiefly includes five links: disaster prevention, disaster warning, disaster evaluation, disaster relief, and post-disaster reconstruction. Therein, disaster prevention refers to the prevention policies of outdoor operations, typhoons, rainstorms, and other secondary disasters and business suspension. Disaster warning includes the policies of warning system establishment, the issuing and propagation of warning signals, etc. Disaster evaluation includes the risk evaluation, emergency evaluation, loss evaluation, social impact evaluation, and performance evaluation, etc.

To ensure the reliability and representativeness of policy selection, we filtered the policy documents according to the following principles: Firstly, issuing agencies are under the direct leadership of the State Council, such as Ministry of Civil Affairs, Bureau of Meteorology, and Ministry of Finance. Although there are five levels of government in China—central, provincial, prefectural, county, and township—this study particularly emphasizes the comparison of typhoon and rainstorm policies between the central and provincial governments, or among the provinces; therefore, no consideration is given to the policies at prefectural, county, and township levels. Secondly, policies cover plans, proposals, measures, and other documents but exclude industrial standards. Thirdly, although some policies are about the prevention of ordinary natural disasters and are not explicitly targeted at typhoons and rainstorms, they are still of some instructive significance. In practice, the organization of the collection of policy documents was accomplished through web crawler technology. Following this, we arranged the policy texts in chronological order. If article 16 of the 12th policy text is for disaster prevention and reduction, we marked 12–16 in the column of disaster prevention and reduction, and so on. In the end, 90 effective documents were collected. As for local governments, 17 policy documents of typical provinces were collected, covering three regions: Eastern China, Central China, and Western China.

## 4. The Selection of Policy Instruments of Meteorological Disasters

### 4.1. Central Policies on Typhoon and Rainstorm Disasters

The X dimension includes three basic policy instruments: supply-oriented, environment-oriented, and demand-oriented policies (see Table 1). Obviously, the number of supply-oriented policy instruments ranks the first (51), accounting for 56.67%. Next comes the number of environment-oriented policy instruments (21), accounting for 23.33%. The number of demand-oriented policy instruments is the least (18), accounting for 20%. The percentage of supply-oriented policy instruments is far higher than that of other two types. This indicates that the central government pays more attention to governance of typhoon and rainstorm disasters by directly boosting the supply of production factors.

Among supply-oriented policy instruments, information sharing and support, infrastructure construction and management, and input of fund and material in disaster prevention and reduction account for 11.11%, 11.11%, and 10%, respectively, and the number of each is larger than that of any other supply-oriented policy instrument. As for the environment-oriented policy instruments,

both goal programming and regulation account for 10%, higher than the percentage attributed to the market participation mechanism. The reason why these two policy documents were used so frequently may be that the implementation fails to meet expectations. Although both the “11th-Five-Year” Plan of Integrated Disaster Reduction and the “12th-Five-Year” Plan of Integrated Disaster Reduction promulgated by the State Council in 2005 and 2011, respectively, emphasized attracting social forces through a market participation mechanism to actively participate in disaster prevention and relief, market participation mechanisms are extremely scant. Documents related to transdepartmental cooperation account for 18.89%, a much greater proportion than for those related to other policy instruments. The reason for this is possibly that cooperation among different departments is the most effective management factor for typhoon and rainstorm disasters.

The Y dimension focuses on analyzing policies from the disaster chain, which chiefly includes five links: disaster defense, disaster warning, disaster evaluation, disaster relief, and post-disaster reconstruction. The frequencies of the policy instruments of these five links are shown in Table 2. As a whole, the number of policy instruments of disaster defense ranks in first place (28). This is followed by the policy instruments of disaster relief (21). The number of policy instruments of disaster evaluation ranks last (4). There are 10 policy instruments covering the entire governance chain.

Based on the synthetic analysis of policy instruments, central policies for disaster defense emphasize engineering construction for disaster prevention and reduction, infrastructure construction and management, goal planning, and transdepartmental cooperation. In the chain of disaster warnings, information sharing and support and transdepartmental cooperation are the concerns of the central government. The chain of disaster evaluation involves only four policy instruments: infrastructure construction and management, information sharing and support, education and training, and regulation. Disaster relief mainly includes transdepartmental cooperation, investment in disaster prevention and reduction, and material reserves. The link of post-disaster reconstruction involves investment in disaster prevention and reduction, infrastructure construction and management, goal planning, and transdepartmental cooperation. Obviously, transdepartmental cooperation is always a policy instrument that arouses the close attention of the central government, running through the entire governance process relating to typhoon and rainstorm disasters.

Table 2 shows that the central government pays tremendous attention to disaster defense, disaster warning, and disaster relief while neglecting disaster evaluation and post-disaster reconstruction. Actually, the latter two links will play a very important role in reinforcing the capacity build-up of disaster monitoring and warning, disaster prevention and preparedness, emergency handling, disaster rescue, and restoration and reconstruction, and promoting the sustainable development of society.

**Table 1.** The distribution percentages of basic policy instruments (national level).

Instrument Types	Instruments	Document Codes	Number of Documents	The Percentage of Total Number of Documents (%)
Supply-oriented policy	Fund and material input	12-16, 17, 20-2-5, 20-2-3, 30, 33, 34, 35, 36	9	10%
	Infrastructure construction and management	42-2, 43-4-11, 44-8, 44-9, 46, 47, 48, 49, 52, 55	10	11.11%
	Engineering construction for disaster prevention	24, 43-4-14, 43-4-15, 45	4	4.44%
	Construction of disaster prevention emergency system	11,16, 19, 32, 43-5, 50, 51	6	6.67%
	Information sharing and support	9, 11-4, 12-11, 18, 20-2-2, 22, 38, 39, 40, 41	10	11.11%
	Material reserve	8-10, 12-12, 23, 29	4	4.44%
	Public service	42-32, 53-1, 53-3, 28	4	4.44%
Environment-oriented policy	Education and training	18, 21-2, 42-4, 43-6-22	4	4.44%
	Goal programming	1-2, 1-3, 10-2,10-3, 37, 54-3-3, 54-3-4, 54-3-5, 53-3-6	9	10%
	Market participation mechanism	25, 27, 31	3	3.33%
Demand-oriented policy	Regulation	2, 3, 7, 8, 13, 14, 15, 26, 32-1	9	10%
	Transdepartment cooperation	4, 5-2, 5-3, 6-2, 6-3, 6-4, 6-5, 6-6, 11-3, 11-5, 11-6-1, 11-6-2, 11-6-3, 12-5, 12-7, 12-6, 42-5	17	18.89%
	Government procurement	N/A	N/A	N/A
	International cooperation	12-14	1	1.11%
Total	N/A	N/A	90	100%

**Table 2.** The frequency distribution of policy instruments based on disaster governance chain (national level).

	Disaster Defense	Disaster Warning	Disaster Evaluation	Disaster Relief	Post-Disaster Reconstruction	Whole Process
Fund and material input	12-16, 35, 36			17, 20-2-5, 30, 33	20-2-3, 34	
Infrastructure construction and management	43-4-11, 44-8, 52, 55	42-2	49	44-9	46, 47,48	
Engineering construction for disaster prevention	24, 43-4-14, 43-4-15, 45					11, 50
Construction of disaster prevention emergency system	16, 43-5	51		19		22
Information sharing and support		9, 11-4, 18, 20-2-2, 38, 39, 40, 41	12-11			
Material reserve	8-10			12-12, 23, 29		
Public service	53-1	42-3		53-3		28
Education and training	43-6-22	18, 42-4	21-2			
Goal programming	1-2, 10-2, 37, 54-3-3, 54-3-4, 54-3-5				53-3-6	1-3, 10-3
Market participation mechanism				25, 27, 31		
Regulation	15,	32-1	26	2, 14		3, 7, 8, 13
Transdepartment cooperation	6-4, 6-5, 6-6, 4, 5-3	5-2, 6-2, 11-3, 11-5, 42-5		6-3, 11-6-1, 11-6-2, 12-5, 12-7	11-6-3, 12-6	
Government procurement						
International cooperation				12-14		
Total	28	19	4	21	8	10

#### 4.2. Local Policies on Typhoon and Rainstorm Disasters

The policy documents were chiefly released by departments relating to civil affairs, finance, meteorology, and housing and urban–rural development in various provinces. All of them are publically available.

The statistics of basic policy instruments in 17 provinces are shown in Table 3. These provinces have a relatively high degree of application to the following five policy instruments: the construction of disaster prevention emergency systems, information sharing and support, material and fund input, goal programming, and regulation. Goal programming and regulation in environment-oriented policies together account for 82.35%. This indicates that most provinces guide local disaster prevention and control by formulating corresponding goal programs against typhoon and rainstorm disasters on the one hand, and reinforce the implementation force of formulated policies with the help of legal regulation on the other, thus ensuring the effective implementation of disaster management policies. As for the supply-oriented policies, the construction of disaster prevention and reduction emergency systems, information sharing and support, infrastructure construction, and material and fund input in disaster prevention account for 70.59%, 76.47%, 61.11%, and 58.82%, respectively, all exceeding 50%. This implies that local governments pay close attention to releasing policy documents that directly boost the supply of production factors. The policy instrument of information sharing and support accounts for as much as 76.47%, which indicates the importance of information for typhoon and rainstorm prevention and control in most provinces. A perfect rapid release and communication mechanism for meteorological disaster warning information can effectively promote the risk-avoiding capacity of the whole society and alleviate the loss from meteorological disasters. Infrastructure construction and management account for as much as 61.11% in various provinces. This means that reinforcing the construction of meteorological infrastructure will promote the capacity of public service by establishing a perfect release network of meteorological information. The build-up of disaster prevention and reduction emergency systems is also a policy instrument that arouses the close attention of most provinces. Some provinces have established local mechanisms of emergency response and systems of emergency warnings in connection with the local situation, which can alleviate the loss caused by typhoon and rainstorm disasters to a certain extent.

As indicated by Table 3, the document number of transdepartmental cooperation, engineering construction, material reserves, and education and training account for relatively lower percentages in the provinces, with 41.18%, 29.41%, 23.53%, and 23.53%, respectively. The small number of policy documents on transdepartmental cooperation illustrates the neglect of the cooperation among various departments. The number of policy texts relating to engineering construction, material reserves, and education and training is also small, which indicates that a lot of provinces are inefficient in supply-oriented policies. Education and training policies include the personnel training of scientific and technological talents and the laws concerning the publicity of meteorological disaster mitigation. On the one hand, these supply-oriented policies will improve the scientific and technological support capacity of meteorological disaster prevention. On the other hand, they can help to promote the consciousness of the whole society in participating in the activities of disaster defense. Relatively, there are much fewer documents concerning participation mechanisms and international cooperation. The establishment of a market participation mechanism will enhance cooperation among governments, social forces, and market mechanisms, and form a joint force. Strengthening international cooperation can help to draw on international advanced disaster relief technology and promote a coordinated response capacity for severe disasters.

The prevention policies for typhoon and rainstorm disasters are mainly concentrated in the following three links: disaster defense, disaster warning, and disaster relief. However, the policies relating to disaster evaluation and post-disaster reconstruction are relatively scant. Some policy texts, which are mainly concentrated on the emergency system for disasters, run through the entire treatment of typhoon and rainstorm disasters. Policies of disaster defense are mainly concentrated in regulation, infrastructure construction, and transdepartmental cooperation. Disaster warning policies



mainly involve information sharing and support, infrastructure construction, and transdepartmental cooperation. Disaster relief policies are mainly represented by material and fund input into disaster prevention. The chain of disaster evaluation is represented by policies of information sharing and support and regulation. Post-disaster reconstruction involves fund and material input into disaster prevention, goal programming, regulation, and transdepartmental cooperation, but is mainly concentrated in funding and material input.

**Table 3.** Distribution of policy instruments (local level).

Instruments	Province	Number of Documents	Percentage (%)
Fund and material input	Jiangsu, Zhejiang, Fujian, Guangdong, Hainan, Anhui, Hubei, Shanxi, Sichuan, Guangxi	10	58.82%
Infrastructure construction and management	Jiangsu, Zhejiang, Fujian, Guangdong, Henan, Anhui, Jiangxi, Hunan, Hubei, Shanxi	11	61.11%
Engineering construction for disaster prevention	Zhejiang, Guangdong, Hainan, Anhui, Jiangxi	5	29.41%
Construction of disaster prevention emergency system	Jiangsu, Shandong, Zhejiang, Fujian, Guangdong, Hainan, Liaoning, Anhui, Jiangxi, Hubei, Shanxi, Sichuan	12	70.59%
Information sharing and support	Jiangsu, Shandong, Zhejiang, Fujian, Guangdong, Henan, Liaoning, Anhui, Jiangxi, Hunan, Hubei, Sichuan, Qinghai	13	76.47%
Material reserve	Guangdong, Liaoning, Shanxi, Guangxi	4	23.53%
Public service	Jiangsu, Liaoning, Jiangxi	3	17.65%
Education and	Jiangsu, Fujian, Liaoning, Sichuan	4	23.53%
Goal programming	Jiangsu, Shandong, Zhejiang, Fujian, Guangdong, Hainan, Liaoning, Henan, Anhui, Hunan, Hubei, Gansu, Shanxi, Sichuan	14	82.35%
Market participation mechanism	Guangdong, Shanxi	2	11.76%
Regulation	Jiangsu, Shandong, Zhejiang, Fujian, Hainan, Liaoning, Henan, Anhui, Jiangxi, Hubei, Gansu, Shanxi, Guangxi, Qinghai	14	82.35%
Transdepartment cooperation	Jiangsu, Zhejiang, Fujian, Guangdong, Henan, Jiangxi, Hunan	7	41.18%
Government procurement	Henan, Shanxi, Guangxi	3	17.65%
International cooperation	Fujian	1	5.89%

Taken together, these provinces attach importance to the three phases of disaster defense, disaster warning, and disaster relief for coping with typhoon and rainstorm disasters. On the one hand, they respond to typhoons and rainstorms through policy instruments, such as information sharing and support, infrastructure construction, and fund and material input, directly boosting the supply of production factors. On the other hand, they provide a desirable policy environment for the government with goal programming, regulation, and transdepartmental cooperation. In Table 4, these provinces highly value information sharing and support in disaster warnings, illustrating the important foundation of this policy instrument for disaster prevention.

One of the policy defects of local governments is the document insufficiency in terms of disaster evaluation and post-disaster reconstruction. Disaster evaluation includes risk evaluation, emergency evaluation, loss evaluation, social impact evaluation, and performance evaluation, etc. For this link, only three provinces (Jiangsu, Shandong and Gansu) have promulgated policy documents. Evidently, a lot of provinces must perfect the techniques of disaster loss and social impact evaluation with the purposes of risk prevention in severe natural disasters, emergency rescue, restoration, and reconstruction. The policy documents related to post-disaster reconstruction are relatively scant. As the last link of the governance chain of typhoon and rainstorm disasters, post-disaster reconstruction involves the restoration and reconstruction of urban and rural housing, infrastructure, organization systems, and social relations. This requires local governments to promote their capacity of demand

evaluation, planning and site selection, project implementation, and technical support according to local situations.

**Table 4.** Comparison of policy instruments of typical provinces.

Instrument	Province
Fund and material input	Jiangsu, Zhejiang, Fujian, Guangdong, Anhui, Shanxi, Sichuan
Infrastructure construction and management	Jiangsu, Zhejiang, Fujian, Guangdong, Liaoning, Henan, Anhui, Jiangxi, Shanxi
Engineering construction for disaster prevention	Zhejiang, Guangdong, Anhui, Jiangxi
Construction of disaster prevention emergency system	Jiangsu, Zhejiang, Fujian, Guangdong, Liaoning, Anhui, Jiangxi, Shanxi, Sichuan
Information sharing and support	Jiangsu, Zhejiang, Fujian, Guangdong, Liaoning, Anhui, Henan, Jiangxi, Sichuan
Material reserve	Guangdong, Liaoning, Shanxi
Public service	Jiangsu, Liaoning, Jiangxi
Education and training	Jiangsu, Fujian, Liaoning, Sichuan
Goal programming	Jiangsu, Zhejiang, Fujian, Guangdong, Liaoning, Henan, Anhui, Shanxi, Sichuan
Market participation mechanism	Guangdong, Shanxi
Regulation	Jiangsu, Zhejiang, Fujian, Liaoning, Henan, Anhui, Jiangxi, Shanxi, Guangxi
Transdepartment cooperation	Jiangsu, Zhejiang, Fujian, Guangdong, Henan, Jiangxi
Government procurement	Henan, Shanxi
International cooperation	Fujian

#### 4.3. Policy Comparative Analysis between Central Government and Local Governments

A comparative study was conducted for the prevention policies relating to typhoons and rainstorms at two levels (central and local).

In terms of the X dimension, the governments at the two levels are highly consistent in applying basic policy instruments. The material and fund input, infrastructure construction and management, and information sharing and support account for more than half of the total number of documents, while environment-oriented policy instruments, such as goal programming and regulation, also account for a high percentage. Obviously, the governments at the two levels prefer the prevention of typhoon and rainstorm disasters by releasing policy documents that directly boost the supply of production factors. Moreover, while formulating goal plans against typhoon and rainstorm disasters, the governments at the two levels will reinforce the implementation force using legal regulations. The only difference between the central government and local government is as the following: the former attaches importance to transdepartmental cooperation in addition to the five types, in contrast with the build-up of an emergency system for the latter. These provinces have established their local emergency response mechanisms for meteorological disasters based on actual conditions.

In terms of the Y dimension, as revealed by Tables 2 and 4, the policies at the two levels are mainly concentrated in disaster defense, disaster warning, and disaster relief, while little attention is paid to disaster evaluation and post-disaster reconstruction. In the link of disaster defense, the central government and local governments will all apply the environment-oriented policy instruments. However, the central government prefers goal programming, and the local governments prefer regulation. As for the link of disaster warning, the central government and local governments all attach great importance to information sharing and support and transdepartmental cooperation. In contrast with the central government, local governments also emphasize promoting the warning

capacity for typhoon and rainstorm disasters through infrastructure construction. As for the link of disaster relief, central government attaches more importance to cooperation among departments, while local governments emphasize fund and material input. The reason for this might be that central government plays the role of leadership in coordinating the disaster relief efforts of various departments, while the local governments, as the subject of disaster relief implementation, need to invest capital and material.

Some policy instruments, such as the build-up of the emergency system, goal programming, and statutory regulation, involve the whole process of typhoon and rainstorm disaster management. Among the five links relating to the prevention of typhoon and rainstorm disasters, disaster evaluation and post-disaster reconstruction are overlooked by the two levels of government. These two links should be received attention in the future.

#### *4.4. Comparative Analysis of Typical Provinces*

The typical provinces were selected chiefly based on the frequency with which they are affected by typhoon and rainstorm disasters. The selected provinces were classified into two groups: the more vulnerable provinces include Jiangsu, Guangdong, Fujian, Zhejiang, and Liaoning, and the less vulnerable provinces include Henan, Anhui, Jiangxi, Shaanxi, and Sichuan.

Obviously, the number of disaster prevention policies released by provinces more vulnerable to typhoon and rainstorm disasters is far higher than that by provinces less vulnerable to disasters. In terms of the policy content, the provincial policies focus on reinforcing the build-up of emergency systems and warning capacity for disaster prevention, and on enhancing the level of meteorological services. As Table 4 shows, the policy instruments employed by typical provinces mostly involve fund and material input, infrastructure construction, the build-up of the emergency system, information sharing and support, goal programming, and regulation. All the six policy instruments are supply-oriented and environment-oriented policies. Demand-oriented policies are clearly insufficient.

Further analysis found that the policy documents related to market participation mechanisms are inadequate. Although both the disaster prevention plan of the State Council and local opinion-based policies stress the role of market participation mechanisms in attracting social forces to actively participate in the prevention of typhoon and rainstorm disasters, two types of policy instruments—goal programming and regulation—are preferred without exception.

### **5. Conclusions and Policy Implications**

Based on content analysis, we established the X–Y dimensions of policy instruments in order to analyze central and local policies on the prevention of typhoon and rainstorm disasters. The findings indicate the following: (1) In terms of basic policy instruments, the central and local governments exhibit high consistency in applying basic policy. Both the central and local governments emphasize the five types of policy instruments: investment in disaster prevention and mitigation, infrastructure construction and management, information sharing and support, goal programming, and regulation. In addition, the central government pays attention to the application of the demand-oriented policy instrument of transdepartmental cooperation, as well as attaching importance to the coordination capacity among different departments during the process of managing typhoon and rainstorm disasters. In contrast, local governments place more emphasis on the build-up of an emergency system for disaster prevention and reduction. Various provinces have established their own local emergency response mechanisms and meteorological disaster warning systems according to the local situation. There is, however, a lack of further policies, e.g., engineering construction for disaster prevention, material reserves, education and training, and international cooperation, for the central government and local governments. (2) The central government and local governments prefer supply-oriented and environment-oriented policies. For environment-oriented policies, goal programming and regulations are too frequent, while market participation mechanisms are relatively few. (3) In terms of the chain of disaster prevention and control, the prevention and control policies relating to typhoon and rainstorm

disasters are mainly concerning disaster defense, disaster warning, and disaster relief, with little attention paid to the two links of disaster evaluation and post-disaster reconstruction. Evidently, disaster prevention and mitigation policies, developed in accordance with local customs, indicate that disaster prevention and relief is given priority while the feedback and post-relief of disaster relief are neglected. This lack of rehabilitation could destabilize disaster areas. It needs to be emphasized that the policy differences in many countries (including China) would be considered efficient, as the central government develops the macro-level policy instruments/areas while local levels focus on their own region. The establishment of provincial emergency response mechanisms and meteorological disaster warning systems verifies the rationality in this difference. Despite this, the central government needs improvement in its macro-level policy instruments, say, disaster evaluation and post-disaster reconstruction. Compared with previous literature, the contribution of this study lies in the use of quantitative methods to investigate typhoon and rainstorm policies. The use of actual policy instrument frequencies leads to more objective and persuasive results. Secondly, by conducting a comparative policy analysis among the central governments, local governments, and typical provinces, we will identify the orientation of policy improvements.

Accordingly, the policy implications are as follows:

- (1) Modestly decrease environment-oriented policies, with an increase in market-oriented measures. In view of the too-frequent goal programming and regulations, we should not only reduce excessive policies but also, at the same, formulate detailed implementation schemes as regards timing, thus promoting the operability of policies. Moreover, considering the lack of market-oriented mechanisms, we need to develop credit mechanisms for loans, tax preferences for disaster engineering construction, and outsourcing. This will alleviate the economic burden of disaster prevention on governments through the application of market forces.
- (2) Focus attention on the formulation and implementation of demand-oriented policies, and reinforce government procurement and international cooperation. Government procurement and international cooperation should be formulated because of the dearth of demand-oriented policies. While developing government procurement policies, certain things should be clarified; these include the purchase object, the purchase lists, purchase conditions, and those products for disaster prevention and reduction that can be preferentially purchased by governments.

In terms of international cooperation, the exchange of disaster information, the sharing of disaster-reducing technology, forecasts, and warnings, and mutual support of emergency rescues should be reinforced.

- (3) Perfecting the policies of disaster evaluation and post-disaster reconstruction. There is a lack of uniform standards and normalized calculation methods as to how to process the statistical data of disasters; this affects disaster prevention and reduction, the distribution of disaster relief materials and funds, and the settlement of insurance claims. We should therefore perfect or create scientific methods of disaster evaluation. Policies of post-disaster reconstruction include land planning for reconstruction, the scale of the investments, the sources of capital, and the methods of financing; these could be further elaborated.
- (4) In view of the fact that the government pays much attention to emergency response, warning systems, and information sharing, the stricken people should strengthen the material reserves and information sharing. To prevent and mitigate disasters, the public can establish training institutions, introduce international cooperators, and promote the establishment of third-party disaster assessment agencies.

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## References

1. Gao, J.M. Analysis and assessment of the risk of snow and freezing disaster in China. *Int. J. Disaster Risk Reduct.* **2016**, *19*, 334–340. [[CrossRef](#)]
2. Xu, D.D.; Peng, L.; Liu, S.Q.; Su, C.J.; Wang, X.X.; Chen, T.T. Influences of migrant work income on the poverty vulnerability disaster threatened area: A case study of the Three Gorges Reservoir area, China. *Int. J. Disaster Risk Reduct.* **2017**, *22*, 62–70. [[CrossRef](#)]
3. Dai, Y.W.; Chang, H.H.; Liu, W.P. Do forest producers benefit from the forest disaster insurance program? Empirical evidence in Fujian Province of China, China. *For. Policy Econ.* **2015**, *50*, 127–133. [[CrossRef](#)]
4. Ye, T.; Li, Y.J.; Gao, Y.; Wang, J.W.; Yi, M.L. Designing index-based livestock insurance for managing snow disaster risk in Eastern Inner Mongolia, China. *Int. J. Disaster Risk Reduct.* **2017**, *23*, 160–168. [[CrossRef](#)]
5. Zhang, J.Q. Risk assessment of drought disaster in the maize-growing region of Songliao Plain, China. *Agric. Ecosyst. Environ.* **2004**, *102*, 133–153. [[CrossRef](#)]
6. Yao, Q.L.; Xie, J.B.; Guo, L.; Zhang, X.L.; Liu, R.H. Analysis and evaluation of flash flood disasters: A case of Lingbao county of Henan province in China. *Procedia Eng.* **2016**, *154*, 835–843. [[CrossRef](#)]
7. Kim, S.; Rowe, P.G. Are master plans effective in limiting development in China's disaster-prone areas? *Landsc. Urban Plan.* **2013**, *111*, 79–90. [[CrossRef](#)]
8. Du, F.; Okazaki, K.J.; Ochiai, C. Disaster coping capacity of a fire-prone historical dong village in China: A case study in Dali Village, Guizhou. *Int. J. Disaster Risk Reduct.* **2017**, *21*, 85–98. [[CrossRef](#)]
9. Menefee, T.; Nordtveit, B.H. Disaster, civil society and education in China: A case study of an independent nongovernment organization working in the aftermath of the Wenchuan earthquake. *Int. J. Educ. Dev.* **2012**, *32*, 600–607. [[CrossRef](#)]
10. Xu, L.; Zhang, Q.; Zhang, J.; Zhao, L.; Sun, W.; Jin, Y.X. Extreme meteorological disaster effects on grain in Jilin Province, China. *J. Integr. Agric.* **2017**, *2*, 486–496. [[CrossRef](#)]
11. Innocenti, D.; Albrito, P. Reducing the risks posed by natural hazards and climate change: The need for a participatory dialogue between the scientific community and policy makers. *Environ. Sci. Policy* **2011**, *14*, 730–733. [[CrossRef](#)]
12. Wu, Z.L.; Ma, T.F.; Jiang, H.; Jiang, C.S. Multi-scale seismic hazard and risk in the China mainland with implication for the preparedness, mitigation, and management of earthquake disasters: An overview. *Int. J. Disaster Risk Reduct.* **2013**, *4*, 21–33. [[CrossRef](#)]
13. Biran, A.; Liu, W.; Li, G.; Eichhorn, V. Consuming post-disaster destinations: The case of Sichuan, China. *Ann. Tour. Res.* **2014**, *47*, 1–17. [[CrossRef](#)]
14. Lei, Y.D.; Liu, C.C.; Zhang, L.B.; Wan, J.H.; Li, D.Q.; Yue, Q.; Guo, Y. Adaptive governance to typhoon disasters for coastal sustainability: A case study in Guangdong, China. *Environ. Sci. Policy* **2015**, *54*, 281–286. [[CrossRef](#)]
15. Qin, B.; Jiao, Y.L. Urban disaster prevention and mitigation planning under the perspective of public policy: A case of removing the threat of infectious diseases. *Plan* **2011**, *27*, 105–109. (In Chinese)
16. Liu, Y.; Yin, K.L.; Chen, L.X.; Wang, W.; Liu, Y.L. A community-based disaster risk reduction system in Wanzhou, China. *Int. J. Disaster Risk Reduct.* **2016**, *19*, 379–389. [[CrossRef](#)]
17. Fang, J.Y.; Liu, W.; Yang, S.; Brown, S.; Robert, J.; Hinkel, N.J.; Shi, X.W.; Shi, P.J. Spatial-temporal changes of coastal and marine disasters risks and impacts in Mainland China. *Ocean Coast. Manag.* **2017**, *193*, 125–140. [[CrossRef](#)]
18. Zhang, C.F.; Dang, X.Y. *Public Management*; Renmin University China Press: Beijing, China, 2001.
19. Chen, Z.M. Research on government tools and improvement of government management. *Chin. Admin.* **2004**, *6*, 43–48.
20. Rothwell, R.; Zegveld, W. *Reindustrialization and Technology*; Longman Group Limited: London, UK, 1985.

