Research on Urban Flood Disaster Response Based on the 4R Crisis Management Theory: A Case Study of the "23·7" Torrential Rain in Beijing-Tianjin-Hebei

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Abstract. Based on the 4R crisis management theory, this paper presents a comprehensive analysis of the extreme heavy rainfall event that occurred in the Beijing-Tianjin-Hebei region from July 27 to August 2, 2023. This torrential rain resulted in severe flooding, leading to significant casualties and property damage. The article begins by detailing the extreme characteristics of the torrential rain through case studies and analysis, including the amount of precipitation, the extent of the impact, and the consequences of the disaster, while comparing these factors to typical historical torrential rain events. A thorough examination of the entire disaster response process is conducted. Utilizing the four stages of the 4R crisis management theory—Reduction, Readiness, Response, and Recovery—this paper analyzes the issues and underlying causes of urban disaster response, such as weak public awareness of disaster prevention, insufficient early warning systems, and inadequate coordination in emergency response and rescue efforts. Finally, the article suggests improvements, including enhancing urban infrastructure, refining disaster warning and emergency response capabilities, and promoting the use of digital watershed technology to bolster cities' capacities to respond to extreme weather events and mitigate disaster losses.

Keywords: 4R crisis management theory; "23·7" Beijing-Tianjin-Hebei torrential rain; urban flooding disaster; disaster response

1 Introduction

The Beijing-Tianjin-Hebei region, as a key economic, political, and cultural center in northern China, possesses a unique geographical location and a variable climate. Given the region's history of experiencing torrential rains and floods, studying disaster response strategies in this area holds great practical significance. From July 27 to August 2, 2023, the Beijing-Tianjin-Hebei region underwent an unprecedented episode of extreme heavy rainfall, referred to as the "23·7" Beijing-Tianjin-Hebei torrential rain, characterized by its intensity, extensive impact, and severe consequences. This incident not only significantly affected the lives of local residents but also posed

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a rigorous test for the city's emergency management system. In light of the increasingly severe urban disaster risks, traditional emergency management models are proving inadequate to meet the demands of modern society. The 4R crisis management theory as a systematic crisis management framework, offers a novel perspective and methodology for urban disaster response, facilitating a comprehensive analysis and enhancement of all facets of urban disaster management. The theory underscores the importance of pre-disaster risk mitigation, enhancing preparedness, prompt response during disasters, and effective post-disaster recovery. This approach allows for a comprehensive analysis and enhancement of urban disaster management strategies. Taking the "23·7" Beijing-Tianjin-Hebei torrential rain event as a case study, this research delves into the characteristics of this extreme rainfall and its urban ramifications. It further explores the applicability of the 4R crisis management theory in urban disaster responses, pinpoints gaps in current systems, and suggests specific ameliorative measures. The objective is to bolster cities' resilience against extreme meteorological events, minimize disaster-related damages, and offer insights for other cities within the Beijing-Tianjin-Hebei region and globally facing analogous challenges.

2 Literature Review

In recent years, the escalating impact of global climate change has led to an increase in the frequency of urban floods, posing a significant global challenge with severe implications for urban safety and residents' well-being. Numerous scholars have undertaken comprehensive research on the causes, effects, and response strategies of urban floods from various perspectives. Hyeon-Tae Moon, Jong-Suk Kim, and others suggested structural mitigation measures such as underground drainage tunnels and the implementation of green infrastructure (GI) technology to effectively mitigate the risk of urban flooding[1]. Kishanlal Darji et al. offered a systematic method for flood disaster assessment and disaster mitigation planning using drones, which will serve as a framework for flood risk assessment in similar situations globally[2]. Yongheng Wang and colleagues are investigating a spatial multi-index model for flood risk assessment at the urban agglomeration scale. This model can be adapted to other regions necessitating large-scale urban flood risk evaluations, contributing to advancements in flood forecasting and disaster mitigation research[3]. Li Yongkun, Hu Xiaohong, and colleagues conducted a study using Beijing as a case. They performed a comprehensive analysis of the city's historical flood disaster characteristics, current flood prevention measures, and existing issues. The research discussed strategies for coping with extreme torrential rain and floods, as well as the construction of a flood disaster prevention and control capacity system in large cities, from a resilient city construction perspective[4]. In light of the issues revealed by the "7·20" heavy rainstorm disaster, Xu Weihong, Liu Changjun, and their colleagues recommended strategies to mitigate the impacts of intense rainfall and flooding. Their suggestions included minimizing damage from downpours, bolstering project-based disaster prevention, reducing vulnerability to disaster vectors, and strengthening the city's capacity to endure floods[5]. The incorporation of the 4R crisis management theory into urban

emergency response has garnered significant scholarly interest. Yuan Mengyao utilized the "Zhengzhou 7·20 Heavy Rainstorm Sudden Disaster" as a case study within the framework of the 4R emergency management theory. Her in-depth analysis, guided by the 4R principles, uncovered instances of underreporting, mishandling, and shortcomings in early warning systems[6]. Wang Wei utilized Robert Heath's 4R theory as an evaluative framework, developing a comprehensive urban emergency management capability evaluation index system and proposing a method for calculating the overall index of urban emergency management capability[7]. Xu Xiaowei, drawing on theories such as the 4R crisis management theory and public governance theory, formulated a holistic geological hazard risk management resilience assessment system that integrates key elements of urban resilience[8]. In essence, contemporary research on urban flood disasters has transitioned from singular disaster assessment and response to the creation of a multi-faceted response system. This involves multiple stakeholders and leverages intelligent management grounded in modern technology. Urban flood response strategies are progressively moving away from conventional disaster management towards more integrated, technology-centric approaches. Nevertheless, the effective amalgamation of these theories and methods into a functional and scalable urban flood disaster response model remains a topic for further investigation and implementation. While the 4R crisis management theory offers fresh insights into urban disaster response, there is a limited body of research focusing on urban flood disaster response based on this theory. Practical application presents numerous challenges, necessitating additional research and experimentation for enhancement. This study aims to delve deeply into the application of the 4R crisis management theory in addressing urban floods, using the “23·7” Beijing-Tianjin-Hebei torrential rain event as a case study. The objective is to furnish both a theoretical foundation and practical guidance for enhancing urban disaster response systems.

3 Case Analysis

3.1 Case Introduction

From July 27 to August 2, 2023, North China was subjected to an unusually intense period of heavy rainfall. This extreme weather event, characterized by torrential downpours in certain areas, led to significant urban flooding. The primary cause of this torrential rain was the extended circulation of the remnants of Typhoon "Du Surui" from North China to Huanghuai. This, combined with a substantial transportation of water vapor and topographic amplification effects, resulted in extreme precipitation in the Beijing-Tianjin-Hebei region. The precipitation levels were exceptionally high within a short span of time. In some regions, the cumulative precipitation reached between 200 to 450 mm, and even exceeded 650 mm in localized areas. For instance, in Beijing, the average rainfall reached 331 mm, with the 83-hour rainfall accounting for 60% of the annual rainfall. The torrential rain caused severe flooding in many parts of the Beijing-Tianjin-Hebei region, damaging public facilities, halting public transportation operations, causing severe flooding on some city streets, and temporarily cutting off water and electricity in certain areas. The recent rainfall re-

sulted in a significant rise in river water levels, with many rivers surpassing warning thresholds. This led to hazardous conditions in certain river sections and embankment failures. As of August 10, the heavy rainfall resulted in 33 fatalities and 18 disappearances in Beijing, with direct economic losses exceeding 1 billion yuan. In Hebei Province, 29 people died, 16 were reported missing, and the province experienced direct economic losses amounting to 95.811 billion yuan. This calamitous event underscores the imperative for heightened focus on natural disaster prevention, enhancing meteorological and hydrological monitoring and forecasting capabilities, and refining disaster warning and emergency response protocols. Furthermore, it emphasizes the need to bolster urban infrastructure, enhance the city's flood prevention and drainage systems.

3.2 Extreme Analysis of Torrential Flood Disasters

Table 1. Torrential rain and flood disasters in the Beijing-Tianjin-Hebei region over the years

Heavy rain and flood events	Maximum point rainfall (mm)	Average rainfall (mm)	24h maximum rainfall (mm)	Casualties	Economic losses
1963 “63·8” torrential rain	588	250	464	5881 deaths	$60 billion
Torrential rain on July 21, 2012	541	192	541	145 dead, 26 missing	$35.25 billion
2016 “7·20” torrential rain	453.8	212.6	<400	167 dead, 108 missing	$502.17 billion
2023 “23·7” torrential rain	744.8	272.5	>450	62 dead, 34 missing	$968 billion

The Beijing-Tianjin-Hebei region, known for extreme rainfall in China, has historically faced numerous severe rainstorms and floods. As shown in Table 1, several metrics from this torrential rain have matched or surpassed previous records. Meteorological data reveal that the heaviest rainfall occurred in the western mountainous districts, with an average of 538mm in Mentougou District, Beijing, and 599mm in Fangshan District. In Hebei Province, the area receiving over 200mm of rain extends to 53,600 km^2, the most extensive since the "63·8" flood of 1963. The province recorded a total of 27.5 billion m^3 of rainfall, with the highest single point accumulation of 1008.5mm in Liangjiazhuang Village, Lincheng County, Xingtai City. Between 8:00 am on July 28 and 8:00 am on August 2, the Haihe River Basin observed an average rainfall of 153mm over five days, amounting to a total of 48.7 billion m^3. This marks the most intense rainfall in the Haihe River Basin since 1963.Within the context of the Beijing-Tianjin-Hebei region, this rainfall is the second most intense since meteorological records began. In Beijing specifically, it has surpassed the "63·8" rainstorm of 1963, thus marking the most severe rainfall in the city's history. However, the distribution of this storm was uneven; urban areas received less rainfall than previous events, while the western mountainous regions experienced precipitation approximately twice the historical maximum. This led to serious mountain floods and geological disasters. On

August 11, a special meeting of the Ministry of Water Resources noted that since late July, the Haihe River basin has seen the largest flood since 1963. As many as 22 rivers exceeded warning levels, with eight experiencing their largest floods since records began. On August 12, the Ministry of Water Resources released a flood report, classifying this event as a regional super flood and labelling it the Haihe "23·7" regional super flood[9].

3.3 Response to Torrential Rain and Flood Disasters

Fig. 1. The developmental trajectory of the "23·7" Beijing-Tianjin-Hebei torrential rain event.

As shown in Figure 1, the measures in disaster response process implemented by different governmental tiers in the Beijing-Tianjin-Hebei region have been both proactive and efficacious. Upon issuance of a heavy rain warning by the meteorological department, emergency response mechanisms were promptly activated across all governmental levels. In tandem with the National Flood Control and Drought Relief Headquarters, the flood control command centers of Beijing, Tianjin, and Hebei issued timely flood control emergency directives, aligning them with prevailing meteorological conditions. These entities ensured the dissemination of pertinent information concerning warnings, rescue operations, and resettlement through a variety of channels, guaranteeing timely public notification. Concurrently, the Haihe River Flood Control Headquarters and the Haihe River Water Conservancy Commission adjusted their flood prevention and defense emergency responses based on the evolving situation. They executed pre-releases of water from reservoirs to augment storage capacity, employing a management strategy that encompassed upper storage, mid-channel diversion, lower drainage, and appropriate retention to address unprecedented regional flooding. In defending rivers such as the North Canal, Yongding River, and Daqing River, they adopted suitable flood prevention techniques. These included scientific scheduling of hubs, ongoing consultations with various regional command centers, and dynamic forecasting of flood peak flow. Through these measures, they managed discharge flow judiciously, minimizing the reliance on flood retention areas, thereby affording sufficient time for personnel evacuation and flood discharge, and establishing favorable conditions for flood conveyance.

In the aftermath of the early warning, local governments initiated the systematic evacuation of residents to secure locations. By August 8, 2023, over 82,000 individuals had been evacuated in Beijing, while Hebei Province relocated a total of 1.7574 million people, inclusive of 978,400 from flood retention zones. Concurrently, Tianjin successfully relocated and resettled 86,484 residents. In response to the catastrophe, fire departments, the People's Liberation Army, and armed police swiftly mobilized, launching rescue operations to aid ensnared individuals and deploying aerial rescue units. Associated departments promptly activated their emergency response protocols. Municipal agencies undertook the swift repair of infrastructure such as roads, bridges, power, and water supply systems to reinstate transportation and fundamental services. Communication departments expedited the restoration of communication services by repairing damaged base stations. The medical and health sectors administered emergency treatments, facilitated the transport of the injured and ill, and implemented post-disaster epidemic prevention measures. In the realm of material transportation and support, collaborative efforts between the National Flood Control and Drought Relief Headquarters, the Ministry of Emergency Management, and the National Food and Strategic Reserves Administration ensured the rapid delivery of substantial disaster relief supplies to the Beijing-Tianjin-Hebei region.In the aftermath of the catastrophe, both the Ministry of Finance and the Ministry of Emergency Management promptly released central disaster relief funds. In addition, the China Development Bank and the People's Bank of China extended emergency loans. Numerous societal sectors contributed significantly in terms of funds and materials to the impacted regions, bolstering recovery and reconstruction efforts. This comprehensive response

underscored the government's swift action, inter-departmental coordination, and robust engagement from diverse societal factions, which collectively diminished the disaster's repercussions.

4 Problems, Causes and Countermeasures in Urban Disaster Response Based on 4R Crisis Management Theory

An examination of human casualty data over the years reveals that this torrential rain and flood disaster resulted in the fewest number of casualties. This suggests an improvement in the Beijing-Tianjin-Hebei region's overall capacity to respond to such natural calamities. Nevertheless, numerous concerns persist in the aftermath of this catastrophe. The four stages of crisis management were scrutinized for the “23·7” Beijing-Tianjin-Hebei torrential rain and flood disaster, using the 4R crisis management theory as a framework. These stages - Reduction, Readiness, Response, and Recovery - correspond to the processes before, during, and after the implementation of the "Measures for Emergency Management of Emergencies". By analyzing these stages, we can reflect on the issues present in this emergency response process and investigate the underlying causes[6].

4.1 Existing Issues

4.1.1 Reduction Phase.

During the reduction phase, several challenges arise, including inadequate public awareness of disaster prevention, limited hydrological monitoring capabilities, and insufficient flood control infrastructure[11]. For example, interview data indicated that a village official transmitted a flood warning through a WeChat group before the deluge; however, the message did not underscore the cause or potential damage, nor did it mandate evacuation. Consequently, many individuals failed to heed this warning. The primary cause of these phenomena is the general public's inadequate awareness of emergencies, which includes a lack of understanding of specific warning levels and insufficient attention to these alerts. Additionally, an objective factor contributing to this issue is the inadequacy of daily emergency management and public education and training provided by government departments.

The effectiveness of hydrological monitoring directly impacts the accuracy and promptness of flood warnings. Inadequate hydrological monitoring capabilities, such as insufficient network density of hydrological stations, low flood control and measurement standards, and a lack of emergency monitoring equipment at the grassroots level, can compromise these efforts. In the Haihe River Basin, only a single set of hydraulic rain sensors is located near the Xiong'an New Area in Hebei, which is insufficient to cover the entire flood-affected area in the watershed. Furthermore, the construction standards for hydrological stations are subpar; 35% of the monitoring facilities in the Haihe River Basin have not been upgraded for over a decade and are therefore highly susceptible to damage during major floods. Preliminary statistics reveal that 408 hydrological stations in the Haiyang Commission, Beijing, Hebei,

Shanxi, and Henan were damaged due to recent torrential rains, with over 70% of the monitoring facilities in the heavily affected areas being waterlogged. The number of emergency monitoring equipment at the grassroots level is insufficient, failing to meet the demands of simultaneous multi-point hydrological emergency monitoring during large flood events. During such disasters, numerous equipment failures occurred due to excessive usage frequency and high sand content, which adversely affected emergency monitoring efforts[11].

The issue of inadequate flood control infrastructure is especially pronounced in small to medium-sized cities. A prime illustration of this can be seen in the city of Zhuozhou, where the embankment project is underdeveloped and the standards for flood barrier design are subpar. The city only has dams capable of defending against floods occurring every five and ten years. Furthermore, the Dashi River, Xiaoqing River, and North Juma River lack comprehensive embankments[12]. This deficiency is a significant factor contributing to Zhuozhou's status as the region most severely impacted by flooding.

4.1.2 Readiness Phase.

The early warning mechanism during the readiness phase is inadequate. Firstly, this mechanism has not fully realized its potential. While the meteorological department has issued advance warnings of heavy rain and flooding, the rainfall is predominantly concentrated in mountainous regions, where its intensity is particularly high. This situation leaves the public unprepared for potential flooding. Due to the limited warning time, residents in towns and villages near the mountains often find it too late to evacuate. Additionally, there are significant weaknesses in the rain monitoring and forecasting system, which complicate the accurate prediction of flood situations for certain rivers. Consequently, this affects both the timeliness and accuracy of disaster warnings, preventing some areas from implementing preventive measures promptly when severe rainstorms occur.

4.1.3 Response Phase.

The Beijing-Tianjin-Hebei region exhibited a robust responsiveness during the "23·7" heavy rain event by implementing immediate and effective flood control and drainage measures. These included timely adjustments of emergency response levels, activation of flood storage and detention areas, and the evacuation of the public. Furthermore, the region effectively organized rescue and disaster relief efforts, maximizing the protection of lives and property and laying a solid foundation for post-disaster recovery and reconstruction. However, issues such as imprecise deployment of rescue forces, insufficient coordination, and poor communication of information were identified. Specifically, the deployment of rescue forces was not sufficiently precise, resulting in inadequate rescue personnel in certain affected areas, delayed assistance in small towns and villages, and reports of 24 individuals trapped in a glass factory for over ten hours awaiting a slow rescue response. This situation highlights structural obstacles within the emergency rescue coordination mechanism and functional deficiencies in the disaster information dissemination system.

4.1.4 Recovery Phase.

The recovery situation in the Beijing-Tianjin-Hebei region following the "23·7" rainstorm disaster is generally positive and effective. However, several challenges persist in the post-disaster recovery process. Notably, the progress of infrastructure reconstruction in certain areas has been slow. The rainstorm caused significant damage to infrastructure, including roads, bridges, and water and power supply facilities. The extensive scope of the damage and the complexity of repairs have contributed to the sluggish pace of infrastructure restoration, which in turn has disrupted normal production and living conditions in the affected areas. Additionally, the reconstruction efforts in some flood storage and detention areas have been inadequate. Many affected enterprises and institutions have not resumed operations promptly, and the resettlement and security measures for the displaced individuals have not been effectively implemented. Furthermore, the disbursement of compensation funds has also faced delays. Secondly, a significant deficit exists in the funding required for post-disaster reconstruction. The process of reconstruction necessitates substantial financial support. However, this is often hindered by constrained budgets and inadequate social contributions, resulting in a notable shortfall that impedes recovery efforts. Additionally, challenges arise in controlling environmental pollution. The rainstorm disaster has precipitated issues such as water contamination and waste accumulation. Overall, the response to the "23·7" rainstorm disaster in the Beijing-Tianjin-Hebei region has exhibited remarkable resilience and adaptability, offering invaluable insights for other regions faced with similar natural calamities.

4.2 The Cause of the Problem

Urban development has significantly increased the impermeable area of cities, reduced the density of permeable surfaces and drainage networks, and made rainfall primarily dependent on underground drainage systems. When rainfall exceeds the system's capacity, it is prone to cause flood disaster disasters[10]. Secondly, the insufficient resilience of urban infrastructure is also one of the important reasons for flood disaster. In the '23·7' Beijing-Tianjin-Hebei rainstorm disaster, the insufficient resilience of infrastructure was mainly manifested in the following aspects: firstly, the existing urban drainage system is insufficient to cope with the increasingly extreme rainfall; secondly, the flood control engineering system has shortcomings. The flood control reservoirs in the upper reaches of rivers have not yet been built, resulting in insufficient flood storage capacity. Thirdly, the standard of construction for certain river embankments in the basin does not meet the acceptable criteria, making their flood discharge capacity fall short of the planned requirements. These factors have limited the flood control engineering's ability to respond to rainstorm disasters. In addition, the construction of flood storage and detention areas is lagging behind, and the facilities for flood inflow and outflow are not perfect, affecting the ability to effectively store and divert floods.

The recent extreme rainstorm event in North China highlighted several issues that require attention. Among these are the inadequate management of mountain torrents, insufficient water storage capacity in piedmont plains, and weak drainage capacity in

flood detention areas. Furthermore, there is a pressing need for improvement in early warning and management protocols for geological disasters associated with mountain torrents. Firstly, a significant enhancement is required in the management of mountain torrents. The current lack of adequate management has resulted in urban flood disaster in Fangshan and Mentougou districts, where streets were converted into makeshift flood channels following the torrents. Secondly, the issue of inadequate water storage capacity is evident. As the mountain torrents flow from the mountains to the plains, the water storage capacity in the piedmont plains proves to be insufficient. There is an inadequate number of reservoirs in the mountains, and no storage areas exist outside the mountains. This leads to the torrents breaching the embankments and causing extensive damage to public facilities. Lastly, the flood detention areas in the Haihe River Basin exhibit weak drainage capacity compared to other basins. Consequently, the water in these detention areas cannot be discharged promptly.

4.3 Suggestions for Countermeasures

Following the intense rainstorm in Beijing on July 21, 2012, China underwent a revision of its drainage and flood prevention standards, incorporating classification design standards. These new standards have been substantially improved and are more targeted, especially for key areas and low-lying regions. In addition, national and local governments have prioritized urban infrastructure development. For example, Beijing has specifically bolstered its drainage and flood prevention capabilities, particularly enhancing its urban waterlogging retention and discharge capacity. This is a significant factor in the minimal impact of the recent urban flooding. However, the rainstorm on July 23, 2023, revealed the inadequate flood control capabilities in small to medium-sized cities and mountainous areas in the Beijing-Tianjin-Hebei region. It also underscored the need for enhancement in early warning systems and management strategies for mountain flood geological disasters.

To address these shortcomings, future efforts should prioritize the enhancement of rainwater monitoring and forecasting systems in small and medium-sized cities as well as mountainous regions. This includes bolstering flood control capabilities, expediting the construction of flood retention areas, and improving infrastructure for effective flood management. In areas adjacent to mountainous regions, high-intensity rainfall can result in sudden urban flooding, particularly when combined with steep terrain. In locations such as Mentougou and Fangshan, flash floods can occur rapidly, necessitating not only engineering measures for flood control but also the timely dissemination of flash flood warnings to ensure adequate evacuation time. Engineering improvements should encompass the enhancement of flood drainage facilities within municipal construction projects to guarantee that newly constructed drainage networks meet the upper limits of national building standards. Renovating outdated drainage networks, repairing damaged and malfunctioning facilities, and improving drainage efficiency are also essential tasks. Dredging rivers in urban areas and their surroundings, as well as widening river channels to increase flood discharge capacity, is of paramount importance. Concurrently, a comprehensive evaluation of the design capacity of bridges over mountain torrents in urban areas, such as Beijing's Mentou-

gou and Fangshan, should be undertaken to enhance their flow capacity and prevent significant damage caused by flood overflow[13]. Establishing intelligent monitoring, early warning, and drainage management systems, utilizing high-precision meteorological radar and remote sensing satellite technology to monitor rainfall and flood conditions in real time, and accurately predicting extreme weather events through big data analysis will facilitate advance warning and guide drainage efforts. Additionally, increasing urban green spaces, constructing permeable pavements and plazas to slow down rainwater runoff, and reducing the risk of flooding are strongly recommended[14]. Furthermore, drainage facilities in downstream flood retention areas should be constructed promptly to drain floodwaters efficiently after the flood diversion area is activated, thereby mitigating the impact of secondary disasters.

The Beijing-Tianjin-Hebei region is notably susceptible to frequent episodes of heavy rain and flood disasters. It is imperative for grassroots units, including schools, community committees, and village committees, to intensify their efforts in promoting and disseminating knowledge about geological disasters. This will enhance public awareness concerning disaster prevention and mitigation strategies. Furthermore, government departments need to establish robust early warning systems and initial response mechanisms specifically for flood disasters, as well as formulate comprehensive emergency plans. Given that emergency management departments often experience delays in initiating action or conducting rescue operations post-disaster, it is crucial for all departments to possess established response mechanisms or emergency plans. Ensuring the immediate execution of these plans following a disaster will substantially mitigate resultant losses and afford invaluable time for subsequent management actions.

5 Conclusions

This study conducts a comprehensive analysis of extreme heavy rainfall events in the Beijing-Tianjin-Hebei region from July 27 to August 2, 2023, utilizing the 4R crisis management theory. The findings highlight the existing deficiencies in urban areas' ability to manage extreme weather disasters. Despite some advancements in disaster prevention, preparation, response, and recovery, there are significant gaps in the accuracy of disaster warnings, the promptness of emergency responses, and the degree of public awareness regarding disaster prevention. These shortcomings were evident during the aforementioned heavy rainfall event. To enhance cities' capacity to handle extreme weather disasters, this paper suggests several targeted improvement strategies. Firstly, the construction of urban infrastructure, particularly drainage systems and flood control facilities, should be reinforced to bolster the carrying capacity and resilience of cities. Secondly, disaster warning mechanisms need to be refined, and the accuracy and timeliness of early warnings should be enhanced through the adoption of advanced technical methods. This will ensure that critical information is disseminated to the public promptly. Thirdly, it is imperative to bolster emergency response capabilities to ensure swift and effective rescue operations during disasters. This can be achieved by establishing a more streamlined command system and a well-

coordinated rescue team. Additionally, there is a pressing need to enhance public education on disaster prevention and mitigation. By doing so, the public's capacity to assist themselves and others will be augmented, fostering a collective societal response to disasters. In conclusion, this paper offers scientific insights and practical recommendations for cities to manage extreme weather disasters effectively, drawing upon the comprehensive application of the 4R crisis management theory and real-world case studies. Future research should delve deeper into this area, aiming for continuous improvements in urban disaster response systems to safeguard lives, property, and ensure stable social and economic development.

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