New challenges to flood governance system in China:

Evidence from Three Recent Floods in North China

Xiaofan ZHAO
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Floods in China

- No.1 climate risk in China.
- China is hit by heavy summer rainfalls every year. The second half of July and first half of August (七下八上) is known as the main flood season in North China.
- Millennia of experience in enduring and taming floods. A centralized bureaucracy was built in as early as 300-200BC (Qin Dynasty) at least partially due to the demand of flood control in the Yellow River, known as the “sorrow of China”.
- Since 1960s, China has witnessed a growing number of extreme rainfall events.
- Over the past decade, the frequency of floods and super typhoons has increased significantly.
- Trend of (super) typhoons heading north, bringing strong rainstorms and floods to North China, such as the 2021.7.20 Zhengzhou/Henan Flood and the 2023.07 North China (Huabei) Flood.
China’s Flood Governance System: central gov organization

- Central coordinating agency/highest authority in flood and drought control: the National Headquarters for Flood and Drought Control (NHFDC)
  - History: first established in 1950 (initially called Central Flood Control Headquarters) led by vice premier DONG Biwu; since then always led by vice premiers in China until 2019
  - Office of the NHFDC used to be located in the Ministry of Water Resources
  - After government reorganization in 2018, Office of the NHFDC relocated to the newly established Ministry of Emergency Management (MEM), which shows that flood prevention and control has been an integral part of emergency management

- Lead agency: Ministry of Emergency Management (MEM), established in 2018 to integrate emergency rescue and disaster prevention, reduction and relief functions previously scattered in many ministries and bureaus.

- National Committee for Disaster Reduction (NCDR), mainly in charge of disaster relief.

- Ministry of Water Resources (MWR) still plays many important roles, such as organizing the preparation and implementation of flood and drought disaster prevention plans and protection standards, undertake monitoring and early warning of water and drought conditions.
China’s Flood Governance System: city gov organization

- Municipal headquarters for flood control and drought relief, usually led by mayors
- “The administrative heads of people’s governments at all levels are responsible for flood prevention and drought relief work.” (National Flood Control and Drought Relief Emergency Plan)
- Accountability system to hold officials responsible for flood control
- Every district and major river channel has a designated “administrative responsible person,” usually the district chief/deputy chief
- Large and medium-sized reservoirs and dams have administrative responsible persons at the municipal level, district level, bureau level, and at the reservoir/dam level.

A top-down integrated flood management system with the Flood Control and Drought Relief Headquarters as the basic structure
China’s Flood Governance System: Law and Policy

- **Laws:**
  - Flood Control Law of the People’s Republic of China (last revised in 2016)
  - Water Law of the People’s Republic of China
  - Flood Prevention Regulations of the People’s Republic of China (Last updated in 2011) *this tiaoli is not strictly a law, but has the effect of law*

- **Emergency plans at all levels of government and bureaus:**
  - National overall emergency plan for public emergencies
  - National Flood Control and Drought Relief Emergency Plan (updated in 2022)
  - River-basin flood control emergency plans
Two new challenges to the flood governance system

- **Climate change-induced extreme weather events**, increasing *magnitude and probability of hazards*
- Rapid, large-scale **urbanization**, which has concentrated population and wealth in cities and increased *exposure* to climate risk

**Question**: can traditional governance system and processes triumph over floods in the face of two new challenges (climate change and rapid urbanization)?
Three Recent Floods in North China

- 2012.7.21 Beijing Flood
- 2021.7.20 Zhengzhou/Henan Flood
- 2023.07 North China (Huabei) Flood - will focus on impacts on Beijing and Hebei Province in this presentation
What counts as a torrential rain (暴雨)?

<table>
<thead>
<tr>
<th>Rainstorm level</th>
<th>Daily precipitation (mm/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>extreme torrential rain</td>
<td>≥250</td>
</tr>
<tr>
<td>severe torrential rain</td>
<td>100.0-249.9</td>
</tr>
<tr>
<td>torrential rain</td>
<td>50.0-99.9</td>
</tr>
<tr>
<td>heavy rain</td>
<td>25.0-49.9</td>
</tr>
<tr>
<td>moderate rain</td>
<td>10.0-24.9</td>
</tr>
<tr>
<td>light rain</td>
<td>0.1-9.9</td>
</tr>
</tbody>
</table>
Flood history in Beijing

- Overall precipitation has decreased since 1951 (same for the entire North China), but more extreme rainstorms
- Since 1951, two storms with daily precipitation > 200 mm
- 22 storms with daily precipitation more than 100 mm
- **1958.07.30-07.31**: average daily precipitation **185.2 mm**, maximum hourly precipitation 122.0 mm
- **1963.08.08-08.09**: average daily precipitation **161.9 mm**
- **2005.07.23**: maximum precipitation >**150 mm**, 2 deaths.
- **2008.06.13**: water accumulated nearly 2 meters deep in some urban areas, many subway stations temporarily closed.
## Comparison of three floods

<table>
<thead>
<tr>
<th></th>
<th>2012.7.21 Beijing Flood</th>
<th>2021.7.20 Zhengzhou/Henan Flood</th>
<th>2023.07 North China (Huabei) Flood</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>City-wide cumulative</strong></td>
<td>190.3 (highest since 1951)</td>
<td>534 in Zhengzhou</td>
<td>311 in Beijing (538.1 in Mentougou District and 598.7 in Fangshan District)</td>
</tr>
<tr>
<td><strong>precipitation (mm)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum precipitation</strong></td>
<td>460 (Hebei County, Fangshan District)</td>
<td>624.1 at Zhengzhou National Meteorological Station (20 July)</td>
<td>745 in Beijing (the heaviest since record keeping began 140 years ago.) 1003 in Xingtai City, Hebei Province.</td>
</tr>
<tr>
<td><strong>at a single station (mm)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>~20h</td>
<td>More than 6 days, but most intense on 20 July</td>
<td>&gt;72 hours in Beijing (8pm 29 July -2 August 2023), longer in Hebei Province</td>
</tr>
<tr>
<td><strong>Max. hourly precipitation</strong></td>
<td>100.3</td>
<td><strong>201.9</strong></td>
<td>111.8</td>
</tr>
<tr>
<td><strong>Casualties</strong></td>
<td>79</td>
<td>398 (380 in Zhengzhou, including missing population)</td>
<td>62 (33 in Beijing, 29 in Hebei)</td>
</tr>
<tr>
<td><strong>Economic losses</strong></td>
<td>11.64</td>
<td>120.06 (40.9 in Zhengzhou)</td>
<td>~100 in Hebei</td>
</tr>
<tr>
<td><strong>(billion RMB)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total population</strong></td>
<td>1.602</td>
<td>14.786 in Henan Province</td>
<td>&gt;5</td>
</tr>
<tr>
<td><strong>affected (million)</strong></td>
<td></td>
<td></td>
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### Historical annual precipitation (mm)
- Beijing: 420~660
- Hebei Province: 484.5
- Zhengzhou: 640.8

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The floodwaters killed 79 people, causing at least 10 billion Yuan (US$1.6 billion) in damages and destroying more than 10 thousand homes. More than 1.6 million people were affected by the flood overall.
### Policy learning after the 2012.7.21 Flood

<table>
<thead>
<tr>
<th>Early warning information release mechanism</th>
<th>2012.7.21 Flood</th>
<th>2016.7.20 Flood</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Characteristics</strong></td>
<td>Total duration short (&lt;20h), but very intense</td>
<td>Total duration long (55h), but not as intense; cumulative precipitation higher</td>
</tr>
<tr>
<td><strong>Total casualties</strong></td>
<td>79</td>
<td>None</td>
</tr>
</tbody>
</table>
| **Mainly released through traditional media, and only some citizens received mobile phone text message warning messages, which were relatively lagging behind.** | - Established a comprehensive early warning information release center, responsible for the release of 14 categories of early warning messages for 10 bureaus.  
- 22 early warning message release channels including Beijing radio stations, TV stations, buses, subways, city TVs, outdoor displays, mobile phone text messages, and Internet applications.  
- Failure to promptly notify citizens to seek refuge in safe places, suspend classes and businesses, etc. | - Activated mobile phone text messages for entire network five times and uninterrupted subtitle broadcast for all Gehua Cable channels.  
- District-level early warning sub-centers issued a total of 4.6194 million text messages.  
- Primary and secondary schools and kindergartens have been suspended, and enterprises and institutions have adjusted their working hours. |
2. 2021.7.20 Zhengzhou Flood

**Extreme Rainfall**
1 h (16:00 – 17:00pm, 201.9mm) ≈ 4 months
24 h (20 July, 627.4 mm) ≈ 1 year (640.8 mm)

**Flooding of a Subway Line 5 car trapped more than 500 passengers and killed 14.**

Photos posted by a Weibo user showing a submerged subway car following heavy rains in Zhengzhou (Photo: Handout/Courtesy of Weibo user MERAKIZZ-/AFP)

(Source: Zhengzhou Meteorological Station)
2. 2021.7.20 Zhengzhou Flood

247 vehicles were flooded in the Beijing-Guangzhou North Road Tunnel, with a total of 6 victims.
### Henan Provincial and Zhengzhou Municipal Observatories’ red rain warning time

<table>
<thead>
<tr>
<th></th>
<th>Henan Provincial Meteorological Station</th>
<th>Zhengzhou Municipal Observatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 19</td>
<td>21:40pm</td>
<td>21:50pm</td>
</tr>
<tr>
<td>July 20</td>
<td>05:50am</td>
<td>06:02am</td>
</tr>
<tr>
<td></td>
<td>9:00am</td>
<td>09:08am</td>
</tr>
<tr>
<td></td>
<td>12:55pm</td>
<td>11:50am</td>
</tr>
<tr>
<td></td>
<td>16:20pm</td>
<td>16:01pm</td>
</tr>
<tr>
<td></td>
<td>19:20pm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>21:40pm</td>
<td>21:32pm</td>
</tr>
<tr>
<td>July 21</td>
<td>00:40am</td>
<td>00:25am</td>
</tr>
</tbody>
</table>

8 times

7 times
Reflection: Loopholes in risk governance system

“Prevent/mitigate-Prepare-Respond-Recover” (2P2R) framework for emergency management

PREPARATION:

- **Flood prevention plans at all levels are incomplete:** disaster scenarios are underestimated and the possibility of water intrusion in the subway is not fully considered. The responsibilities of the transportation department in the plan are vaguely described.
- The public and policymakers have **low perception of disaster risks.** Many people traveled during heavy rains and even chose to drive.

RESPONSE:

- **Disconnect between meteorological warning and emergency response:** The Municipal Flood Control Headquarters organized a consultation on the morning of the 20th, but underestimated the impact of the heavy rain and only raised the emergency response level to Level II. It was not until 16:30pm on the 20th that the flood control emergency response was raised to Level I.
- **The transportation department responded slowly.** Insufficient coordination among organizations (such as the subway company, the Transportation Administration and the Flood Control and Drought Relief Headquarters), many waiting for orders from above.
- **Poor risk communication:** 1) **Incomplete early warning message:** None of the 7 red warning signals for heavy rains released prevention guidelines, but only reminded the public to pay attention to travel safety. 2) **Limited communication channels and belated warning.** Early warning messages mainly sent through traditional media such as television, radio, newspapers and periodicals. Only some people received text messages of red weather warnings, and the text messages did not include defensive guidance information.
Quick policy learning following the Zhengzhou Flood - particular focus on subway safety

Instructions from President Xi and then Premier Li Keqiang:

▶ Then Premier Li Keqiang: “Especially for urban subways, tunnels, underground spaces, etc. with dense flow of people, hard measures must be taken to ensure the safety of the masses. It is better to err on the side of safety and stop and shut down the facilities when necessary, and to effectively avoid casualties.”

▶ NDRC: Immediately carry out a comprehensive investigation of potential safety hazards for important urban infrastructure.

RESPONSE FROM LOCAL GOVERNMENTS:

▶ Provincial and municipal governments all over China started to check and strengthen subway flood prevention within their respective jurisdictions. Some governors and mayors (e.g., governor of Zhejiang Province, mayor of Shanghai) went to subway stations to check safety issue in person.
3. 2023.07 North China (Huabei) Flood
Xitan Hotel in Suburban Beijing damaged by floodwaters

- A top luxury hotel operated by RELAIS & CHATEAUX
- Located on a hillside in the picturesque Mentougou area, surrounded by magnificent mountains and lakes.
- Construction lasted 8 years starting in 2012, with 800 million RMB investment
- Soft opening on April 30, 2022
The plight of flood detention basins: Hebei Province
Adaptation (In)justice: “Build a ‘moat’ for the capital”? 

- Diversion and storage areas, also known as flood detention basins, are low-lying regions and lakes outside the river embankments where floodwaters are temporarily stored during floods.

- Officials in Hebei Province, which borders Beijing, had opened flood gates and spillways in seven low-lying flood control zones to prevent rivers and reservoirs from overflowing in Beijing and the region’s other metropolis, Tianjin.

- The Communist Party leader of Hebei, Ni Yuefeng, ordered “activation of flood storage and diversion areas in an orderly manner, so as to reduce the pressure on Beijing’s flood control and resolutely build a ‘moat’ for the capital.”
Zhuozhou City, Hebei Province

- Zhuozhou flooding was not only due to heavy rains, but also the temporary release of floods in flood storage and detention areas.
- Warehouse (a publishing hub) and logistics as pillar industries; the “storage center” of Beijing
- Fulfillment center for many courier service companies such as Beijing Zhongtong
- Central warehouse of “bookschina.com”, the earliest online book sales platform in China; at least 4 million books flooded, worth more than 300 million RMB
- A 15-hectare logistics park received early warning; all staff evacuated, but goods and equipment had not been transported in time. Losses exceeded 100 million RMB. About 500 trucks entering and exiting daily, with a throughput of about 1,000 tons. About half of the vehicles were flooded.
Reflections

- **Risk perceptions need to be updated**: heavy precipitation and flash flood no longer black swan events (low probability, high impact), but grey rhino events (high probability, high impact). Even People’s Bank of China’s reports still characterize climate extremes as “low-probability, high-impact,” which could mislead policymakers and the general public.

  - **Residents** reluctant to evacuate at first; did not have clear understanding the severity of the flooding.
  
  - **Businesses** still took the chance and did not transport goods on time.

  - **Local governments**, such as Changping District of Beijing, organized flash flood drills in seven municipal-level flash flood geological disaster key risk villages. But the simulation scenarios are only for 50mm or 70mm precipitation within 3 hours.
Reflections

A lack of readiness to use water-retention zones to control floods, and a failure to coordinate along rivers.

Enhance risk communication and notification system. Early warning dissemination system significantly improved in Beijing, but how about in flood detention basins? Were residents informed of evacuation plans in advance?

Enforce and enhance compensation for losses in flood retention basins. According to Article 32 of the Flood Control Law, the authorities of regions and units that benefit directly from the flood storage and detention basins are obliged to pay compensation and provide relief for these basins. But compensation can be complicated if flooding extends beyond designated flood storage areas. Compensation issues for residents who do not have local household registration (hukou) also need to be considered.

Update siting and design standards for buildings and municipal infrastructure (e.g., drainage systems) to fully consider climate change impacts. Review disaster resilience of buildings in non-built-up areas.
Summary

In the 2P2R framework, China has continued its **relative strengths in “preparation” and “response”**

- **Preparation**: quick update of emergency plans following major floods, e.g., 2022 Henan Province Flood Control Emergency Plan linked heavy rain warning and emergency response.

- **Response**: 2013-2021, deaths, collapsed houses and economic losses in GDP associated with natural disasters decreased by 87.2%, 87.4%, and 61.7% compared to the decade before. Fast growth of professional water rescue teams.

**Weaknesses in prevention/mitigation and recovery/resilience**

- **Prevention/mitigation**: migration of residents living in flood-prone areas; flood insurance

- **Resilience**: follow the precautionary principle in urban planning; revisit and reassess design and construction standards; create water buffers instead of building dykes
Sharing the responsibilities in flood governance

- **Status quo**: overreliance on the government
- **Future**: promote pluralistic governance that engages the private sector (e.g., insurance companies) and the general public. Only when all parties are sufficiently involved, can we have equitable, effective, and inclusive climate risk governance.