

Governance and Crisis Management: Coordination and Roles in Rio Grande do Sul's Flood Response

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Abstract

Increased flood disasters and their impacts emphasize the urgent need for resilient and effective governance systems to enhance disaster response and mitigation. This study aims to analyze the multi-level governance structure of flood response in Brazil, particularly focusing on the case of Rio Grande do Sul state. The research steps achieved in this paper includes identifying key stakeholders involved in flood management, mapping their roles, and examining coordination mechanisms that facilitate effective disaster response to potentially uncover critical information flows that underpin decision-making and operational efficiency. The findings provide a foundation for developing a structured data governance strategy that enhances coordination, improves information sharing, and strengthens resilience in flood disaster management.

Keywords

Data Governance, Emergency Response, Flood Resilience

1. Introduction

Disasters both natural and man-made disasters, have seen a significant rise over the decades, with a total of 25.836 disasters recorded worldwide from 1900 to 2024, of which almost 70% were natural disasters [1]. The same study concludes that floods were most frequent in Asia (9.40% of all recorded disasters), with significant events in Africa (4.80%) and North America (2.66%), while Oceania had the lowest occurrences of floods (0.62%). Besides, climate change has increased the intensity of natural disasters, with economic losses more sensitive to the severity of events than their frequency [2]. Flood disasters account for a large proportion of mortality and economic loss worldwide. According to the [3], flooding accounts for 44% of all recorded weather, climate, and water-related events, 16% of reported deaths, and 31% of reported economic losses. These statistics highlight the imperative to construct resilient and effective systems of governance to manage flood disasters.

This paper addresses the multifaceted character of disaster governance challenges. At the individual level, bottom-up action initiated by individual actors is essential during disasters. At the community level, social solidarity fosters civic engagement, which goes beyond moral support to encompass active volunteering and collective problem-solving. At an institutional level, established social networks are key in mobilizing resources and coordinating response. Overall good social cohesion in society will make communities more resilient to disasters through increased volunteering behavior, organizational membership and collective problem solving [4]. Emergent social cohesion—temporary social networks that form in the event of a disaster—has also been discovered to play an important part in helping communities adjust to the disruptions caused by disasters [5].

Digital government platforms further increase the capability for efficient disaster response through increased coordination, communication, and information sharing among stakeholders. Despite such

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potential, integration of digital technology into disaster management is underexplored, and is a key research gap [6]. Social media platforms, for example, enable real-time communication between governments and citizens in times of disasters, with important information and feedback mechanisms to increase disaster management [7]. Mobile government services improve public sector operations through the use of mobile technologies [8], which are particularly needed in disaster situations when technologies are needed to provide support for the increased mobility needs of citizens.

Management of flood disasters involves a clear understanding of the principal actors involved and the activities that must be coordinated in efforts to realize prompt and effective action. Harmonization of the most important stakeholders is essential for realizing seamless cooperation and optimal disaster management efforts, particularly at the response phase. Based on this consideration, the study explores three primary research questions:

- Which levels of actors need to be involved in this governance setup?
- What specific tasks require multi-level coordination in the response phase of managing flooding disasters?

This study aims to investigate the multi-level governance model of flood response in Brazil, focusing particularly on the case of Rio Grande do Sul. This research approach entails mapping critical stakeholders in flood management, mapping their roles, and analyzing coordination mechanisms that facilitate effective disaster response to potentially uncover critical information flows that underpin decision-making and operational efficiency. The findings provide a foundation for developing a well-organized data governance strategy that enhances coordination, improves information exchange, and improves resiliency in flood disaster management. The remainder of this paper is organized as follows: Section 2 locates the research in context within the broader literature, Section 3 sets out the research method, Section 4 presents the analysis results, Section 5 provides a thorough discussion of these findings, and Section 6 concludes with the main findings and recommendations for future research.

2. Literature background

In the context of resilience-related decisions, effective and inclusive decision-making, considering heterogeneous perspectives is crucial when establishing priorities for actions and investments [9]. In dealing with complex scenarios such as disaster response, decision-making is central to government operations, and understanding how it evolves with the integration of emerging technologies, such as big data and AI is crucial [10, 11]. Building on that, digital governance is defined as a process where multiple stakeholders—governments, businesses, and citizens—use information and communication technologies (ICT) to enhance service quality, promote openness, transparency, and collaboration, and support evidence-based decision-making [12, 13]. This concept is particularly relevant in disaster governance, which requires coordination among various stakeholders across different phases—pre-disaster, trans-disaster, and post-disaster—to mitigate the impacts of natural disasters [14, 15].

Community resilience is influenced by the interactions among various stakeholder groups. However, enhancing these interactions is complex, often due to conflicting preferences and priorities among stakeholders [9]. The authors suggest that for effectively incorporating relevant stakeholders into decision-making processes, mapping different operations and focusing on interactions areas is critical. In the context of disaster management, there is a challenge to align decision-making and organizational processes to data to inform decisions [10].

The need for addressing multi-level governance and vertical and horizontal integration is also identified as key challenges for supporting actions against the impacts of floods and drought in cities [16]. Adaptive multi-level governance, learning to work with uncertainty and long-term vision, and horizontal and vertical (improved relationships) governance are among the main triggers of change towards achieving sustainable, resilient, and adaptive cities [17].

3. Method

This research adopted an exploratory strategy, giving its context, research problem, and goals. Qualitative data was collected mainly through focus group sessions with disaster management and flood response experts. Three focus group sessions were organized in November 2024, one with four experts and two with five ones. Additionally, an extra expert was interviewed. Considering its different steps, data collection was performed with 15 disaster management and flood response experts. The experts are government officials or civil servants from the Rio Grande do Sul State Civil Defense, Police Force, Firefighters, the Integrated Center for Command and Control, and ICT Agency, as well as a representative of a group of volunteers that helped the rescue of people in May 2024 through small boats, lifeboats, and water scooters. All of them were highly involved in the floods in May 2024 (and the two ones before, in September and November of 2023) in activities coordination, communication straight to society or media groups, back-office activities, and field/rescue activities, bringing to the data collection a comprehensive perspective of coordination and governance structures of flood response in the RS State.

A script with nine aspects to be discussed was prepared. Participants received a set of post-its to register their answers using a representative category. After interviewers presented a question, respondents wrote down their answers, which were then discussed with the group. After that, connection was made among the answers, aiming at having a map of answers and even orientating the discussions of the following questions.

4. Case Description

Rio Grande do Sul, the southernmost state of Brazil, was dramatically affected by intense rains and floods in September and November 2023 and especially May 2024. Guaíba Lake waterfront, a massive water mass that is also an estuary covering 1% of the state area with 2,5 thousand square kilometres, received the waters from the four biggest rivers in the RS state, themselves also with very high-water volume. The lake level in Porto Alegre, the state capital, was 5.35 meters above the riverbed, reaching 46 neighbourhoods (out of 96) and directly impacting around 157 thousand people (14% of residents), which stayed almost a month without being able to go back to their homes or business. In the state, downpours, floods, and mass sliding affected around 100 thousand buildings, and around 32% could not be recovered, as well as 14 bridges.

Impacts were extensive, reaching almost 60% of the 497 cities in the RS State, leaving them isolated for several days or weeks due to falling points, highway ruptures, or serious cracks in streets, roads, or bridges, and this situation caused shortages of potable water, food, medications, oxygen for hospitals, and even the possibility of receiving aid to help victims from other cities by land.

Amidst all this, it is possible to observe difficulties in articulating government officials, community representatives, volunteers, and citizens. Government officials involved in this flood, especially the one in May 2024, include Federal, State, and municipal civil defenses, firefighters, military police, civil police, and technical and political actors from the federal, state, and municipal levels. According to the National Civil Protection and Defense Policy, civil defenses are responsible for coordination, governance, and official communication. Rescuing people, organizing shelters, preparing food, finding dry garments and keeping them clean for all the days in the shelter, providing physical and mental health support, and receiving and organizing donations were also supported by many volunteers, following the civil defense requests but mainly self-organized. It is estimated that the number of volunteers working during this period will be twenty times more than the 15,000 volunteers registered with the state's civil defense department.

5. Analysis of Empirical Results

The analysis is divided into four primary categories. Firstly, major tasks requiring collective emergency response actions are examined, with a particular focus on the challenges encountered by the relevant actors. Secondly, governance arrangements are reviewed, with a focus on setups that support the challenges posed by decentralised actions and communication. Thirdly, the study investigates crisis communication, addressing the associated difficulties and potential solutions. Finally, the fourth and last section focuses on three obstacles, which must be addressed in the management of crises.

5.1. Mapping the tasks

Previous research highlights that interdependence of actors and tasks influence the formation of collaborative networks where a good fit in tasks is associated with more effective collaboration [18]. This study initially sought to identify and contextualize the core operational tasks that emerged during the disaster response phase. The tasks conducted during the crisis were diverse and complex, including (1) emergency rescue operations, (2) volunteer coordination, (3) establishing and managing rescue points, (4) acquiring and sharing victim data, (5) facilitating internal and external communication, and (6) managing logistics and humanitarian aids. Prior investigations about wildfire disasters indicate that a lot of emergency support functions are not exclusive to wildfire scenarios, including evacuations, road closures, restoration of transport system, provision of shelters, mass care, public information, utility restoration and maintaining public safety, among others [19]. Our tasks exhibit substantial correspondence with the compilation provided in the wildfire disaster report.

Emergency rescue operations included the manual rescue of affected individuals and animals and facilitating safe evacuation through hazardous conditions. Participants presented specific challenges, particularly related to navigating flooded areas using boats. One participant described the difficulties clearly: *“We had to navigate through flooded streets. If there were speed bumps, we’d hit them. If there was a park on the side, we’d collide... the boats inevitably ran into significant obstacles.”*

Effective emergency management typically involves coordinated engagement across public institutions, private entities, and civil society organizations [19]. Our focus group underlined that volunteer coordination was critical for effectively mobilizing the numerous volunteers and efficiently allocating donated resources. Efforts included registering volunteers, clearly assigning roles, and linking volunteers’ local knowledge to areas in urgent need. One participant explained the scale and organization involved: *“We had 65,000 volunteers registered from across Brazil. Initially, we partnered with a company that facilitated volunteer calls through an app. People registered, chose their preferred shifts, and then arrived ready to assist.”*

Rescue points functioned as operational centers for organizing relief activities and managing resource distribution during the response. Shopping malls proved useful, due to their structural suitability, proximity to affected areas, and available resources. Occasionally, rising floodwaters forced the relocation of operations from compromised sites to safer areas. As a participant noted, rescued persons had to be directed to available shelters: *“We ended up transferring people to local shelters, such as the ABB Club.”*

A rather improvised system for collecting and disseminating victim data emerged, finally enabling coordination among agencies and supporting family reunification efforts. This registry included comprehensive information such as names, evacuation points, special needs, and shelter destinations, enabling official agencies to avoid duplicated rescue attempts and facilitate family reunification. Given the absence of official tools at first, improvisation was necessary: *“We initially created a parallel system because we didn’t have the official one. At first, we used clipboards, and by the second day, we moved to Excel.”*

Timely and transparent communication proved critical for synchronizing internal operations and maintaining public engagement through media and social platforms. Major efforts focused on disseminating alerts, preventive measures, and regular operational updates. While WhatsApp proved particularly valuable, participants also highlighted challenges: *“WhatsApp was beneficial, but... we often didn’t know when the information was created. Messages circulated repeatedly, and by the time they*

reached someone who could act, it was unclear how old the information was.”

Additionally, teams carried out significant work related to humanitarian logistics, managing shelters, distributing food, clothing, and medicine, and maintaining the overall flow of humanitarian aid. Participants described logistical complexities vividly: *“Five trucks were on their way, roughly tracked... and then arrived like Pandora’s boxes filled with water, useful items, and chaos. The challenge was in managing storage and distribution effectively.”*

5.2. Governance arrangements

Collective emergency management was defined as a joint activity of two or more agencies that aim to work together in order to create better public good [19]. Our talks identified three major hubs organizing this collective emergency management. The Crisis Cabinet and the State Civil Defense, together with Civil Defense Communication, played central roles in managing the crisis response.

The Crisis Cabinet was activated as part of the governance framework once the disaster exceeded local capacities, with overall coordination assumed under the authority of the governor. Due to the extensive scale of the disaster, several decentralized crisis cabinets were quickly established. Initially, the governor set up cabinets in São Sebastião do Caí, Santa Cruz do Sul, and Bento Gonçalves, strategically reflecting the areas which were most significantly impacted. Each decentralized cabinet employed an incident command structure designed to facilitate efficient local responses.

Civil Defense actions started proactively during the pre-disaster phase, containing early warnings and preparedness initiatives. These efforts also included establishing governance mechanisms to ensure readiness for rapid mobilization. During all phases of disaster management, Civil Defense operated as the primary coordinating body at the state level, overseeing evacuation, rescue operations, and distribution of humanitarian aid. It maintained direct coordination with municipalities, state secretariats, armed forces, federal agencies, and volunteer organizations. Emphasizing the value of preparedness, one participant highlighted the importance of establishing governance structures in advance: *“This governance must be set up ahead of time; people must already know each other and have established contacts. During the disaster, it’s simply about putting into practice what has been planned and rehearsed beforehand.”* Empirical studies proved that members of disaster networks with densely connected cooperative relationship could sustain the collaboration of those organizations over time. Trust and close relationships are motivating factors for organisations to collaborate with the network [20].

A specialized Civil Defense Communication unit was established to address the significant demand for timely and accurate information from the public as well as local, national, and international media. This crisis communication office managed many information requests regarding disaster impacts, casualties, and victim statuses, while working closely in coordination with the State Communication Secretariat.

5.3. Crises communication

Participants consistently reported that formal communication channels became overloaded or unavailable early in the crisis, compelling them to rely on improvised solutions. One participant described the situation clearly: *“With the floods, power stations collapsed... repeaters equipped with generators or batteries operated until those batteries ran out, at which point we lost connectivity.”* Alternative methods, such as WhatsApp, face-to-face interactions, and amateur radio communications were then adopted. Another participant emphasized the critical role of radio communications: *“Amateur radios are included in national policy precisely because they provide redundancy and should be the last means of communication to fail.”* These findings go along the case descriptions of floodings in Myanmar, where flooding and landslides devastated public transportation and communication infrastructure [20].

Simultaneously, the demand for information from local, national, and international media was exceptionally high. One participant highlighted the intensity of this demand: *“People from about 15 different countries were reading our updates and asking questions. Large groups, many individuals, all were requesting information, data, and updates.”* Consequently, daily official briefings became crucial to meet these needs. An effective disaster response network must be able to manage distributed information so

that information can flow directly from those who have it to those who need it in sufficient time to inform actions [21].

Participants in the first focus group mentioned the disruptive impact of misinformation, highlighting that fake news not only created confusion but diverted valuable resources. One participant explained the significance of combating misinformation: *“We created a dedicated team specifically tasked with managing and countering false information, which could otherwise cause substantial harm. For instance, rumors like ‘There are 2,000 bodies floating’ needed immediate verification.”* The establishment of this “fake news office” illustrated clearly that addressing misinformation was as critical as disseminating accurate emergency information. As actors with a stronger reputation for resources and information are popular actors in a network system [20], they are also ideal units for spreading correct information and counteracting false information.

5.4. Crises Management Interaction

Participants highlighted three key interaction challenges. The first challenge centred around the tension between decentralized and centralized decision-making. One focus group participant captured this issue: *“Many times, decisions ended up being made at the local level because sometimes the query at the top level... by the time the answer came, it was no longer timely.”* Previous work emphasises the strategy of giving actors considerable freedom to find effective ways of collaborating and to decide with whom to collaborate as viable [18].

The second challenge was the information overload faced by central decision-makers. Participants suggested that concentrating all information centrally could overburden decision-makers, forcing them to make faster, more localised decisions. However, participants also emphasised the importance of ensuring that these local decisions remained in line with the overarching strategic guidance provided by those with a comprehensive view of the disaster response. This finding is consistent with previous work suggesting that incident response to complex disasters is more effective when organised in a core-periphery structure rather than a more centralised network structure [21].

The third challenge concerned the effective coordination and management of a large number of volunteers. Volunteers were primarily organized from the bottom up but required central guidance to better align their activities. One participant described the situation as followed: *“We realized there were volunteers standing idle, eager to help, with plenty to be done—but there was no one connecting them. The first day was just a sea of people with no clear tasks.”* Additionally, participants emphasized the difficulty of organizing volunteers in a way that prevented them from entering high-risk areas, thereby avoiding interference with professional response teams.

6. Discussion

An effective emergency response is founded on robust and reliable communication systems, supported by scholars reporting about near or complete collapse of terrestrial telecommunication infrastructures as typical consequences of disasters [22]. Redundant communication infrastructures ensure uninterrupted operability, even in the event of widespread disruption. The redundancy is required to ensure reliable sharing of information and coordination during challenging circumstances. Supporting strong communication, the development of integrated information-sharing systems is important. These systems allow the free flow of important data from dispersed sources to the stakeholders who have the duty of making informed decisions. That integration eliminates fragmentation of information and improves situational awareness among responding agencies.

In a case of precise communication and a cancelling-out of misinformation, institutionalized authoritative daily reports in authentic sources exist. Regular dissemination of verified news decreases uncertainty, removes panic, and reduces dependence on unverified information, which improves public involvement and confidence. Disaster situations were identified as one of the socially sensitive domains where misinformation creates further disasters [23].

Before disasters happen, good preparation will help in the reactive phase or post- disaster phase [24]. One example of this preparedness mentioned in the focus groups was the advance manufacturing of resources such as navigational maps showing areas that are likely to be under flood. These maps guide first response people through ruined terrain easy. Also, victim registries and effective humanitarian logistics make it possible for the responders to react quickly to provide the immediate needs, significantly optimizing the response speed. Therefore, effective disaster management is based on clear governance mechanisms established prior to emergencies to allow for rapid mobilization and trust generation between the stakeholders.

In addition, the integration of volunteers into networks in times of emergency significantly enhances responsiveness. Properly organized volunteer management is key to expanding rapidly and effectively using available resources. Having a well-organized but flexible volunteer involvement significantly improves overall emergency response capability. A study in Europe supports these findings about the importance of informal volunteering in disaster management, and the same time highlight that the response is more efficient when procedures for informal volunteer engagement are in place [25].

Finally, core-periphery organizational designs use centralized control of main resources and knowledge together with decentralized responsiveness [21]. The design efficiently satisfies local information needs while ensuring strategic consistency and coordinated response action among various operational levels. Effective collaboration is strongly related to interdependence and task clarity with concurred responsibility [18]. The balancing of centralized direction and localized decision-making was a key challenge found in this case study.

The study provides empirical evidence and context-specific information, primarily highlighting the balance between centralized control and decentralized agility, robust crisis communication processes, proactive management of disinformation, and organized coordination of voluntary efforts.

7. Conclusion

The findings of our study indicate the need to establish a multi-level governance framework and data governance strategy to ensure robust communication, unified information-sharing and defined governance structure for effective disaster management.

This research has a few limitations, including the unit of analysis limited to the public sector agencies and the number of executed focus groups. Complementary data collection could include community representatives, citizens and other stakeholders that supported the response to the flood event in Rion Grande do Sul, but also events in other locations.

To enhance flood resilience, it is essential to understand the role of data in promoting sustainability transformation. This involves ensuring that digital technologies and datasets are developed, processed, disseminated, and utilized in accordance with governance frameworks and the changing dynamics of power relations [26]. In this line, and as a response to the findings of this study, the identification of critical information flows for data governance in flood disasters and designing multi-level governance frameworks is critical in supporting flood response and resilience. Next steps of this research will propose a multi-level framework for flood management and a data governance strategy based on mapping the critical information flows that emerged during the response phases of the flooding event.

Declaration on Generative AI

During the preparation of this work, the authors used Chat-GPT-4 and Deepl Write in order to: Grammar and spelling check. After using these tools, the authors reviewed and edited the content as needed and takes full responsibility for the publication's content.

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