

Logistical challenges faced by Civil Defense in the 2023 São Sebastião disaster

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Abstract

Paper aims: This case study analyzes the logistics challenges faced by the Civil Defense in responding to the disaster that hit São Sebastião City, in February 2023.

Originality: The study contrasts theory with practice by analyzing a real case considering the concepts of humanitarian logistics and disasters.

Research method: This research is classified as qualitative, applied, and exploratory, based on an inductive logical framework, using the case study method. It examines a variety of information sources, including bulletins, reports, municipal data, media content, and information from disaster management-related entities' websites. Data interpretation was conducted continuously, starting from the collection phase, and was detailed and analyzed using a crisis management model prevalent in the literature.

Main findings: The results offer practical lessons for professionals and contribute to enhancing disaster preparedness policies and response manuals, emphasizing the importance of coordination among response agencies, the need for effective communication with affected community stakeholders, and the mobilization of logistical resources for the distribution of relief supplies.

Implications for theory and practice: This research addresses the necessity of documenting logistics challenges in the face of disaster events, contributing to knowledge management within entities. It also maps the operational bottlenecks encountered in disaster coordination.

Keywords

Humanitarian Logistics. Disaster Response. Socio-Environmental Vulnerability. Civil Defense. Climate Events.

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1. Introduction

The recurrence of disasters due to uncontrolled population and urban growth exposes the population to difficult-to-control risks (United Nations Office for Disaster Risk Reduction, 2011). In 2023, Brazil recorded a record number of hydrological and geohydrological disaster occurrences, totaling 1,161 events, 716 associated with hydrological events such as river overflow, and 445 with geological events such as landslides. These figures surpassed the records of 2022 and 2020 (Brasil, 2023d). In a disaster, its repercussions cause multiple disruptions and impacts on the political, social, and economic development, physical and psychological health, and social well-being of those affected (Mattedi, 2017).



Factors contributing to triggering these events in urban areas include soil sealing, building densification, heat conservation, and air pollution (Kobiyama et al., 2006). The socioeconomic vulnerability of these regions compromises their ability to adapt and mitigate impacts, influenced by factors such as poverty levels, social inequality, educational attainment, economic development, and resilience (Dias et al., 2018; Renteria et al., 2021). This socioenvironmental scenario results from vulnerabilities and degradation of the physical environment that, consequently, increase the quantity and intensity of disasters occurring in the country (Valencio, 2012).

Such events in the Brazilian Southeast region occur most frequently during the summer, characterized by high levels of rainfall (Brito Junior et al., 2020), leading to increased soil weight and reducing its shear strength due to decreased apparent cohesion caused by saturation and an increase in hydrostatic pressures. These factors favor the occurrence of mass movements on the terrain (Tatizana et al., 1987). This scenario was observed in February 2023, with the disaster caused by heavy rainfall and landslides on the North Coast of the state of São Paulo (ReliefWeb, 2023).

In the aftermath of a disaster, humanitarian logistics, a branch of logistics science responsible for mobilizing people, resources, skills, and knowledge, is immediately activated to assist a community and its victims, alleviating the suffering and losses caused by the event (van Wassenhove, 2006; Thomas & Kopczak, 2007). The role of logistics in humanitarian operations encompasses a variety of activities, including preparation, planning, procurement, warehousing, transportation, distribution, tracking, location, and other related issues to assist affected people (Thomas, 2004; Cardoso et al., 2023; Cunha et al., 2024a). In Brazil, disaster response is coordinated by the states through the National System of Civil Protection and Defense (SINPDEC), under the National Secretariat for Civil Protection and Defense (SEDEC), which is part of the Ministry of Regional Integration and Development (Brasil, 2024). In a disaster context, response actions encompass rescue, assistance, and restoration. During rescue operations, the priority is to save victims, provide medical care, and evacuate affected areas. Assistance actions include the distribution of hygiene and cleaning supplies, food baskets, clothing, coordination of temporary shelters, and logistics for the response team. Regarding restoration, the actions focus on the recovery of essential services such as water, energy, transportation, road clearing, and urban cleaning, aiming to restore normality after the disaster (Brasil, 2020). Local authorities take the lead, planning and executing actions, providing resources, and establishing procedures.

Despite the assigned responsibilities, challenges are faced related to formal training in command and control structures, as well as in the integration between disaster response agencies. This skills gap compromises the effectiveness of disaster response, as it results in difficulties in minimizing the resulting impacts (Escudeiro et al., 2022). Amid the Brazilian scenario, this case study aims to analyze the Civil Defense's actions in the aftermath of a climatological disaster based on two research questions:

RQ 1: How the Civil Defense responded to the disaster that occurred in São Sebastião, on the north coast of São Paulo, in 2023?

RQ2: What logistical challenges did the institution face in its disaster response efforts?

The paper aims to provide an overview of disaster response strategies undertaken by Civil Defense, examining the mobilization of logistical, human, and material resources to address the situation. The analysis seeks to document the challenges faced by the organization during its response operations, aiming to enhance organizational knowledge management and improve future interventions in similar situations (Gonzalez-Feliu et al., 2020).

For this, a qualitative case study was conducted to collect and analyze data on the performance of the Civil Defense during this disaster. Data were collected from the Civil Defense internal reports, public bulletins, content from journalistic websites, and institutional portals of organizations involved in humanitarian aid. The scope of the study follows the parameters outlined in the Civil Defense disaster management manual Oliveira, 2009) (National Policy on Civil Protection and Defense (Brasil, 2012a), and Article 2 of Decree number 10.593/2020, which deals with “[...] response actions - emergency measures carried out during or after a disaster, aiming to rescue and assist the affected population and restore essential services [...]” (Brasil, 2020).

The contribution of this work lies in the analysis and transcription of various materials, contributing to the literature through a precise description of the operation, enabling the mapping of operational logistical bottlenecks encountered in disaster coordination. The significance of the study lies in the aim to achieve the 17 Sustainable Development Goals of the UN, specifically target 11.5, which focuses on reducing the number of deaths and people affected by disasters.

This research is structured into seven major sections, including this introduction that presents the issue and its context, objectives, justification, significance, and limitations. In the following section, the theoretical foundation is presented. The third section presents the methodology adopted for the proposed case study. After that, the fourth section offers a case description, while the fifth section presents the results. The sixth section

discusses the lessons learned in disaster management. The document concludes with the seventh section, where final considerations are considered to drive future studies.

2. Theoretical foundation

Logistics is a cornerstone of disaster management, enabling effective coordination and rapid response to humanitarian crises. Municipal Civil Defense plays a central role in mobilizing and managing material, technological, human, informational, and financial resources to address immediate needs and restore normalcy in disaster-affected areas. Working alongside federal and state governments, these agencies utilize structured frameworks such as the Incident Command System (ICS) to ensure clarity in roles, streamline operations, and maintain effective communication among diverse stakeholders (Brasil, 2024; Oliveira, 2009). Figure 1 illustrates this organizational structure, emphasizing how logistical workflows are designed to optimize resource allocation and prioritize operational efficiency during emergencies.

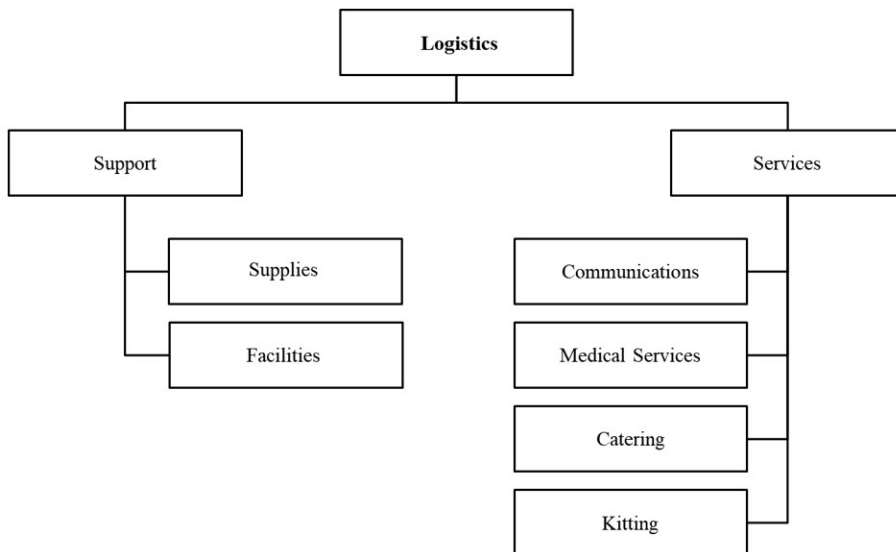


Figure 1. Logistic structure of Civil Defense. Source: Adapted from Oliveira (2009).

The logistical process spans all phases of disaster management: mitigation, preparedness, response, and recovery. During mitigation, measures like constructing warehouses, reinforcing critical infrastructure, and developing transportation networks reduce disaster vulnerability. In preparedness, pre-positioning supplies, allocating transportation resources, and training response teams ensure that rapid and effective interventions can be carried out when disasters occur. Response efforts focus on mobilizing resources to deliver aid, ensure medical support, and access affected areas despite disrupted infrastructure. Recovery logistics support the restoration of critical systems and community rebuilding, underscoring the long-term importance of logistics in disaster resilience (Apte, 2020; Besiou & Van Wassenhove, 2020).

Donation management is a key element of humanitarian logistics, directly influencing the efficiency and equity of disaster response. Effective systems for controlling the flow of donations help prevent overloads, avoid duplication, and ensure that resources reach affected populations. Processes such as sorting, categorizing, and storing items, combined with real-time monitoring systems, enhance transparency and accountability. These measures enable the prioritization of essential goods and optimize the allocation of resources in complex disaster environments (Holguin-Veras, 2018). Failure to implement such systems exacerbates operational challenges and delays aid delivery, increasing the vulnerability of affected populations (Camero-Quispe et al., 2024).

Coordination among stakeholders is critical to overcoming the complexities of disaster logistics. Municipal Civil Defense must facilitate collaboration between government agencies, NGOs, private entities, and community organizations. Disruptions to infrastructure and communication systems, common in disaster scenarios, heighten the need for adaptive and collaborative strategies. Mixed coordination mechanisms, which integrate vertical (e.g., government-led) and horizontal (e.g., NGO and community-driven) partnerships, have proven effective in enhancing efficiency, equity, and sustainability in humanitarian operations (Bertazzo et al., 2018; Cunha et al., 2024b).

The chaotic and resource-scarce conditions typical of disasters further highlight the importance of integrating logistics with effective decision-making criteria. Applying principles of efficiency, equity, and sustainability to logistics operations ensures a balanced approach to resource allocation, reducing risks and improving outcomes for disaster-affected communities (Carnero-Quispe et al., 2024). Additionally, the complexity of these environments requires Civil Defense to continuously gather and analyze information on emergencies, implement robust supply chain management practices, and provide critical services like communication, medical care, and transportation (Barino & Cardoso, 2023).

In conclusion, logistics and donation management are indispensable to the success of disaster response and recovery. By fostering coordination, applying structured frameworks such as the ICS, and integrating adaptive strategies, Civil Defense and its partners can overcome operational challenges and improve humanitarian outcomes. These approaches ensure the timely delivery of aid, strengthen resilience in disaster-affected communities, and enhance preparedness for future crises. Figure 1 underscores these principles, offering a visual representation of the recommended logistical structure for Civil Defense operations.

3. Research methodology

The research is classified as qualitative, applied, and exploratory, employing an inductive approach and open data sources. Qualitative research, commonly used in business, social sciences, and organizational studies, is well-suited to explore the complex realm of logistics and supply chains due to its focus on various contextual contingencies, variations, and interactive issues (Karlin, 2004). Subjective analysis within the interpretive paradigm seeks to understand human experiences and construct meanings, capturing the complexity of social reality that quantitative methods cannot adequately represent. Focused on individuals' perceptions and interpretations, this approach is particularly relevant in contexts shaped by factors such as culture and interpersonal interactions, providing a deeper insight into social reality in contrast to the superficiality of quantitative analyses (Morgan & Smircich, 1980).

The case study method is characterized by its in-depth investigation, providing principles and guidelines to be observed during the exploration process (Gil, 2009). We adopt the six steps proposed by Miguel (2012) to conduct the case study (Figure 2): (i) definition of the conceptual-theoretical structure; (ii) case planning; (iii) pilot test conduct; (iv) data collection; (v) data analysis; and (vi) report generation.

The first stage, constructing the theoretical framework, was developed through literature review and documentary research. This included the enactment of laws following major disasters in Brazil, the cataloging and characterization of disaster events in the state of São Paulo over 10 years, and the logistical operational structure of Civil Defense.

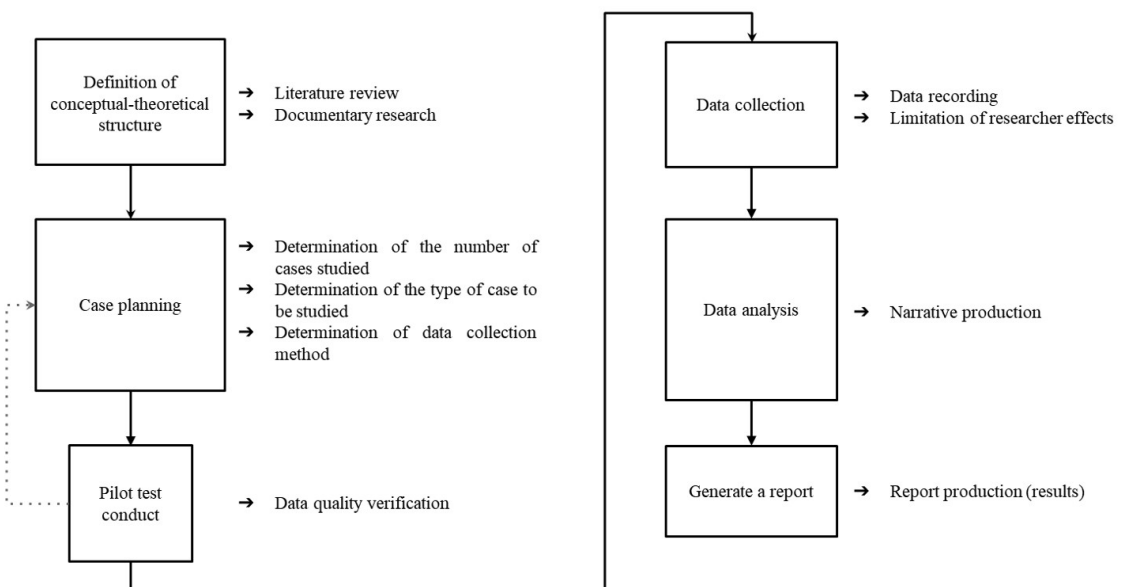


Figure 2. Methodological proposal. Source: Adapted from Miguel (2012).

The second stage, case study planning, involved determining the number and type of cases to be studied, followed by the data collection and quality verification. A specific case study was chosen to allow for deeper and richer data collection. A retrospective case was selected to investigate the past and gather historical data.

Data collection involved analyzing and selecting information from multiple sources, including daily bulletins from the municipal and state Civil Defense, data from the municipal government, content from journalistic portals, and information from institutional websites of companies and agencies involved in the disaster response process. Additionally, internal reports from the state Civil Defense were consulted. By collecting data through government agencies report directly involved in the disaster, we ensured the credibility of the obtained information, enabling the analysis of official and accurate data regarding the event.

Data interpretation was conducted continuously during collection, following guidelines for qualitative methods (Lincoln & Guba, 1985) and constant comparative techniques (Glaser & Strauss, 1967). Therefore, in the data analysis stage, the data were interpreted in the context of article 2 of decree number 10.593/2020, which regards “[...] response actions - emergency measures carried out during or after a disaster, aimed at rescuing and assisting the affected population and restoring essential services. [...]” (Brasil, 2020). This regulation encompasses actions involving: i) responding to the event; ii) providing relief to the victims; iii) assisting victims and the community; and iv) restoring essential services. These actions fall within the purview of the state Civil Defense during the critical phase of disaster management, with a predefined time frame, subsequently transferring its administration to the local Civil Defense and public authorities in the area affected.

Clear definition of themes and dimensions were defined, in accordance with the crisis management interpretation model proposed by Silveira dos Santos et al. (2016), which includes elements such as Crisis Constraints, Organizational Structure, Cognitive Factors, Development of Solutions, and Motivation Mechanisms. This model guides the analysis by specifying how data should be interpreted to effectively understand and manage crises. It outlines recommended steps and methods for examining and interpreting collected information, offering a clear framework for analyzing and understanding the events and decisions made during crises.

Table 1 shows the data analysis framework, demonstrating the relationship between “First Order Concepts” and “Second Order Themes.” It visually exemplifies how qualitative data are organized and interpreted, illustrating the transition from raw data to a more structured and in-depth analysis.

Table 1. Data structure.

First-Order Concepts	Second Order Themes
Logistical resources	
Human resources (response teams)	
Informational resources (telecommunications)	Crisis Constraints
infrastructure damage (roads and highways)	
Local Civil Defense	
State Civil Defense	
Crisis Management Office	Organizational Structure
Other Agencies and NGO's	
Interaction among diverse actors	
Previous experience of the involved actors	Cognitive Factors
Adaptation of strategies	Development of Solutions
Leadership, communication, and role definition in actions	Motivation Mechanisms

Source: Adapted from Silveira dos Santos et al. (2016).

In qualitative data analysis, “First Order Concepts” and “Second Order Themes” represent different levels of categorization and abstraction. The former refers to raw data derived from observations, reflecting participants’ perceptions without interpretation. The latter emerges from the analysis of these concepts, organizing them into broader categories that identify common patterns. Thus, first-order concepts provide the initial descriptive layer, while second-order themes structure the data, enabling a more detailed and coherent interpretation. In qualitative data analysis, “First Order Concepts” and “Second Order Themes” represent different levels of categorization and abstraction. The former refers to raw data derived from observations, reflecting participants’ perceptions without interpretation. The latter emerges from the analysis of these concepts, organizing them into broader categories that identify common patterns. Thus, first-order concepts provide the initial descriptive layer, while second-order themes structure the data, enabling a more detailed and coherent interpretation.

Finally, the conclusions are presented in the present paper, from the comparison between the theoretical framework presented and the case study exposed, focusing on the performance of the São Paulo Civil Defense.

4. Case description

In this section, a review of legal documents underpinning disaster law in Brazil was conducted, followed by the characterization of the case study.

4.1. Legal framework

Academics around the world are increasingly focusing their attention on the role of the legal system in disaster scenarios. In Brazil, the legal system is constantly adapting to these emerging demands. By defining disasters and establishing their theoretical and regulatory framework, a new branch of law emerges, complementary to Environmental Law, albeit sharing intersections with it (Farber, 2012). Therefore, disaster law encompasses not only the regulation of prevention and mitigation but also the stages of preparedness, response, and reconstruction of affected areas (Andrea, 2023).

Disaster Law is characterized by its interdisciplinarity, encompassing fields such as Environmental Law, Urban Planning Law, Insurance Law, Criminal Law, Contract Law, Administrative Law, Constitutional Law, and Civil Law. Liability and risk-sharing, contractual breaches with defenses of commercial impracticability or frustration of purpose, and the dynamics of federalism play significant roles in disaster management. These legal and structural issues influence how disasters are approached and shape the policies and practices adopted by governments and organizations in preparing for and responding to crises (Farber, 2012; Andrea, 2023).

Disaster law in Brazil is recent and possesses an autonomous regulatory framework, including laws such as Law No. 12.340/2010 (Brasil, 2010a), Decree No. 11.219/2022 (Brasil, 2022a), Law No. 12.608/2012 (Brasil, 2012a), Decree No. 10.593/2020 (Brasil, 2020), and Decree No. 10.692/2021 (Brasil, 2021), which address the prevention, mitigation, preparedness, response, and recovery of affected areas. These legislations complement the constitutional basis of the 1988 Federal Constitution (Brasil, 1988), which grants the Union the competence to defend against public calamities, such as droughts and floods, and provides measures such as the declaration of a state of defense and the institution of compulsory loans in cases of calamity. This set of norms, known as the “constitutional crisis system,” establishes a robust legal structure to manage disasters in the country (Brasil, 2012a; Coutinho, 2014; Andrea, 2023). With the enactment of Law 12.608/2012 (Brasil, 2012a), there was a multisectoral integration aimed at reducing disaster risks.

Brazilian legislation defines concepts, guidelines, objectives, and norms for dealing with disasters in the country, evolving to adapt to new realities and emerging needs. Decree No. 5.376/2005 (Brasil, 2005), established fundamental concepts such as civil defense, disaster, emergency, and state of public calamity, and outlined the purposes of the National Civil Defense System (SINDEC). This decree was later replaced by Decree No. 7.257/2010 (Brasil, 2010b), which introduced significant changes to expand and incorporate new concepts such as relief actions, assistance, and recovery. Additionally, the decree included a chapter on the Transfer of Federal Government Resources to states, the Federal District, and municipalities aimed at executing relief operations, assisting victims, restoring essential services, and reconstruction (Brasil, 2022c).

Subsequently, Law No. 12.608/2012 (Brasil, 2012a), established the National Policy on Protection and Civil Defense (PNPDEC), defined the National System for Protection and Civil Defense (SINPDEC) and the National Council for Protection and Civil Defense (CONPDEC), and authorized the creation of the Disaster Information and Monitoring System, currently known as the Integrated System of Disaster Information (S2iD). In 2016, Normative Instruction No. 2/2016 (Brasil, 2016), established procedures and criteria for declaring a state of emergency or public calamity by states, municipalities, and the Federal District, as well as for federal recognition of abnormal situations declared by federal entities. Currently, the regulation governing these declarations and recognitions is Ordinance No. 260/2022 (Brasil, 2022b) (amended by Ordinance MDR No. 3.646/2022). According to Article 13 of the Normative, the Union must adopt the disaster classification as described in the Brazilian Disaster Coding - COBRADE (Brasil, 2012b).

By Law No. 12.608/2012 (Brasil, 2012a), Decree No. 10.593/2020 (Brasil, 2020) regulates the organization and operation of SINPDEC and CONPDEC, establishing guidelines for the National Plan for Protection and Civil Defense and the National Disaster Information System. In 2023, Decree No. 11.774/2023 (Brasil, 2023a) amended Decree No. 10.593/2020 (Brasil, 2020) to define the framework of SINPDEC further. This decree stipulates that organs and entities within the federal, state, district, and municipal systems of protection and civil defense should operate in a coordinated manner, without hierarchy, under the coordination of the National

Secretariat of Protection and Civil Defense of the Ministry of Integration and Regional Development. Recently, Law No. 14.750/2023 (Brasil, 2023b), amended Laws No. 12.608/2012 (Brasil, 2012a), and No. 12.340/2010 (Brasil, 2010a), aiming to enhance the instruments for prevention and recovery of areas affected by accidents or disasters, risk monitoring, and issuance of early warnings. The evolution of the National Policy on Civil Protection and Defense, along with its related legislation, stands out among public policies, requiring coordinated and integrated implementation. This approach aims to strengthen institutional articulation and interdisciplinary organization to enhance response and prevention in emergencies (Brasil, 2017).

4.2. Overview of climate-related disasters in the state of São Paulo

In the state of São Paulo, events caused by natural processes are directly associated with landslides, flooding, drainage floods, and heavy rainfall (Brasil, 2012b). Note there are regional differences in these processes. In the central-western portion of the state, there is susceptibility to heavy rainfall and storms. In the eastern region, landslides and flooding processes prevail. However, while these events occur throughout the state, the regions of “Vale do Paraíba Paulista” and “Litoral Sul”, due to the higher volume of frontal rainfall, which can be more intense and prolonged, are more affected, impacting a larger number of people and triggering more significant processes. Many of these processes are associated with the morphology of the drainage basins in these areas (Tominaga, 2012).

In addition to this inherent environmental characteristic, other factors amplify the risks. According to Carvalho (2004), extreme rainfall events show interannual variability associated with “El Niño” and “La Niña” phenomena, as well as intraseasonal variations related to the activity of the South Atlantic Convergence Zone and the Low-Level Jet of South America. The impact of these phenomena is observed in the state of São Paulo, where since 2013, there have been 8,733 records of occurrences, with 116 specifically in the municipality of São Sebastião (São Paulo, 2023c). To better visualize the evolution of these events, Table 2 lists data on the nature of the events extracted from the Integrated Disaster Information System (S2iD), about the recent history of disasters recognized by the National Civil Defense and according to UNDRR-ISC Hazard Definition & Classification (United Nations Office for Disaster Risk Reduction, 2021). The data for the year 2023 includes information extracted from the S2iD database up to July 31, 2023.

Table 2. São Paulo Civil Defense Occurrences list with intervention over 10 years.

Year	Disaster Numbers	Disaster Type
2013	10	Heavy rains (05), floods (02), viral infectious diseases (01), urban fires (01), tornado (01).
2014	11	Heavy rains (01), floods (04), landslides (01), flash floods (01), squall (01), drought (03).
2015	3	Heavy rains (02), squall (01).
2016	29	Heavy rains (12), landslides (02), floods (07), flash floods (01), drainage flood (01), hail (01), squall (04), tomado (01).
2017	25	Heavy rains (16), floods (03), flash floods (02), hail (01), drought (01), water supply failure (01), building collapse (01).
2018	12	Heavy rains (06), flash floods (02), drainage flood (02), hail (01), building collapse (01).
2019	23	Floods (02), flash floods (03), drainage flood (01), heavy rains (14), squall (01), cyclones (01), building collapse (01).
2020	198	Heavy rains (19), drainage flood (01), landslides (01), flash floods (01), cyclone (01), forest fires (02), and viral infectious diseases (173).
2021	41	Heavy rains (09), viral infectious diseases (23), forest fires (01), squall (06), and drought (02).
2022	27	Heavy rains (25), hail (01), and rockfall (01).
2023	53	Heavy rains (48), floods (03), flash floods (01), dam collapse (01).

Source: S2iD (Brasil, 2023c).

The frequency, severity, and intensity of disasters in the state have shown a sharp increase, as indicated in Table 2. This implies the need for intervention by the state Civil Defense in the municipalities, given its greater organizational capacity and resources to deal efficiently with such emergency demands. Regarding São Sebastião, a coastal municipality in northern São Paulo, the subject of this paper case study, Table 3, based on S2iD data, quantifies the number of occurrences and losses over 10 years.

Table 3. São Sebastião municipality disaster historical occurrences.

Year	Disaster Type	Consequences
2013	Floods	Homeless (37), displaced (2,340), other affected (4,200), sick (10), injured (200), and death (01).
2018	Flash floods	Homeless (74), displaced (287), other affected (351).
2019	Heavy rains	Homeless (124), displaced (27), other affected (73,682).
2023	Heavy rains	Deaths (65), rescued alive (28), missing (1), displaced (1,521), homeless (1,144), other affected (71,075).

Source: S2iD (Brasil, 2023c).

The analysis of Table 3 reveals an alarming scenario of disaster occurrences in São Sebastião, evidencing an increase in their consequences, manifested in deaths, missing persons, displaced persons, and homeless people.

4.3. São Sebastião February 2023 disaster contextualization and characterization

On February 19, 2023, the northern coast of the state of São Paulo was hit by high-intensity and long-lasting rains, with a precipitation accumulation of 682 millimeters, causing floods, tree falls, landslides, and the overflow of watercourses, resulting in the declaration of a state of emergency. Additionally, the federal government requested the recognition of the disaster situation in the area.

Due to the rains, there were severe landslides on the Rio-Santos highway SP-055, resulting in blockages and the formation of dams, and on the Mogi-Bertioga highway (SP-98), there were obstructions with erosion and asphalt sedimentation, making traffic impossible, disruption of rescue teams' mobility, restricting or interrupting the flow of vehicles and equipment traffic, as well as blocking transportation routes, making it unviable to move supplies, equipment, and human resources intended for disaster response. In addition, this condition makes it difficult to access assistance centers, negatively impacting both assisted people and response teams. The inaccessibility of the area is highlighted in Figure 3, which shows 18 blocked points resulting from the disaster along the Rio-Santos highway, specifically in the section between Juquehy and Sahy.

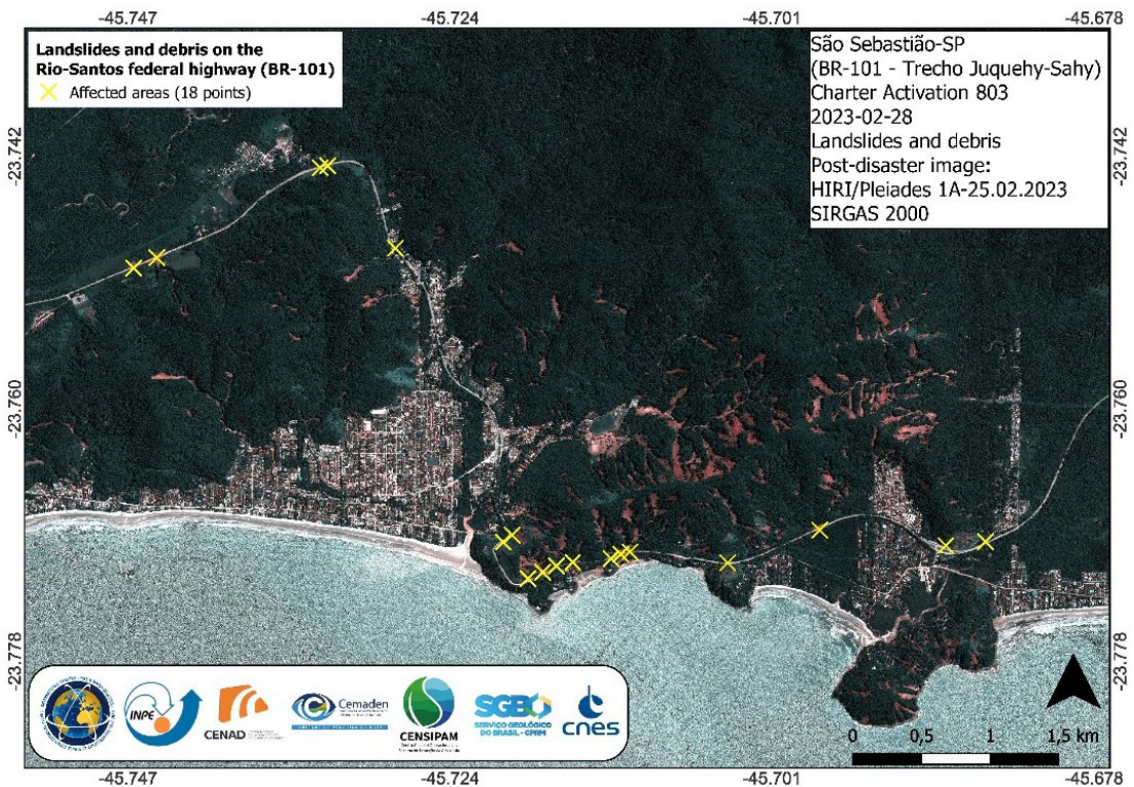


Figure 3. Landslides and debris on the Rio-Santos federal highway- Juquehy beach to Barra do Sahy. Source: Disaster Charter (2023). International Charter: Space and Major Disasters. Pleiades material © CNES (France, 2023), Distribution Airbus DS. Map produced by CENAD.

Since the event began in the early hours, most residents and tourists were asleep or resting during the landslides, which swept away buildings, vehicles, vegetation, and people. The most affected areas were Vila Sahy, Juquehy, Boiçucanga, and Camburi, as there were irregular dwellings in an environmentally protected area, exacerbating the situation. The soil in the affected region remained saturated due to the continuous rainfall. This situation left numerous individuals homeless, with some refusing to evacuate the risk area and others going missing. Data provided in the latest emergency bulletin regarding the state of public calamity issued by the São Sebastião municipality shows the real extent of what happened in the region, as demonstrated in Table 4.

Table 4. 2023 São Sebastião municipality disaster damage quantification.

Disaster Consequence	Quantitative	Descriptive
Confirmed deaths	65	Men: 22; Women: 19; Children: 23
Rescued alive	28	Not specified
Missing	1	Man / Baleia Verde Neighborhood
Displaced	1,521	Not specified
Homeless	1,144	Not specified
Emergency shelter / Social hosting	1,096	Public buildings and hotel chain agreements
Pet accommodation	60	Zoonosis Centers and Shelters
Building closures	79	Houses
Dismantle	18	After expert assessments

Source: São Paulo (2023b).

After the event, five new areas prone to risks were identified in the neighborhoods of Juquehy, Camburi, Vila Sahy, Boiçucanga, and Baleia Verde. In the São Sebastião Municipal Risk Reduction Plan, nine thousand individuals were estimated to be living in vulnerable areas. However, based on post-disaster estimates, this number increased to sixteen thousand people.

5. Results

This section presents the logistics initiatives of the Civil Defense to assist the population in restoring essential services according to Article 2 of decree number 10.593/2020.

5.1. Responding to the event

Due to the severity of the situation, a crisis management team was established. The situation was identified by the Civil Defense, goals were defined, strategies were formulated, and the necessary logistics resources were mobilized for relief and recovery operations. The response actions were coordinated by the state of São Paulo in conjunction with the Civil Defense Coordinator, with the support of the entities and institutions detailed in Table 5, as well as the human and logistical resources provided by them.

Other institutions, entities, and organizations were also involved in the response efforts, including the Highway Patrol, Environmental Police, National Telecommunications Agency, National Health Foundation, Health Surveillance of São Sebastião, the NGO Gerando Falcões, the Brazilian Bar Association - SP, Buser, and SOU Transportes (São Sebastião, 2023). The multiplicity of actors involved was a challenge in establishing command in terms of defining the roles and responsibilities of each institution involved. Climate variability presented a significant challenge in coordinating the teams involved, directly impacting the mobilization of resources and personnel, as well as worsening the conditions of the incidents.

The disaster response in São Sebastião involved the mobilization of human and material resources from various entities, highlighting the importance of efficient coordination among actors for the timely execution of actions. Role definition and management of variable weather conditions required effective communication and flexibility in logistical planning. The articulation between governmental and private sectors was fundamental for resource allocation, facilitating air search and rescue, victim transfer, transportation of supplies, optimization of access to affected areas, and delivery of aid. This integrated approach not only enabled initial relief efforts but also supported long-term recovery and restoration of affected areas, emphasizing logistical management as a key factor in the operation's success.

The articulation between sectors such as government agencies, government bodies, and the private sector to provide and allocate logistical resources was the key element to the success of this disaster response operation. The use of these resources initially allowed the implementation of actions such as air search and rescue, victim transfer, transportation of priority inputs, optimization of access opening to affected areas, expansion of search and rescue operations, rescues, and, later, delivery of aid (materials, supplies, donations). As the operation progressed, these resources were directed to mitigate the social and material losses of the affected population, involving waste removal and the restoration of essential services (São Sebastião, 2023).

Table 5. São Sebastião disaster response logistics efforts quantification.

Entity	Human Resources	Logistics Resources
Fire Department	944	35 Light vehicles; 15 4x4 vehicles; 02 Minibus vehicles; 03 Fire Engines
State Civil Defense	76	07 service vehicles
Municipal Civil Defense	8	02 service vehicles
Disaster Relief Group (GADE)	02 National Civil Defense 02 Maceió Civil Defense	-
Technological Research Institute (IPT)	01 Civil Engineer 03 Civil Technologists 01 Environmental Engineer 04 Geologists 01 Hydraulic Engineer 01 Assistant 06 Geologists	-
Environmental Research Institute (IPA)	01 Environmental Specialist 01 Assistant	-
São Paulo Municipality Civil Guard	26 officers	-
Military Police	Local military police: 162 Reinforcement: 300 Total Staff: 462	05 helicopters AS350 Squirrel 01 helicopter EC135 01 helicopter AW109SP
Brazilian Army	01 Search and rescue team 20 Technical and operational military personnel 380 Soldiers	03 helicopters HM-1 Pantera 02 helicopters HM-4 Jaguar 01 helicopter HM-3 Cougar 13 engineering vehicles and equipment 30 vehicles
Brazilian Navy	28 doctors 180 marines	01 Multipurpose Aircraft Carrier 06 helicopters 03 landing craft for vehicles and personnel Field Hospital
Energias de Portugal (EDP) Concessionaire	Over 100 people distributed in response teams	01 mobile unit
The State of São Paulo government	Três Rios Inter-municipal Consortium	01 recycling Construction and Demolition Waste machine
Others - Urban Cleaning	2500 workers	500 machines including garbage trucks, debris removal trucks, loaders, skid steer loaders, water jetting trucks, and others
ROUGH TOTAL ESTIMATE	5209	632

Source: Compiled from São Sebastião (2023) and São Paulo (2023b).

Considering the magnitude of the event, on March 3, 2023, State Decree No. 67,530 was issued, establishing the creation and organization of the Litoral Norte Support Office within the State Governor. This measure aimed to address the emerging needs resulting from the event. To ensure assistance to affected families and the restoration of logistical, transportation, sanitation, housing, and tourism infrastructure in the areas affected, the decision was made for the “State” to remain in São Sebastião City (São Paulo, 2023a). Following the decree, actions related to the disaster response were initiated, as described in the following subtopics.

5.2. Providing relief to the victims

In the disaster response process, addressing the needs of affected individuals presented logistical challenges for Civil Defense, as outlined by Decree No. 10,593 of December 24, 2020, and disaster management guidelines. Mobilizing and effectively coordinating resources involved multiple stakeholders such as the Fire Department, NGOs, volunteers, Military Police, Army, and Navy, necessitating clarity in roles to prevent communication failures. Road blockages hindered access, underscoring the need for adaptive infrastructure solutions, including the strategic use of heliports as outlined in the decree. Establishing improvised operational bases and the ongoing challenge of ensuring sustainable supply for teams underscore the importance of flexible and adaptable logistical planning. Continuous information management, crucial for effective operational coordination, emphasizes the need for investments in robust communication technologies and alternative solutions for areas affected by infrastructure damage.

Three support stations were established based on severity and need. The first and central one was set up at the headquarters of São Sebastião City Hall, under the Governor's coordination along with the Civil Defense Coordinator. Subsequently, the second advanced command post was established at the Verde Escola Institute, maintaining continuous communication with the main command post due to road blockages. An assessment of the disaster magnitude was carried out, and a review of resource needs was conducted to ensure an appropriate response to the event. The third and final advanced command post was established in the southernmost area to serve the district of Juquehy, under the supervision of the São Sebastião command post, responsible for controlling and directing the flow of information (São Paulo, 2023b).

The command posts, once established, instituted a routine comprising two daily meetings at 7:30 AM and 5:00 PM. These meetings allowed for better organization of teamwork, enabling daily evaluation and improvement of activities related to the operation, with a special focus on the Civil Defense measures to protect the individuals affected. The command posts operated continuously, 24 hours a day, providing frequent updates and real-time dissemination of administrative or operational incidents (São Paulo, 2023b).

The Fire Department camp was established in the Verde Escola Institute court facilities located in Vila do Sahy, and routines were implemented. Due to the inability to transport food supplies to the teams, they relied on a diet based on cereals from their operational kits. Later, as operations progressed, meals were provided to the operational personnel, totaling approximately 6,500 meals, along with 6,000 liters of potable water for consumption. Since the disaster occurred during the Summer Operation period, the region had a workforce of 944 people. With this contingent, a review of the service schedule was conducted, resulting in adjustments to team compositions (São Paulo, 2023b).

Faced with the challenge posed by roadblocks involving the movement of emergency response teams. Given the mobility limitations, the strategy adopted included using the heliport known as SDG9, under the jurisdiction of the Navy in São Sebastião, as a point of embarkation and disembarkation for the operational teams of the Fire Department, as well as for victims who had been triaged and transported by the supporting aircraft of the Military Police and the Brazilian Army. These operations were coordinated by the Fire Department Command Post. Due to the isolation of the areas in Vila Sahy, the teams were stationed on the local soccer field or in the square, which had been previously adapted to allow for the aerial operations of the aircraft involved in the emergency response.

Due to the extent of the area affected, there was the need to delimit, monitor, control, and categorize access to the affected site. The region where the victims were located was designated as the "hot zone," with restricted access allowed only for individuals directly involved in the response to the incident. The "warm zone" was delimited by the location of the vehicles, and also not freely accessible. The "cold zone" was situated at the Verde Escola Institute, serving as the operational base for conducting the operation.

The search for the missing was carried out for seven days, resulting in a total of 65 fatalities and 28 injured individuals. In the district of Boiçucanga, there were 5 fatalities, and 1 person was rescued. In Vila do Sahy, the number of fatalities was 49, with 27 people being rescued alive. Initially, due to the blocked access to Vila do Sahy, victim assistance procedures, and body preparations were conducted at the Verde Escola Institute. There, victims underwent triage performed by volunteer doctors. The most severe cases and fatalities were then transported by aircraft.

Due to the magnitude and scope of the disaster, the resident population in the locality was substantially impacted by the consequences of the event, leading to various aspects, including a significant number of minor injuries, disruption of service infrastructure and supply, as well as structural collapse of buildings. As the roads were reopened, identified victims were transported to regional hospitals in the area, while fatalities were transferred to the Institute of Forensic Medicine.

Following the allocation of teams, materials, equipment, and supplies to address the disaster, actions were initiated to assist victims and support the community, focusing on deploying available resources to mitigate damages, restore essential services, and provide immediate aid to identified needs.

5.3. Assisting victims and community

Faced with the extent of the consequences of this sudden disaster and the challenges faced in the first hours of the initial response, the projection of the demand of the population to be assisted proved to be uncertain, increasing as the relief operations progressed. The disruption of communication and information systems heightened the complexity of estimating the number of victims, due to the inaccessibility of data regarding the occupancy of hotels, inns, and similar establishments. This occurred during the carnival season when the city

was hosting tourists, with the absence of residents and the presence of second-home owners and temporary renters (Associação Brasileira de Internet, 2023).

The disruption of information management systems compromised the coordination of response operations, fragmenting communication and hindering the allocation of resources, as the lack of electrical infrastructure and communication networks prevented the transmission of vital data between rescue teams and the affected population. To mitigate these issues, solutions such as the use of high-frequency radios (amateur radio) and satellite communication systems were implemented, ensuring communication even in the event of failures in traditional networks. Additionally, digital platforms specific to disaster management were introduced, functioning offline, allowing for the recording of critical information. Partnerships with local organizations, community leaders, and NGOs facilitated the dissemination of information through social networks, enabling the rapid spread of essential information to the population and, thus, ensuring greater efficiency in rescue and aid operations (São Paulo, 2023a).

Although the State Civil Defense maintained depots at strategic points, their capacity proved insufficient to meet the emergency needs. In this scenario, the São Paulo Social Fund made its warehouses available for collecting food donations. The volume of contributions exceeded the needs, resulting in a total of 600 tons of donated resources. Given the scale, the distribution was centralized at the humanitarian logistics hub, which coordinated the storage of resources. Additionally, it managed the stock control, overseeing both the demand and the transportation of materials, resulting in approximately 150 movements (São Paulo, 2023b).

The donations transportation process was fully coordinated by SIEPDEC, with logistical support from trucks provided by the Military Police and other organizations. Due to road blockages, trucks departed from the São Paulo Social Fund and unloaded their cargo in adjacent locations where aircraft or vessels were on standby. Additionally, support for receiving, sorting, storing, and distributing the donations was made available. These actions were carried out by members of the São Paulo Social Fund team, public officials, volunteers, and 60 cadet-soldiers from the Superior School of Soldiers of the Military Police. Figure 4 shows the supply flow established for this disaster.

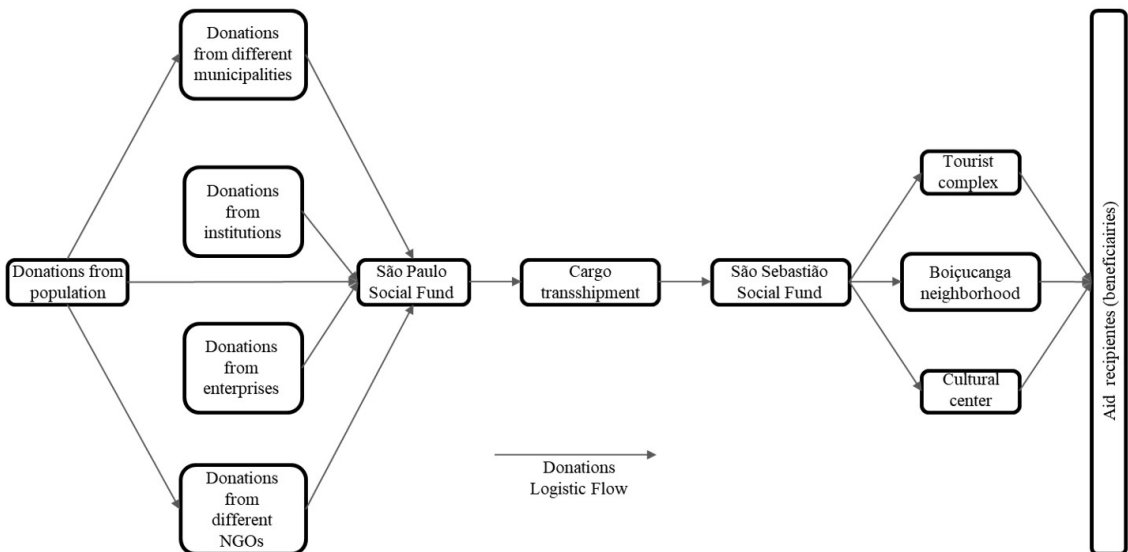


Figure 4. Donations logistics flow of São Sebastião disaster. Source: The author's (2024).

The disaster occurred during the festive Carnival period and resulted in a high number of displaced and homeless individuals, posed difficulty in distinguishing between victims who were displaced or homeless, given the significant presence of tourists in the area. It became essential to identify residents of housing that had been destroyed, damaged, or located in high-risk areas, and to relocate them to shelters. CEPDEC, in collaboration with the Municipal Department of Social Development and Tourism, coordinated the relocation of 1,144 homeless individuals, temporarily accommodating them in 21 guesthouses in São Sebastião. This process considered criteria such as the proximity of lodging to the affected residences, costs, and availability of vacancies. Subsequently, this responsibility was transferred to the municipal government (São Paulo, 2023b).

The logistical challenges faced during the disaster revealed the complexity of accurately estimating the number of victims due to interruptions in communication and information systems, exacerbated by the lack of data on hotel and similar establishment occupancy during the festive period. Additionally, the positioning of Civil Defense depots to meet emergency needs necessitated the establishment of new collection and storage centers, impacting the speed of aid delivery. The logistical coordination for donation transport also proved challenging, directly affecting distribution efficiency, particularly in the face of roadblocks. The relocation of the displaced required meticulous planning and extensive resources. This underscores the importance of robust information systems, well-equipped depots, and effective coordination among involved agencies to better prepare for and respond to future crises with increased readiness and efficiency.

After the initial disaster response, actions were undertaken to restore basic services, which were fundamental for optimizing the efforts of rescue teams, addressing the immediate needs of victims, and mitigating the impacts on the affected population.

5.4. Restoring essential services

As a result of the disaster unfolding, a task force involving public utility companies with teams and equipment from various sectors. There was initially a partial interruption of access due to landslides and floods, and in this scenario, the first actions to assist the victims were taken. However, with the continuation of the rains, seven more landslide events were triggered that completely compromised access to the region. The adverse weather conditions imposed limitations on the mobilization of teams dedicated to search and rescue activities, covering land, sea, and air approaches (São Sebastião, 2023). The interruption of the water supply resulted in periods of deprivation of access to this essential resource by the affected families. Resupply could only be carried out through operations via boat or aircraft, which were subject to prevailing weather conditions. The complexity of the scenario was compounded by the interruption of the electricity supply, which left the response teams without communication capacity for 48 hours, hampering the flow of information about those involved in the occurrence. To mitigate the situation, efforts were immediately triggered to clear the roads. The process was initiated by the less complex roads, allowing access to hospital units and the Command Post. Nevertheless, it was evident that the success in rescuing the victims was subordinate to the restoration of the affected basic services (São Sebastião, 2023).

The demobilization of the response operation derived from the operations progress and demobilization efforts were carried out simultaneously. This was executed sequentially, starting in Bertioga, followed by Vila do Sahy, and lastly, at the City Hall facilities. The command post located within the City Hall premises was officially deactivated on March 12, 2023, coinciding with the completion of operational activities (São Paulo, 2023b).

The disaster response in São Sebastião highlighted the complexity of logistical management and the importance of coordination between public and private entities. The operation included search and rescue, victim transportation, supply distribution, and recovery of affected areas, facing challenges such as access difficulties and lack of communication infrastructure. Local collaboration, the use of adaptive solutions, and the restoration of essential services, such as water and electricity, were crucial for the success of the operation. The experience emphasized the need for continuous planning and greater efficiency in the use of resources and technologies in future crises.

6. Discussion and lessons learned

The São Sebastião disaster highlighted several challenges and lessons to be addressed, enhanced, and disseminated by civil defense structures and other organizations involved in sudden disaster response. As outlined by Thomas (2004), Cardoso et al. (2023); and Cunha et al. (2024b), the array of activities performed by humanitarian logistics, such as transportation, distribution, and other related activities to aid affected individuals, can be observed in the February 2023 São Sebastião event. These challenges encompass the organization and capacity of personnel and material resources within municipal civil defense frameworks, alongside the complexity of coordinating multiple stakeholders, constraints, and the distribution of responsibilities, as outlined in Table 6 below.

The disaster response capability in São Sebastião was compromised by the scarcity of local Civil Defense resources but was enabled by coordinated support from the state and federal governments, alongside human and logistical assistance from neighboring municipalities in São Paulo. This underscores the vulnerability of the affected areas, highlighting their dependence on external support for a swift and effective response. By Decree No. 10,593, which delineates the specific responsibilities of each governmental level, the Municipal Civil Defense is tasked with immediate response, the State Civil Defense with regional support and coordination, and the

Table 6. Disaster bottlenecks occurrence finds and bullet points.

Bottleneck	Findings
Disaster response Capability	Establishment of a crisis management team with support from other Civil Defenses at the state and national levels.
Complex coordination among multiple actors and entities involved	Mobilization of logistical, human, and material resources required for response and relief operations.
Logistical challenges	Roadblocks hindering access to affected areas and material transshipment operations across different regions.
Camps and shelter	Difficulty in estimating the number of victims due to lack of information and disrupted communication systems. Challenges in distinguishing residents from tourists. Lack of planning for shelters in situations with a large number of tourists.
Relationship between rescue teams during disaster operations	Effective and clear communication between teams and coordination.
Donations	The difficulty of determining the priority needs and ensuring a fair and effective distribution of donated.

Source: The author's (2024).

Federal Civil Defense with crisis management and national coordination. The study revealed that the municipal civil defense failed to respond adequately to the disaster, requiring human, material, and logistical support for relief operations. This highlighted its limitations in fulfilling the responsibilities outlined in the cited document, emphasizing the urgent need for structural and operational improvements to address large-scale events.

The disaster response in São Sebastião underscores the critical importance of a coordinated and integrated approach, as stipulated by Decree No. 10,593 and the civil defense disaster management manual. Inter-agency coordination is crucial to avoid overlaps and ensure efficiency and promptness in disaster response times. Clear and direct communication with affected communities is essential for proper guidance. Swift mobilization of resources, including personnel and supplies, is crucial for an effective response to emergent needs. Rapid decision-making is essential to mitigate immediate disaster impacts. Additionally, efficient management of shelters, team safety, and ongoing damage assessment are indispensable for restoring normalcy. In the specific case of São Sebastião, the inherent complexity of the large-scale disaster, coupled with the municipality's capacity limitations to respond to the event, emphasizes the critical need for real-time data management and prompt intervention from state and federal support, as required, to ensure a comprehensive and effective response.

The logistical challenges associated with disaster assistance and victim support encompass the identification and location of affected populations (search and rescue), provision of adequate medical care, secure shelter, food, access to clean water, sanitation, and hygiene. The distribution of humanitarian aid, from collection at collection points to transportation, transshipment, and delivery to its destination, faced challenges mitigated through the use of various transportation modes including land, sea, and air. These challenges reflect the scale of the disaster, which disrupted transportation routes, damaged infrastructure, and underscored efforts undertaken to address the situation. In this specific disaster, the logistics of the state Civil Defense (Oliveira, 2009) partially met the needs of relief operations, necessitating the involvement of other state agencies such as the Brazilian Armed Forces for search and rescue operations, and the São Paulo State Military Police for the transportation of donations.

The organization of camps and shelters in response to the São Sebastião disaster revealed various challenges, such as ensuring adequate accommodation, food, and hygiene conditions for response teams, including efficient management of resources like food, water, and hygiene materials. Additionally, efforts were needed to provide essential infrastructure such as electricity and sanitation to support relief operations effectively. Managing limited resources in the camps required inter-agency coordination to integrate efforts among different levels of government and organizations, ensuring clear and effective communication. The safety of teams and the mental health of members presented ongoing challenges that necessitated protective measures such as psychological support programs. Proper management of equipment and supplies maintained efficient logistics and provided all necessary elements for an effective disaster response. This item reflects what is addressed by Mattedi (2017), that the impacts of a disaster affect social well-being and physical and psychological health. In the case of São Sebastião, this factor affected not only the victims but also those involved in response operations.

Additional difficulties encompass coordination with partner agencies, agile adaptation to changes in local needs and conditions, safety in potentially hazardous environments, and clear communication between teams in the camp. Managing fatigue, sustaining team engagement during extended periods, and integrating various specialties within the workforce are also critical considerations to address. Escudeiro et al. (2022) point out that these activities are the responsibility of local authorities, which was not the case in São Sebastião. According to the author, local authorities are responsible for leadership, planning, and execution of actions, as well as the provision of resources and procedures.

Regarding the relationship between rescue teams during disaster operations, several challenges arise. Effective and clear communication between teams, coordination, and collaboration to avoid redundancies or gaps in assistance is crucial. Managing conflicts and differences of opinion and building mutual trust and respect among teams are fundamental aspects of this relationship. Clearly defining the roles and responsibilities of each team, promoting cooperation and resource sharing, as well as swiftly and effectively resolving problems and challenges that arise during disaster response logistics, are critical components. Other challenges include coordinating and integrating different specialties and skills within the teams, fostering a culture of continuous learning and improvement, ensuring a fair and equitable distribution of tasks and responsibilities, and managing the safety and protection of teams due to the severity of the disaster. Additionally, managing external expectations and pressures on the teams is challenging, emphasizing the need for effective and inspirational leadership to create a healthy and safe working environment.

Regarding donations, the challenge lies in the difficulty of determining the priority needs of affected communities and ensuring a fair and effective distribution of donated resources to meet the actual needs of the victims. Additionally, there are challenges related to screening and proper management of donations, verifying the quality and safety of donated items, the need for adequate storage and transportation, coordination with other organizations to avoid duplication of efforts, and maximizing the impact of donations. Managing the supply and demand for different types of donations, such as food and clothing, and preserving the dignity of the individuals affected when receiving donations are relevant issues (Cunha et al., 2022). Coordinating and managing volunteers and receiving donations, as well as mitigating the economic impacts caused by the disaster, are also a part of this challenging context.

In summary, the research questions are addressed based on the conducted discussion and are presented briefly as follows.

In addressing the first research question regarding the Civil Defense's response to the disaster that occurred in São Sebastião, located on the northern coast of São Paulo in 2023, the study reveals the following facts concerning the institutional response to the event:

- a) **Establishment of Coordination Structures:** The Civil Defense organized a crisis management team to assess the situation and set goals and strategies. This structure was essential for mobilizing the logistical resources required for relief and recovery operations.
- b) **Mobilization of Resources:** The response involved the mobilization of human and material resources from various entities, highlighting the importance of coordination among different actors, including government agencies and the private sector. This coordination was crucial for the timely execution of rescue and assistance actions.
- c) **Rescue and Assistance Actions:** Rescue operations were conducted under adverse weather conditions, including landslides and flooding. The Civil Defense prioritized victim assistance, including the distribution of essential supplies and the restoration of basic services such as water and electricity.

Regarding the second research question concerning the logistical challenges encountered during disaster response efforts, these are listed as follows:

- a) **Adverse Weather Conditions:** Rescue and relief operations were severely impacted by unfavorable weather conditions, including heavy rainfall that caused landslides and flooding. These conditions hindered access to affected areas and the mobilization of response teams.
- b) **Disruption of Essential Services:** The interruption of water and electricity supplies exacerbated the situation, resulting in periods of deprivation for affected families. The lack of electricity also impaired communication, complicating the coordination of response operations.
- c) **Compromised Access:** Landslides and flooding caused significant disruptions to access routes, limiting the ability of rescue teams to reach the most affected areas. Civil Defense had to prioritize road clearing to restore access to hospitals and command centers.
- d) **Coordination Among Multiple Actors:** Effective coordination among various governmental and private entities posed a challenge. Collaboration between these sectors was crucial for the allocation of logistical resources but also required clear communication and role definition to avoid overlaps and gaps in operations.
- e) **Limited Logistical Capacity:** The analysis revealed inadequate logistical capabilities within local Civil Defense and neighboring municipalities to handle large-scale events. The effectiveness of emergency operations heavily depended on the collaboration and support from state and federal agencies.

The challenges faced by the São Sebastião Civil Defense in managing the February 2023 disaster highlight the need to improve coordination and logistical capacity. The response to the event required the formation of a crisis management team, the mobilization of human and material resources, and rescue operations beyond municipal capabilities. Logistical issues, such as interruptions in essential services, access difficulties due to the condition of the roads, and the complexity of coordinating among different actors, exposed the limitations of the local infrastructure. The analysis revealed the reliance on state and federal support and the urgent need for improvements in the Civil Defense's infrastructure and operational processes. Furthermore, shelter management, donation distribution, and communication with affected communities were identified as critical factors for enhancing the efficiency of large-scale disaster response efforts. The disruption of information systems during the disaster hindered communication, complicating the coordination of rescue teams, delaying humanitarian aid, and the distribution of resources. The lack of data slowed the mobilization of responders and the delivery of supplies, increasing response time and exacerbating the impact on the victims.

7. Final considerations

The purpose of this paper was to present the challenges faced by Civil Defense in response to the tragedy that occurred in São Sebastião in February 2023. The work aimed to identify and map operational bottlenecks, exposing critical points found in the coordination of this disaster. Initially, the role of São Paulo Civil Defense was characterized. Then, a comprehensive overview of the disaster events was outlined, and how socio-environmental vulnerability manifests in the municipality of São Sebastião was defined.

Subsequently, a case study was developed using the structure parameters outlined in the Civil Defense disaster management manual (Oliveira, 2009), National Policy on Civil Protection and Defense (Brasil, 2012a). and Article 2 of Decree number 10.593/2020, which addresses the components of "response," "relief," "assistance," and "restoration." From the analysis, the challenges permeating the coordination of the operation were visualized, highlighting the dynamic interaction among the different actors involved, as well as the complex sequence of actions taken to rescue the victims and mitigate the occurrence. The case study focused on describing and analyzing the role of the state Civil Defense in coordinating disaster response, without addressing other entities.

Based on the analysis of this specific case, it can be concluded that the coordination structure of the São Paulo Civil Defense, along with its human and material resources, demonstrates an aptitude for responding to incidents of the magnitude presented. This conclusion is based on the observation that the efforts made by the Brazilian Navy were directed, after the immediate response to the disaster, towards providing outpatient care to patients in the municipal health network, reducing the waiting list for specialties. This redirection demonstrates the evolution of the state Civil Defense's capacity and capability to address and promptly respond to extreme events, such as this specific one of great magnitude.

On the other hand, the results showed a lack of logistical capabilities in the municipality of São Sebastião and its neighboring municipalities to deal with large-scale events. The effectiveness of the emergency efforts was only possible due to the task force and the allocation of capabilities provided by state and federal agencies.

Lessons have been learned. Adequate preparation, planning, and training of response teams played a decisive role in assisting victims and effectively mobilizing society. The inclusion of the special needs of vulnerable groups proved to be a cornerstone for a rapid and efficient response, minimizing damage and saving lives. Coordination and collaboration among various agencies played an essential role in designing comprehensive, flexible, and effective plans tailored to the needs of the affected public. Clear and precise communication emerged as a fundamental factor in disseminating information, ensuring that a unified message reached as many people as possible. Effective leadership and logistical coordination were crucial in assigning roles and involving the local community in response actions. The availability of targeted financial resources and the ability to adapt to unforeseen circumstances highlighted the importance of resilience. Lastly, considering the socioeconomic impacts of the disaster and integrating technology and innovation into the response process stand out as differentiating elements to be considered in the planning and execution of disaster response measures.

Identified as practical contributions, the contingent staffing of the Fire Department due to the Carnival holiday minimized the delay in time between mobilization and deployment of rescue teams. Therefore, reviewing the staffing of emergency agencies such as the Fire Department in disaster-prone areas mapped in Civil Defense plans can contribute to enhancing the phases of prevention and preparedness for sudden-onset emergencies.

As reported and evidenced in this paper, disasters attributed to landslides in Brazil involve factors such as socio-environmental vulnerability, irregular settlements on city slopes, and changes in climatic patterns. Water, an essential element for life, is also a driver of fatalities resulting from these types of events.

The study's findings offer practical lessons for professionals and contribute to enhancing disaster preparedness policies and response manuals, emphasizing the importance of coordination among response agencies, the need for effective communication with affected communities and stakeholders, and the mobilization of logistical resources for the distribution of relief supplies.

This paper also suggests creating a documented record of the logistical challenges encountered in response to the Sao Sebastiao disaster. This would contribute to knowledge management in similar operations, offering insights into the operational difficulties of coordination and bottlenecks encountered during the response efforts.

In future investigations, interviews with other stakeholders than Civil Defense involved in disaster response operations and research on post-disaster recovery strategies are valuable approaches suggested. Focused on gathering insights and feedback on the organization's performance and identifying areas for improvement in disaster response operations. Additionally, it is suggested to narrow the scope of research to detail specific actions, considering the breadth of activities and responsibilities of Civil Defense in disaster management. These efforts can contribute to enhancing the effectiveness of the Civil Defense in managing similar incidents in the future.

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