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EDITED BY

Simon Gray,
Independent Researcher, Invercargill,
New Zealand

REVIEWED BY

Srirath Gohwong,
Kasetsart University, Thailand
Muhammad Ahsan Samad,
Tadulako University, Indonesia

*CORRESPONDENCE

Ahmad Harakan
✉ ahmad.harakan@unismuh.ac.id

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Inter-agency collaboration in building urban fire resilience in Indonesia: how do metropolitan cities address it?

Ahmad Harakan^{1*}, Yusuf Adam Hilman², A. Junaedi Karso¹, Awaluddin Awaluddin¹, Nurhalijah Nurhalijah¹, Indah Sidrawaty Muin¹, Aldy Nurdiansyah B¹, Arfan Fadillah¹ and Rudi Hardi¹

¹Department of Government Studies, Universitas Muhammadiyah Makassar, Makassar, Indonesia,

²Department of Government Studies, Universitas Muhammadiyah Ponorogo, Ponorogo, Indonesia

Introduction: Urban fire disasters pose a significant challenge to city resilience and sustainability, particularly in the Global South, where rapid urbanization exacerbates existing vulnerabilities. In Indonesia, recurring fire incidents, ranging from forest fires to residential fires in densely populated areas, highlight the urgent need for effective fire disaster management. This study focuses on Makassar, a metropolitan city facing increasing fire risks due to high population density, aging infrastructure, and limited preparedness.

Methods: This research employs a qualitative approach, drawing on fire incident data from 2018 to 2023, interviews, and historical analysis to assess collaboration mechanisms in fire disaster management. The study examines inter-agency coordination, communication gaps, and resource allocation issues, which hinder effective disaster response.

Results: Findings reveal a concerning rise in fire incidents in Makassar, leading to significant socio-economic impacts, including fatalities and property damage. The study identifies critical deficiencies in inter-agency collaboration, largely due to differing organizational cultures, inadequate coordination mechanisms, and resource distribution challenges.

Discussion and conclusion: By evaluating global fire resilience models, the research proposes a governance framework to enhance inter-agency cooperation in Makassar. The study advocates for integrated strategies, combining infrastructure development with community-driven initiatives to strengthen disaster prevention, response, and recovery. These findings contribute to sustainable urban development, ensuring greater resilience against fire disasters in rapidly urbanizing cities.

KEYWORDS

inter-agency collaboration, urban fire resilience, vulnerabilities, adaptation strategies, smart cities

1 Introduction

Fire disasters pose a significant threat to the sustainability of urban development, especially in the Global South, where rapid urbanization and limited resources exacerbate existing vulnerabilities. In Indonesia, frequent fire incidents—ranging from large-scale forest fires in regions like Kalimantan and Sumatra to residential fires in densely populated urban centers such as Jakarta and Surabaya—highlight the urgent need for comprehensive preparedness and adaptive strategies (Sufianto and Green, 2012). Collaboration between government agencies

and the public is essential to build urban resilience and effectively manage these recurring challenges. These fire disasters not only endanger lives and property but also disrupt the social and economic fabric of cities, mirroring challenges faced across the Global South (Sanderson, 2000; Cross, 2001).

In response to these pressing issues, the concept of a Safety Resilient City has gained considerable importance (Jabareen, 2013; Desouza and Flanery, 2013). Resilient cities, particularly those with well-developed fire prevention and response systems, are equipped to not only withstand but also recover swiftly from such disasters. This resilience extends beyond physical infrastructure, encompassing social, economic, and institutional dimensions that collectively ensure effective disaster response and post-disaster recovery.

Makassar, a dynamic metropolitan city and a key economic hub in Eastern Indonesia, exemplifies the fire disaster challenges faced by urban centers in the Global South. Similar to other Indonesian cities that have struggled with frequent fire incidents, Makassar's dense population and intensive urban activities heighten its susceptibility to fires. Between 2018 and 2023, the city recorded significant fluctuations in fire occurrences, as shown in Figure 1. In 2023 alone, Makassar experienced a surge with 359 fire incidents, resulting in material losses of IDR 19.2 billion, 592 injuries, and 3 fatalities. Fire incident data for each sub-district in Makassar (Figure 2) underscores the increasing risks and severe impacts, emphasizing the need for integrated and sustainable approaches to disaster management and public safety in the city.

The lack of effective collaborative synergy among disaster management agencies has resulted in communities being increasingly vulnerable and ill-prepared to cope with fire disasters. Negligence and inadequate coordination in both administrative processes and implementation before and after fire incidents have led to significant losses, including human casualties, damage to non-human resources, financial losses, and more (Kumari, 2022). Disaster management in urban areas is particularly complex due to urbanization and its associated impacts, which often exacerbate community and economic

asset exposure to hazards, thereby creating new risk patterns. The increasing risk of fires correlates with the intensification of urban development, making inter-agency collaboration crucial and necessitating the activation of services from various agencies in emergency management (Menya and K'Akumu, 2016).

Traditional approaches to disaster management often tend to be reactive and focused on a single agency or sector, a condition frequently observed in cities in the Global South, including Makassar, Indonesia. However, in an increasingly interconnected and complex world, isolated approaches are no longer sufficient. There is a need for a more collaborative and integrated approach, where various agencies—including government, the private sector, communities, and non-governmental organizations—work together to create more adaptive and resilient systems. As Makassar's urban development becomes increasingly dynamic, the city faces significant challenges in effectively managing fire disaster governance amidst the demands of rapid urbanization.

The existing research and publications do not fully address fire disasters and their relationship with urban resilience in a comprehensive manner, nor do they commit to developing an applicable urban resilience model. The study titled “Evaluating Urban Fire Risk Based on Entropy-Cloud Model Method Considering Urban Safety Resilience” focuses on the development and application of a theoretical framework to evaluate urban safety resilience against fire risks. This approach involves the use of a triangular model that includes fire hazards, regional characteristics, and fire resilience as key components (Bai and Liu, 2023). In contrast, the article “The Dual Discourse of Urban Resilience: Robust City and Self-Organised Neighbourhoods” explores the dual discourse in urban resilience discussions, particularly the tension between the concepts of a “robust city” and “self-organized communities (Meriläinen, 2020).” This study argues that there is a disconnect in this discourse: on one hand, there is a call to create a resilient city unaffected by disasters, while on the other hand, disaster-affected residents, especially in informal and low-income settlements, are encouraged to self-organize. Meanwhile, the article “Urban Infrastructure Resilience to

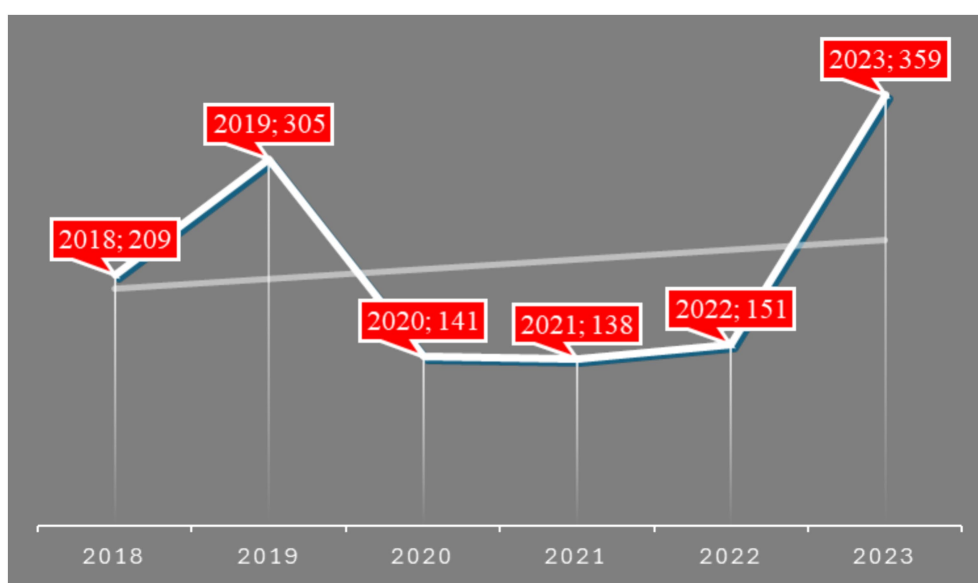


FIGURE 1
Trends in fire incidents in Makassar, Indonesia (2018–2023).

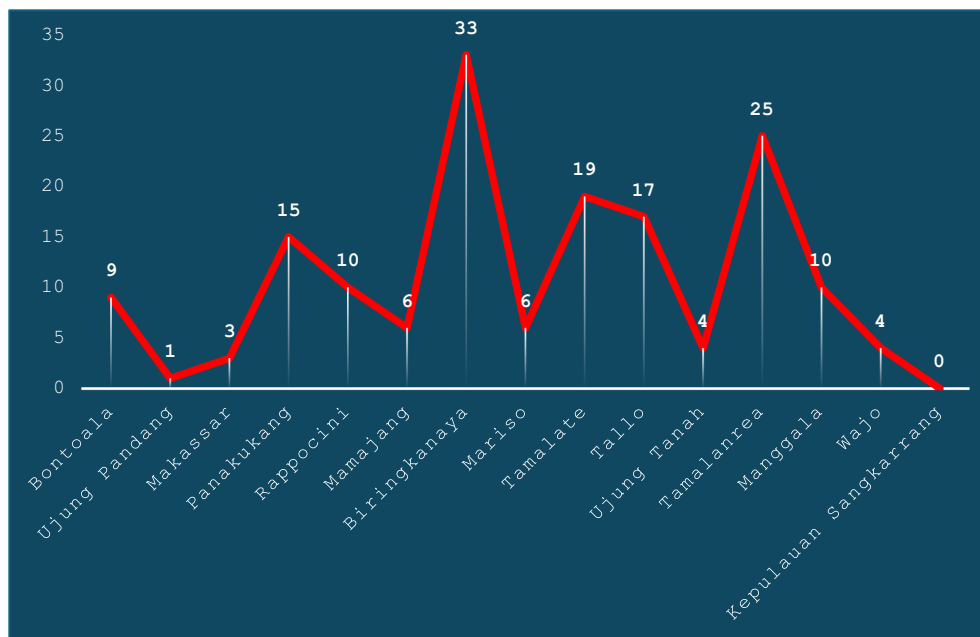


FIGURE 2
Fire incident statistics by sub-district in Makassar, Indonesia (2023).

Fire Disaster: An Overview” provides an overview of how urban infrastructure can be made more resilient to fire disasters (Gernay et al., 2016). Its primary focus is on addressing the shortcomings of traditional approaches that tend to assess fire safety at the level of individual elements or buildings, without considering the global risk to the functionality of infrastructure systems.

The gap addressed by this research-based article emphasizes the identification of institutions involved in fire disaster management, along with their respective roles and responsibilities, and the analysis of collaborative mechanisms between these institutions. This approach aims to make Makassar a safer and more resilient city. The study also recommends a new governance structure, collaborative incentives, and a legal framework that supports comprehensive urban fire resilience planning.

2 Literature review

2.1 Inter-agency collaboration

Inter-agency collaboration refers to the arrangement between two or more organizations and/or government agencies that work together to address cross-sectoral issues and provide integrated policy and service delivery (Ranade and Hudson, 2003; Hudson et al., 1999; Sakti et al., 2024). These cross-sectoral issues are becoming increasingly prevalent in our interconnected and complex society. This collaboration represents a positive relationship between organizations or various public administration units aimed at achieving shared goals, particularly in the face of complex and uncertain networks (Sienkiewicz-Małjurek, 2022). Inter-agency collaboration in disaster management is a collective effort, promoted through effective cooperation, communication, and decision-making among actors and organizations (Padiila and Daigle, 1998).

An effective response to fire disasters requires close cooperation between various agencies, both governmental and non-governmental, as well as key stakeholders (Crane, 2023). Agencies such as the Disaster Management Agency, the Red Cross, and the police play crucial roles in these efforts, collectively building a resilient response network, as outlined in Table 1. Through strategic planning, joint training, and regular evaluations, this collaboration not only enhances preparedness but also ensures that disaster management is carried out efficiently (Bodin et al., 2022). In the post-disaster phase, integrated coordination in providing relief and rehabilitation facilitates the efficient distribution of resources, ensuring that aid reaches those in need in a timely and effective manner (Shah et al., 2022).

Another crucial aspect is the need to understand the key components of collaboration in implementing adaptive strategies. The main components of collaboration within an emergency management system include communication, consensus in decision-making, involvement of diverse stakeholders, setting common goals, leadership, shared resource utilization, the formation of a shared vision, and trust (Zhang et al., 2023), as illustrated in Table 2. These components are neither exhaustive nor mutually exclusive, and they often reinforce each other. This emphasizes that successful collaboration relies on active participation, shared goals, and mutual trust among all parties involved.

2.2 Dimensions of fire-resilient cities

This study highlights the critical need to proactively address the threats posed by fires and develop effective, long-term solutions to mitigate their impact. The urgency of this approach stems from the oversight in acknowledging the intricate factors that contribute to urban resilience. When these complexities are not considered, cities are left vulnerable to challenges that could otherwise be anticipated

TABLE 1 Collaborating agencies in fire disaster management and their roles.

Fire disaster management agencies	Roles of the agencies
Fire Department	<ol style="list-style-type: none"> 1. First line response to fires 2. Search and rescue 3. Fire prevention and safety 4. Ambulance services 5. Post-disaster recovery efforts 6. Public awareness campaigns
National/Regional Disaster Management Agency	<ol style="list-style-type: none"> 1. Coordination at the national level 2. Command center for all communication and information 3. Collaborate with responsible ministries 4. Search and rescue, including rapid assessment, data collection, and dissemination 5. Monitoring disaster events 6. Legislative considerations
Red Cross/Red Crescent	<ol style="list-style-type: none"> 1. Search and rescue 2. First aid 3. Ambulance services 4. Post-disaster recovery efforts 5. Public awareness
Medical Personnel/ Health Services/ Hospitals	<ol style="list-style-type: none"> 1. First aid 2. Ambulance services 3. Public awareness
Police/Military	<ol style="list-style-type: none"> 1. Law enforcement and order maintenance at disaster sites 2. Search and rescue 3. Evacuation

and mitigated (Zevenbergen et al., 2008). A lack of proper planning and foresight can result in a cascade of problems that may be difficult or impossible to avoid. Therefore, integrating a comprehensive understanding of resilience into urban planning is crucial for preventing future disasters (Sharifi and Yamagata, 2018).

A Safety Resilient City refers to an urban area's capacity to withstand, adapt to, and quickly recover from various potential hazards. The urban safety resilience model is illustrated in Figure 3, which includes: public safety events, the urban disaster management system, and resilient safety management as part of a triangular theoretical model, with key features being response, recovery, and adaptation as the core of resilience (Bai and Liu, 2023). Additionally, urban resilience is built upon three aspects: adaptability, robustness, and recovery (Chen et al., 2020). The dimensions and indicators of urban safety resilience are detailed into three dimensions and three indicators (Huang et al., 2023), as shown in Table 3.

3 Research methods

This study was conducted in Makassar, Indonesia, based on several crucial factors: (1) Makassar represents a real-world example of the challenges in managing fire disaster risks in a large city with dense urban dynamics and high activity levels; (2) Makassar has experienced

TABLE 2 Key components collaboration.

Collaboration component	Description
Communication	Frequent and open communication channels help promote healthy dialogue, share information, and enhance social capital.
Consensus in decision-making	Requires well-defined and mutually agreed-upon consensus. Promotes teamwork, risk-sharing, and inclusive collaborative processes.
Common goals	Common goals must be clearly articulated and achievable to provide effective evaluative criteria.
Leadership	Strong leadership adds legitimacy and credibility to the collaborative process.
Shared resource utilization	Resource pooling is one of the main reasons for agreeing to collaborate.
Trust	Based on mutual understanding and developed through significant dialogue, trust is essential for bringing stakeholders together to share resources.

significant fluctuations in the number of fire incidents; and (3) Fires in Makassar have had both social and economic impacts, including material losses and fatalities. These factors underscore the need for an integrated and sustainable model for fire disaster management.

To achieve accurate research results, an approach integrating both qualitative methods and historical research methods was used. This study not only provides a comprehensive analysis of the current state of inter-agency collaboration in disaster management but also offers actionable insights to enhance the effectiveness of such collaboration in the future.

The qualitative approach, derived from interviews, focus groups, and observations, offers new depth and context (Sofaer, 2002), revealing the dynamics of inter-agency cooperation, communication barriers, resource allocation, and the roles and responsibilities of various stakeholders. This approach also draws on the experiences and perceptions of individuals directly involved in disaster response efforts, including firefighters, local government officials, community leaders, and residents. Through semi-structured interviews, this study captures the subjective realities of inter-agency collaboration, including challenges related to coordination among different organizational cultures, the impact of bureaucratic obstacles, and effective strategies for fostering cooperation.

The historical research method in this study is used to contextualize the current state of inter-agency collaboration within a broader historical framework. This includes examining archival records, policy documents, and previous research (Porra et al., 2014), especially on disaster management in Makassar City. By tracing the evolution of fire safety measures, disaster management policies, and the development of inter-agency networks over time, this study identifies historical precedents and patterns that have shaped current practices and perceptions.

This historical perspective allows the study to assess the progress made in building a resilient city and understand how past fire disaster experiences have influenced current strategies and responses. The report also highlights lessons learned from past mistakes and successes, providing valuable insights into the effectiveness of various approaches in inter-agency collaboration.

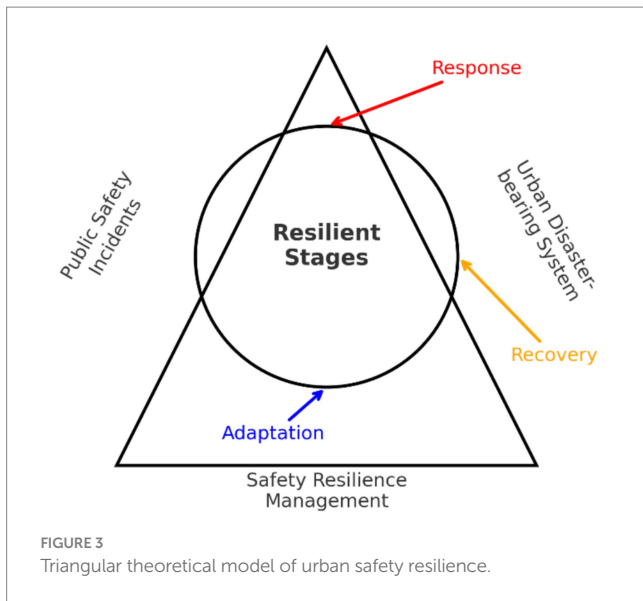


TABLE 3 Dimensions and indicators for urban safety resilience.

Dimensions of safety resilience	Indicators
Urban facility safety resilience	<ol style="list-style-type: none"> 1. Project development 2. Transportation facilities 3. Life-line engineering facilities 4. Monitoring and early warning facilities 5. Industrial enterprises 6. Emergency safety facilities
Urban community safety resilience	<ol style="list-style-type: none"> 1. Basic population attributes 2. Readiness for social participation 3. Sense of security and safety culture
Urban safety management resilience	<ol style="list-style-type: none"> 1. Management system construction 2. Prevention and response 3. Risk control level 4. Safety support and feedback

4 Results and discussion

Fires in urban areas, including Makassar, Indonesia, are among the disasters that significantly impact various aspects of community life. In the Global South, where urban resilience is often underdeveloped (Mallick et al., 2021; Mitlin and Satterthwaite, 2012), fires frequently result in substantial material losses, loss of life, and severe environmental damage. The increasing frequency and severity of urban fires can be attributed to several interrelated factors. One major contributor is the phenomenon of rapid urbanization, which has led to overcrowded cities and stretched municipal resources. Climate change has also played a significant role by intensifying weather conditions that increase fire risk, such as prolonged heatwaves and droughts. Moreover, rising population density in urban areas has escalated the potential for human-related fire incidents.

Compounding these issues, many cities are burdened by aging infrastructure, which includes deteriorating electrical systems prone to malfunction. Furthermore, construction practices that prioritize speed and cost over safety considerations have left many buildings

vulnerable to fire hazards. These factors collectively heighten the risk of urban fires, creating challenges for city planners and policymakers. In contrast, the indicators of a city’s urban advancement capability, as presented in Figure 4, provide a framework for assessing progress and resilience in the face of such risks. These indicators highlight the capacity of a city to mitigate, respond to, and recover from disasters, including fires, through improved infrastructure, safety regulations, and strategic urban planning. The juxtaposition of these fire risks against urban development markers underscores the importance of integrating comprehensive safety measures into the growth strategies of rapidly expanding cities to ensure both their safety and sustainability.

Rapid urbanization, particularly in developing countries, often leads to uncontrolled city growth (Cohen, 2004). Many large cities experience significant population increases without corresponding planning and management of adequate infrastructure (Henderson, 2010; Dahiya, 2012). This has resulted in the emergence of slums and densely populated areas that are highly vulnerable to fire disasters. For instance, in several major cities in Asia, such as Dhaka in Bangladesh and Mumbai in India, fires in densely populated residential areas have become a major issue that is difficult to address (Kumar et al., 2022; Ahmed et al., 2018). Fire disasters pose a significant challenge for countries in the Global South.

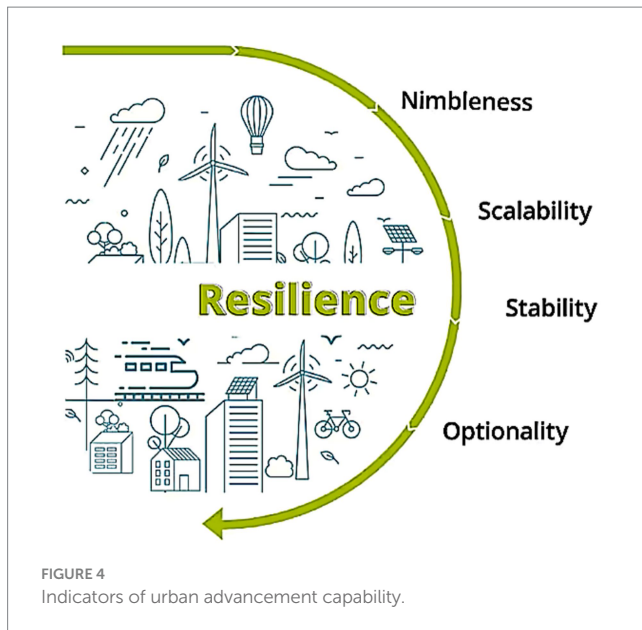
Climate change also plays a significant role in increasing the risk of urban fires (Fox et al., 2015; Jones et al., 2022). Rising global temperatures, altered rainfall patterns, and increased frequency of heatwaves have contributed to the growing incidence of fires, particularly in regions with dry and semi-arid climates. In Australia, for example, bushfires have become a serious threat to cities especially during the summer months (Filkov et al., 2020).

Moreover, many cities around the world have aging infrastructure that does not meet modern safety standards. Outdated electrical systems, lack of building maintenance, and the use of flammable building materials are among the factors that exacerbate fire risks. In cities, fires caused by electrical short circuits and faulty equipment often result in significant losses. The 2017 Grenfell Tower tragedy in London is a stark example of how inadequate infrastructure can lead to catastrophic fire disasters (Stec et al., 2019). Post-incident investigations revealed that the use of flammable cladding materials and the lack of adequate fire suppression systems were key factors in the rapid spread of the fire.

In addition to these factors, a lack of public awareness and education about fire hazards also contributes to the high risk of urban fires. Communities often underestimate the importance of preventive measures, such as installing smoke detectors, regularly inspecting electrical systems, and having a clear evacuation plan. Additionally, there are several challenges, as shown in Figure 5, that must be addressed to ensure sustainable urban fire resilience.

To address these threats and challenges, a comprehensive and collaborative approach is required to reduce fire risks in urban areas. Governments, the private sector, and communities must work together to improve infrastructure, strengthen regulations, and raise public awareness about fire hazards. Furthermore, the adoption of technology and innovation in fire management systems is crucial to creating safer and more resilient cities against future fire disasters.

The dynamics of safety resilience in cities and the occurrence of fires in various countries, particularly in the Global South, highlight the need for concrete action. This section will provide a specific,



comprehensive, and systematic discussion on the identification of institutions involved in fire disaster management, their respective roles and responsibilities, an analysis of collaboration mechanisms between these institutions, and the proposal of an innovative model for inter-agency collaboration. This model aims to create a more integrated and efficient response to fire disasters, with a particular focus on building fire-resilient cities, especially in Makassar.

4.1 Mapping institutions involved in building urban fire resilience

Inter-agency collaboration is a key component of effective disaster management, particularly in building Fire Safety

Resilience capable of addressing various fire threats and levels. In emergency situations, no single agency or organization can manage all aspects of disaster response independently (Janssen et al., 2010), especially in the case of fire disasters. Close cooperation between multiple entities, from national and local governments to private sector organizations, non-governmental organizations, and organized community groups, is essential (Lassa, 2018; Batley and Rose, 2011). This collaboration is not only vital for coordinating a swift and effective response during a disaster, but also for ensuring that prevention, mitigation, and post-disaster recovery efforts are carried out in an integrated and efficient manner.

Inter-agency collaboration in the context of fire disaster management refers to the process by which various organizations, government agencies, and private entities work together toward the common goal of protecting lives, property, and the environment from the impacts of disasters. In disaster situations, this collaboration requires close coordination among different stakeholders, who may have diverse missions, organizational cultures, and priorities (Vaugh and Streib, 2006; Kalkman and de Waard, 2017; Gabler et al., 2017; Chen et al., 2013). Effective communication, information sharing, and coordinated action among all parties involved are essential for this collaboration to be successful (Martin et al., 2016).

Such inter-agency collaboration aims to integrate various sectors to enhance the efficiency and effectiveness of disaster response (Shah et al., 2022). In the context of fire disaster management in Makassar, the local fire department collaborates with entities such as the police and health organizations to address security concerns and provide medical care to fire victims. This collaboration ensures that necessary resources are available and that decisions made can manage the situation on the ground effectively.

However, inter-agency collaboration in disaster management does not happen automatically (Ray-Bennett et al., 2020; Kapucu and Garayev, 2011). It requires thorough planning, intensive training, and, most importantly, a strong culture of cooperation among the involved organizations. One of the greatest challenges in building effective collaboration is the difference in organizational cultures and priorities between agencies. For instance, organizations like the police or military may have rigid hierarchical structures with clear chains of command, while humanitarian organizations tend to be more flexible and responsive to field needs. These differences can lead to friction and inconsistencies in decision-making and operational execution. The levels on inter-agency collaboration as shown in Figure 6.

To overcome these challenges, it is important for all agencies involved in fire disaster management to develop a deep understanding of each other's roles and responsibilities, and to establish open and transparent communication mechanisms. This can be achieved through joint training sessions, fire disaster simulations, and inter-agency workshops designed to strengthen working relationships and build trust among stakeholders. Additionally, a clear framework for joint decision-making should be established, including agreed-upon procedures for coordinating actions in the field to ensure all parties are working toward the same goals. Thus, inter-agency collaboration should go beyond mere agreements and on-the-ground actions and be supported by structured preparation and planning.



This collaborative framework should also be complemented by supporting technology, such as integrated information management systems that allow agencies to share data and information in real-time about fire disaster. For instance, in large-scale wildfires, access to real-time data on fire locations, weather conditions, and the movement of firefighting teams can significantly enhance response effectiveness. Reliable communication technology is also essential to ensure that information can be quickly disseminated to all involved parties. In some countries, integrated communication and information management systems are a critical part of their disaster management strategies, enabling better coordination among various agencies (Comfort, 2007). The integration and effectiveness of communication and information management systems remain a challenge for fire disaster management governance in both Makassar and Indonesia as a whole.

In addition to technology, inter-agency collaboration must be supported by a clear legal and regulatory framework that outlines the roles and responsibilities of each agency during emergencies (Menya and K'Akumu, 2016). This framework should cover decision-making procedures, coordination mechanisms, resource allocation, and protocols for information sharing and accountability. In many cases, unclear or overlapping regulations can lead to confusion and inefficiency in fire disaster response. Therefore, it is important for each country to develop a regulatory framework that fosters inter-agency collaboration and ensures that all parties understand their roles in emergency situations.

Furthermore, inter-agency collaboration must consider the social and cultural aspects of the communities affected by disasters (Ray-Bennett et al., 2020). Understanding social dynamics, including

local beliefs, values, and norms, is crucial to ensuring that disaster responses are not only effective but also accepted by the community. This is especially important in diverse communities, where culturally sensitive and inclusive approaches can make a significant difference in the effectiveness of response efforts. Collaboration with local community organizations and leaders can help ensure that actions taken are in line with the community's needs and expectations, while also building trust and fostering public participation in disaster management efforts. Building public trust is essential for establishing a robust urban fire resilience.

Inter-agency collaboration in fire disaster management goes beyond merely cooperating in ad-hoc ways during emergencies. It is a complex and ongoing process involving careful planning, training, and coordination among various organizations and agencies. By fostering a strong culture of collaboration, leveraging supporting technology, and having a clear regulatory framework in place, cities and countries can improve the effectiveness of their disaster response efforts and, ultimately, better protect lives and property from the devastating impacts of disasters.

4.2 Collaborative mechanisms among institutions

The structure and mechanisms of inter-agency collaboration form the foundation that determines how effectively various agencies can work together in disaster management. Without a clear structure and efficient mechanisms, collaborative efforts are likely to encounter obstacles such as miscommunication, redundancy, or even failure to

respond effectively to disasters. This chapter will provide a detailed examination of various organizational structures and operational mechanisms that can be employed to enhance coordination and cooperation among the agencies involved in disaster response.

An effective collaboration structure encompasses not only how various agencies are organized within an integrated framework, but also how they interact with each other during emergency situations (Kapucu et al., 2010). This includes clearly defined roles and responsibilities, well-established communication channels, and jointly agreed-upon standard operating procedures.

An appropriate organizational structure is a key element in ensuring effective inter-agency collaboration within the context of disaster management. This structure not only determines how various agencies are organized and operate but also influences information flow, decision-making, and resource allocation. Without a clear organizational structure, collaborative efforts often encounter numerous challenges, such as role ambiguity, duplication of efforts, and inter-agency conflicts (Ranade and Hudson, 2003). Therefore, it is crucial to understand the various organizational structure models that can be implemented in inter-agency collaboration, as well as how these structures can be tailored to meet the specific needs and contexts of disaster situations. The presence of an appropriate organizational structure needs to be supported by suitable mechanisms as well.

Effective operational mechanisms are crucial in ensuring smooth inter-agency collaboration during disaster situations. These mechanisms encompass procedures, tools, and processes that enable various agencies to work together in a coordinated manner, share information, manage resources, and make decisions swiftly and efficiently.

Standard operating procedures (SOPs) form the backbone of operational mechanisms in inter-agency collaboration. SOPs provide clear guidelines on how various agencies should operate during fire disasters, detailing the steps to be taken, responsibilities for each task, and communication protocols. With clear SOPs in place, each agency can operate with a shared understanding of what is expected of them and how they should coordinate with other agencies.

Effective SOPs should encompass various critical aspects of disaster management operations, including risk identification, initial response, resource coordination, evacuation, rescue, recovery, and communication. For example, in a wildfire scenario, SOPs should establish safe evacuation routes, meeting points, and coordination among fire services, police, and health services to ensure all residents are safely evacuated and receive necessary medical attention if required.

However, developing effective SOPs is not a straightforward task. They need to be flexible enough to adapt to changing field situations yet stringent enough to ensure that all agencies operate consistently. Moreover, it is vital that all involved agencies understand and adhere to the established SOPs. This requires regular training and disaster simulations, where SOPs can be tested and refined based on real experiences.

The Incident Management System (IMS) is an operational mechanism designed to coordinate responses to incidents or disasters involving multiple agencies and resources (Perry, 2003). IMS provides a structured framework for managing all aspects of disaster operations, from planning through execution and monitoring. A well-known example of an incident management system is the Incident Command System (ICS), widely used in

various countries to manage responses to major disasters (Jensen and Thompson, 2016).

ICS provides a clear structure for command and control during disasters, with well-defined roles and responsibilities for each involved agency. This system facilitates seamless integration among various agencies and ensures that all actions are coordinated according to a predetermined plan. ICS also allows for scalability in operations according to the disaster's magnitude, meaning that command can be expanded or contracted as needed to suit the situation (Harrald, 2006).

A major advantage of IMS is its ability to enhance efficiency and effectiveness in managing complex incidents. With a structured system and clear standards, agencies can work together more coordinatedly and integrally. Moreover, IMS supports rapid, data-driven decision-making, as all necessary information is centralized and accessible to all involved parties. However, implementing IMS also presents challenges, particularly in terms of local-level training and adaptation. To ensure the success of IMS, it is crucial for all agencies to commit to ongoing training and simulations, and to develop the capacity needed to effectively implement the system.

Information sharing and communication mechanisms are key to ensuring that all agencies involved in disaster management have equal access to relevant information and can communicate effectively (Waring et al., 2018). Without reliable mechanisms for information sharing, inter-agency collaborative efforts can be hindered by miscommunication, delays, and lack of coordination.

A common tool used to support information sharing in disaster management is cloud-based information management systems. These systems allow various agencies to upload, access, and share data in real-time, ensuring that all parties have equal access to the information they need.

Advanced communication technologies such as emergency radios, satellite phones, and robust internet networks with detection capabilities are crucial in supporting information-sharing mechanisms. During fire disasters, communication infrastructure often becomes overwhelmed, preventing the public from quickly reporting incidents, which can hinder the dissemination of information to firefighters.

However, effective information sharing relies not only on technology but also on the organizational culture and trust between agencies. It is essential for each agency to understand the importance of information sharing and to commit to transparency and openness in communications. This requires developing policies that support information sharing and training designed to build trust and strengthen inter-agency collaboration.

Effective resource management is a major challenge in disaster management, especially when multiple agencies are involved, and resources are limited (Chang et al., 2012; Miao et al., 2013; Rolland et al., 2010). Good resource management mechanisms should include procedures for the procurement, distribution, and monitoring of resource usage, as well as mechanisms for coordinating resource allocation among various agencies.

One commonly used mechanism is a technology-based logistics system (Didin et al., 2024), which allows for real-time tracking and management of resources. This system also supports the monitoring of resource usage, helping to prevent waste and ensure that all resources are utilized optimally.

Moreover, it is crucial to have coordination mechanisms that allow various agencies to share resources. For example, in scenarios where the fire department needs more vehicles or equipment while the health department requires more medical personnel, coordination mechanisms should enable prioritizing resource allocation based on the most urgent needs. This requires developing a comprehensive resource management plan, which includes procedures for sharing and allocating resources across agencies.

However, a major challenge in resource management is the gap between demand and availability. Often, the available resources may not be sufficient to meet all needs, leading to competition among agencies. To address this challenge, it is important for governments and agencies to collaborate in planning and identifying resource needs before disasters occur, and to ensure that there are adequate reserves of resources available for emergency situations.

Rapid and accurate decision-making is a critical element in disaster management. Effective decision-making mechanisms should allow various agencies to coordinate well, share relevant information, and make decisions based on accurate and up-to-date data. Additionally, these mechanisms should support flexibility and adaptability, allowing for changes in strategy or actions if field conditions change.

A commonly used approach in decision-making is the centralized command model, where a single entity is responsible for coordinating strategic decision-making, while other agencies provide input and support the implementation of these decisions. However, in some situations, a decentralized or hybrid model may be more effective, where each agency has the autonomy to make operational decisions based on their expertise yet remains coordinated with the command center to ensure consistency and alignment with the strategic plan.

Challenges in decision-making also relate to the dynamics between agencies and the complexity of disaster situations (Janssen et al., 2010). Conflicts of interest, differing priorities, and uncertainties often pose obstacles in decision-making. Therefore, it is crucial to develop mechanisms that support collaboration, consensus, and open communication among all parties involved. This includes the use of techniques such as focus group discussions, multi-stakeholder meetings, and simulation exercises designed to enhance collective decision-making capabilities.

Operational mechanisms in inter-agency collaboration are key to ensuring that disaster responses are effective and efficient. By developing and implementing mechanisms that support coordination, information sharing, resource management, and decision-making, agencies can work together more harmoniously and effectively. However, the success of these mechanisms also depends on the commitment of all parties to collaborate, as well as on the support of adequate technology and infrastructure. Therefore, it is vital to continually develop and refine these operational mechanisms to meet the challenges of future disaster management.

Stakeholders are crucial in ensuring the implementation of strategies set forth in urban fire resilience development. Stakeholders play a pivotal role in inter-agency collaboration, particularly in the context of disaster management (Shah et al., 2022). This includes a diverse array of actors from public and private sectors, non-governmental organizations, local communities, and international organizations. Their involvement in the collaborative

process not only helps strengthen disaster response capabilities but also ensures that disaster mitigation efforts are inclusive, effective, and sustainable.

Central and local governments are key stakeholders in disaster management, responsible for policy formulation, resource allocation, and inter-agency coordination. The central government often acts as the primary decision-maker in major disaster situations, setting national priorities, coordinating international aid, and providing the necessary funding and resources. In contrast, local governments play a more direct role in implementing policies, executing disaster responses on the ground, and interacting with affected local communities.

The role of central and local governments in inter-agency collaboration often requires balancing centralized authority with local autonomy. The National Disaster Management Agency is responsible for national coordination in disaster mitigation, while Regional Disaster Management Agencies in each province and municipality are tasked with executing disaster responses within their jurisdictions. Effective collaboration is essential to ensure that disaster responses are prompt and accurate, and that national policies are effectively translated into actions at the local level.

However, the main challenge in involving central and local governments in inter-agency collaboration often relates to differences in priorities, resources, and capacities. Local governments may face limitations in resources or a lack of expertise, which can hinder their efforts in disaster.

5 Conclusion

Inter-agency collaboration plays a pivotal role in enhancing fire disaster resilience in urban areas, particularly in a rapidly growing city, especially Makassar. Evidence and dynamics indicate that relying solely on a single agency's response is inadequate to address the multifaceted challenges posed by modern urbanization. Effective disaster preparedness and response requires the active involvement of various stakeholders, including the government, private sector, and local communities.

Continuous improvements in communication, coordination, and information management systems among these agencies are critical for achieving faster and more effective disaster response. By enhancing integration between agencies, the impacts of fire disasters can be mitigated, thereby strengthening long-term urban resilience. Additionally, collaborating agencies must prioritize policy adaptation, technological innovation, and community engagement to fortify fire management systems at the city level.

A more dynamic and adaptive governance model is an essential one that incorporates immediate disaster response while emphasizing long-term prevention and recovery strategies. However, several challenges must be anticipated, including potential bureaucratic inertia, limited resources, and varying levels of commitment among stakeholders. Differences in organizational cultures and technological capabilities can also hinder seamless collaboration. By addressing these challenges proactively and fostering collaboration across all sectors, Makassar and other cities facing similar issues can enhance their resilience to fire disasters, ultimately ensuring safe, adaptive, and sustainable urban development.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

AH: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. YH: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. AK: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. AA: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. NN: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. IM: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. AB: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. AF: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. RH: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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