(p-issn: 2089-8630) Journal Science and Technology Tadulako (e-issn: 2962 5696)
Jurnal Sains dan Teknologi Tadulako
DOI: https://doi.org/10.22487/jstt.v12i1.1025

DISASTER REVIEW, RESPONSE, RISK, AND PUBLIC OPEN SPACES IN URBAN AREAS

Altim SETIAWAN[1*], AMAR[2], and Rivai MARDIN[3]
[123]Civil Engineering Doctoral Study Program, Tadulako University
email: altimsetiawan@gmail.com

Abstract
The increasing risk of disasters in urban areas demands a new spatial planning paradigm that prioritizes disaster risk reduction (DRR). Public Open Spaces (POPs) not only serve as aesthetic and recreational elements but also have the potential to serve as strategic soft infrastructure in integral disaster management, as demonstrated by current literature and regulations. This study aims to analyze the role of POPs in supporting urban resilience by integrating disaster mitigation concepts into urban spatial planning in Indonesia. The study uses descriptive qualitative literature review with analysis of national regulations (Law No. 24 of 2007, Regulation of the Minister of Agrarian Affairs and Spatial Planning/National Land Agency No. 14 of 2022), international frameworks (Sendai Framework, UNDRR), and academic literature related to the disaster management cycle and risk-based urban planning. The results show that POPs have a significant role in four phases of disaster management: (1) mitigation as an ecological buffer zone; (2) preparedness as a training location and assembly point; (3) emergency response as an evacuation space and logistics centre; and (4) recovery as a place for socio-psychological rehabilitation. The application of the dual-use planning concept optimizes the RTP function under both normal conditions and in crises. This research contribution strengthens academic understanding of the integral relationship between green infrastructure, spatial planning, and risk reduction, and offers policy recommendations for more effective implementation at the local level.

Keywords: Public open spaces, disaster mitigation, disaster risk reduction.

1. Introduction

Disasters are complex phenomena that are not only triggered by natural factors but are also greatly influenced by the interaction between hazards, vulnerability, and human exposure. In an urban context, disaster risk increases along with the growth of population density and intensive infrastructure development. Disasters are events that threaten life and livelihoods, whether caused by natural, non-natural, or human factors. (Indonesia, 2007). The shift in the global paradigm, as seen in the Sendai Framework for Disaster Risk Reduction 2015–2030, demands a change in approach from reactive responses to continuous preventive efforts, namely Disaster Risk Reduction (DRR). One of the key elements in this strategy is the integration of spatial planning that is adaptive to risk (Kelman & Glantz, 2015).

Globally, the 2015–2030 Sendai Framework, the Sendai Framework, serves as the main reference in disaster risk reduction. The Sendai Framework emphasizes a shift from reactive disaster management to preventive risk reduction, highlighting the importance of understanding risk, strengthening governance, investing in risk reduction, and preparedness for Build Back Better in recovery. This

Received October 09, 2025, Revised April 15, 2026, Accepted for publication April 20, 2026

framework asserts that disaster risk reduction is an integral part of sustainable development. For example, the Sendai Framework calls on each country to integrate disaster risk assessment into land-use policies and urban planning (Development et.al, 2015), in order to prevent the creation of new risks through hazard-sensitive planning. The Sendai Framework also emphasizes the importance of community involvement, attention to vulnerable groups, and the protection of ecosystems as part of risk reduction strategies.

In the context of urbanization, Public Open Space (POS) such as city parks, squares, and greenways is often viewed only from an aesthetic or ecological aspect. However, recent literature and regulations indicate that POS has an important role as soft infrastructure in disaster management (Alawi et al, 2023, French et al, 2019, The et al, 2016, Asnudin et.al, 2023). The strategic role of public spaces in disaster mitigation lies in the concept of dual-use planning: spaces that serve recreational and social functions under normal conditions, but can transform into critical rescue spaces during a crisis.

The public open space must be usable in emergencies and in daily life, not just as a dedicated mitigation hall. Another study stated that urban-scale public open spaces have an important contribution to making cities sustainable (socially, economically, and environmentally sustainable). The potential use of public open spaces can be grouped based on the type of disaster, namely: earthquake—by providing shelters and distributing goods; tsunami—public open spaces that function as evacuation sites provided there is adequate accessibility, and it is important to locate public open spaces that are easily reachable and away from tsunami-prone areas; flooding—by converting flood-prone areas into green open spaces (Jayakody et al., 2018; Alawi et al., 2023; and Winandari, 2018).

1. Methode

This research uses a descriptive qualitative method with a literature study approach (literature review). The analysis is conducted by examining various secondary data sources that include:

1. Regulatory Framework: Legislation in Indonesia, such as Law No. 24 of 2007 on Disaster Management, Regulations of the Head of BNPB, and Minister of ATR/BPN Regulation No. 14 of 2022 concerning Green Open Spaces.

2. Global Framework: International documents, such as the Sendai Framework for Disaster Risk Reduction and UNDRR guidelines (*United Nations Office for Disaster Risk Reduction*).

3. Academic Literature: Journals and previous studies that discuss the disaster management cycle, namely mitigation, preparedness, response, and recovery, as well as the specific role of public open spaces in each of these phases.

Received October 09, 2025, Revised April 15, 2026, Accepted for publication April 20, 2026

Through this literature synthesis, this study aims to formulate the concept of integrating public open space into a comprehensive urban resilience strategy.

2. Literature Review

2.1. Disaster Response and Its Phases

Disaster response is the phase during or immediately after the occurrence of a disaster, where emergency actions are carried out to save lives and meet the basic needs of the affected community. According to disaster literature, the classic disaster management cycle consists of four stages: mitigation, preparedness, emergency response, and recovery. Law No. 24/2007 clearly regulates the implementation of disaster management, which includes pre-disaster stages (including prevention activities, mitigation, hazard impact reduction, and preparedness), during emergency response, and post-disaster (including recovery through rehabilitation and reconstruction).

2.2. The Role of Public Open Spaces in the Disaster Management Cycle

Recent research shows that open spaces are not only of aesthetic and ecological value but can also function as a component of soft infrastructure for urban resilience to disasters (The et al., 2016; Jayakody et al., 2018; Alawi & Chu, 2024). Here are the key roles of public open spaces in each phase of disaster management:

- Mitigation: At the stage of prevention and risk reduction, public open spaces act as buffer zones that can reduce the impact of natural hazards. According to White and other researchers, the most common way to protect flood-prone areas is to maintain them as open spaces, thereby preventing settlements in hazardous zones (The et.al., 2016). Similarly, setbacks from tsunami-prone coastlines can be turned into coastal greenways or parks, reducing the risk of building damage while also providing natural evacuation areas (The et.al., 2016). Urban green open spaces also help mitigate climate risks (floods, heatwaves) by providing ecosystem services such as water infiltration, reduction of urban heat islands, and habitat protection. Ministerial Regulation of ATR/BPN No. 14 of 2022 on the provision of open space acknowledges this, stating that open spaces play an important role in providing environmental services for ecological, water infiltration, social, aesthetic, and other functions.

- Preparedness: In this pre-disaster phase, public open spaces can be utilized as places to enhance community preparedness. Open spaces as places for education and training: Parks and town squares can serve as locations for disaster simulations, mass evacuation training, or public outreach on preparedness. Open spaces facilitate evacuation planning: the determination of assembly points is usually directed to the nearest open spaces that are sufficiently large and free from threats. The importance of evacuation routes usually points to parks or fields as gathering points during earthquakes or major fires. ATR No.14/2022 regulates that public open spaces should ideally be equipped with disaster management functions, including providing evacuation

Received December 25, 2025, Revised April 18, 2026, Accepted for publication April 22, 2026

assembly points, emergency evacuation routes, and supporting installations such as fire hydrants (Minister of ATR/BPN, 2022). Thus, public space infrastructure has been prepared to face emergency conditions. Open spaces can also serve as locations for storing community emergency response equipment (e.g., logistics warehouses in parks) or permanent disaster preparedness posts.

- Emergency Response: Historical studies of the 1906 San Francisco earthquake show that the city's open space network functioned as a "second city" after the disaster – parks and squares were used for gathering, setting up refugee tents, communal kitchens, aid distribution, and even emergency services, while the main city was paralyzed (The et.al, 2016). Various types of public spaces contribute to this function: small squares can serve as first aid posts, large parks accommodate thousands of refugees, and open parking areas become logistics distribution centre. Research by Fuentes and Tastes (2012) in Chile also emphasizes the importance of connected open space networks as corridors for evacuation and response in earthquake/tsunami-prone cities (The et.al, 2016). Strategically located and easily accessible open spaces can save many lives as immediate evacuation sites. Therefore, urban planning needs to ensure that every residential area has access to open spaces for emergency evacuation. Besides evacuation, other emergency response operational functions also take place in open spaces: emergency helipads in fields for aid delivery, coordination posts established in town squares, and so on.

- Recovery: The role of open spaces continues into the post-disaster recovery phase. As temporary housing and basic services: In some cases, open land is used as locations for temporary housing construction. As community and memorial spaces: Public spaces also aid the social-psychological recovery of the community. City parks can serve as places for residents to gather, support each other, hold trauma healing activities, memorial rituals for victims, etc., which are important for the community's mental recovery. For example, in San Francisco after the 1906 earthquake, besides serving as refugee tents, parks were used for memorial ceremonies and to rebuild social bonds (Jayakody et.al., 2018; The et.al., 2016). In the long term, the concept of build back better advocates that the physical reconstruction of cities includes more high-quality open spaces as mitigation and recreational elements, making the city more resilient. Open spaces can be redesigned post-disaster to commemorate the disaster (e.g., a tsunami memorial park) while also functioning as evacuation areas if a similar disaster occurs in the future. Several studies also emphasize the need for interconnected open spaces post-disaster, rather than being viewed separately, so that the city has a green network that supports long-term resilience.

2.3. Integration of Concepts in Urban Policy and Spatial Planning

Integrating disaster risk reduction into urban policy and spatial planning is essential for creating safe and resilient cities. At the international level, this has already become a common agreement.

Received October 09, 2025, Revised April 15, 2026, Accepted for publication April 20, 2026

The UNDRR emphasizes that land use and urban planning must involve disaster risk reduction measures and be applied down to the local level. The Sendai Framework also encourages the inclusion of disaster risk reduction in various development sectors. Specifically, the Sendai Framework highlights the importance of risk assessment in land use policy, urban planning, environmental degradation assessment, and informal housing (Development et al., 2015). This means that disaster-prone maps, risk data, and mitigation strategies need to be included in regional spatial planning and detailed city spatial planning. In this way, spatial planning decisions such as determining residential, industrial, and infrastructure zones are based on disaster risk considerations to prevent development in hazardous areas and reduce potential future losses.

Indonesia has taken policy steps towards this integration. Law No. 24 of 2007 requires the government to include disaster risk reduction efforts in both national and regional development planning. As a follow-up, Ministerial Regulation of ATR/BPN No. 1 of 2021 on Spatial Planning Activity Standards was issued, which mandates disaster risk analysis as one of the requirements for the preparation of spatial plans. Even earlier, BNPB Regulation No. 2/2012 (Risk Assessment Guidelines) had already been used as a reference for local governments to conduct risk assessments and create hazard maps as a basis for spatial planning (State Civil Service Agency, 2020). This means that in preparing a city plan, the government needs to map threats (zones prone to earthquakes, tsunamis, floods, volcanoes, etc.), analyze who/what is exposed, and determine mitigation measures in the spatial planning documents. For example, the regional spatial plan (RTRW) of an earthquake-prone city must set evacuation routes and evacuation locations on the plan map, as well as establish earthquake-resistant building regulations in the area.

In addition to general regulations, there are also special policies that link open spaces with disaster risk reduction. Ministerial Regulation of ATR/BPN No. 14 of 2022 concerning green open spaces (RTH) requires each city to provide at least 30% of its area as open space, with 20% for public use and 10% for private use. Interestingly, this regulation also mentions that RTH can be used for disaster management, and every level of park (city, sub-district, village, and others) is expected to have disaster-related facilities (Minister of Agrarian Affairs and Spatial Planning/National Land Agency, 2022). For example, the annex of the regulation suggests that a Neighborhood Park (RW) should be equipped with a multifunctional area that can serve as a temporary evacuation space, complete with evacuation routes and fire hydrants (Minister of Agrarian Affairs and Spatial Planning/National Land Agency, 2022).

This demonstrates real integration, where disaster preparedness is directly applied in public space design standards at the local level. Likewise, Head of BNPB Regulation No. 4/2012 on the preparation of risk-based spatial plans stipulates that hazard maps must be attached to spatial plans as information on safe and vulnerable zones. Several local governments have also developed

Received December 25, 2025, Revised April 18, 2026, Accepted for publication April 22, 2026

Regional Disaster Risk Management Plans that are integrated with medium-term development plans and spatial plans, so that urban planning programs align with risk reduction strategies.

At the urban policy level, the integration of disaster concepts, emergency response, risk, and public space has given rise to initiatives such as the Making Cities Resilient Program by UNDRR, which encourages cities to include resilience indicators (including the availability of evacuation spaces, the effectiveness of risk-based spatial planning) in their planning (The et.al., 2016). A good example can be seen in Japan, where urban planning in cities like Tokyo and Kobe systematically designates parks as evacuation parks complete with water facilities, emergency toilets, logistics stockpiles, and helicopter landing sites in anticipation of major earthquakes. A case study in Thủ Đức, Vietnam (supported by the World Bank) shows that a risk-informed city master plan can guide infrastructure investment while creating public spaces that function to absorb floodwater and become city assets. This underscores that integrating risk reduction in urban planning does not hinder development; on the contrary – cities can grow more sustainably, safely, and continue to provide quality living spaces for residents.

4. Results and Discussion

This section presents the results of a literature synthesis on the role of public open spaces in disaster management in urban areas, which are then discussed with empirical examples from the 2018 Palu earthquake–tsunami–liquefaction and the major earthquakes/floods in Aceh in recent years as illustrative applications.

Synthesis shows that public open spaces have a strategic role in the entire disaster management cycle: mitigation, preparedness, emergency response, and recovery. Open spaces planned with consideration of hazard maps and risk analysis can function as buffer zones, evacuation areas, and post-disaster social infrastructure. National regulations and global frameworks such as Law No. 24 of 2007, Head of BNPB Regulations, Minister of ATR/BPN Regulation No. 14 of 2022, as well as the Sendai Framework—explicitly encourage the integration of risk analysis and the provision of evacuation spaces into spatial planning documents and open space design standards.

The 2018 disaster in Palu showed that the limited safe open spaces in densely populated areas contributed to high vulnerability, especially in coastal areas and settlements affected by liquefaction. Many existing public spaces were not designed as tsunami evacuation corridors or clear gathering points, so the evacuation process occurred sporadically and relied on local residents' knowledge. This experience underscores the importance of a network of connected open spaces, located at relatively safer elevations, and equipped with signs and evacuation routes integrated into urban planning.

In Aceh, the experience of the 2004 tsunami and more recent disasters (such as flash floods and earthquakes in several regencies) shows the evolution of the use of open spaces as disaster

Received October 09, 2025, Revised April 15, 2026, Accepted for publication April 20, 2026

infrastructure. After the tsunami, several cities/regencies began designating fields, town squares, and city parks as evacuation locations and temporary shelters, accompanied by the construction of monuments and memorial parks that function dually as spaces for social reflection as well as gathering areas in the event of a similar disaster. This practice is consistent with the concept of build back better and dual-use planning, which positions open spaces as part of a long-term resilience strategy.

Literature findings assert that public open spaces can no longer be viewed as supplementary elements, but rather as essential urban infrastructure whose importance is on par with road networks, drainage, and other utilities in the context of disaster risk reduction. Within this framework, the policy of providing a minimum of 30% open space (with 20% public) is not only an ecological mandate but also a structural and non-structural mitigation instrument through zoning regulations, the establishment of coastal setbacks, and the provision of evacuation parks.

For example, in Palu, there is a gap between the normative framework and implementation on the ground. The disconnect between risk data, hazard maps, and the determination of open space locations causes many densely populated areas to lack quick access to adequate evacuation spaces. This aligns with critiques that risk data is often available but has not been effectively integrated into planning practices due to the limited technical capacity of local governments and weak regulatory enforcement. Thus, strengthening governance and the capacity of spatial planners becomes a prerequisite for public spaces to truly function as mitigation areas, not just aesthetic spaces.

The post-disaster experience in Aceh showed a more progressive direction: public spaces were redesigned to include memorial functions, disaster education, as well as emergency facilities such as gathering points, evacuation routes, and refugee tent areas. This practice is consistent with the idea that open spaces should be used daily by residents (recreation, sports, social interaction) so that they are familiar with the locations, access, and facilities, making the transition of function to evacuation spaces more effective during a disaster. This approach supports the argument in the literature that open spaces projected only for emergencies tend to be neglected and unfamiliar to the public, whereas multipurpose spaces strengthen social resilience and community capacity (Mirza, 2015).

Conceptually, the results and case examples above reinforce the scientific contribution of this study, namely: (1) articulating public open spaces as critical urban infrastructure from the DRR perspective, (2) linking national and international legal frameworks with the practice of public space design and planning at the city level, and (3) offering an operational dual-use planning framework for urban disaster-prone contexts in Indonesia. This contribution is relevant to the development of regional and urban planning science, disaster studies, as well as public policy studies focused on urban resilience.

In the context of urban policy, the integration of disaster concepts, emergency response, risk, and public space has resulted in initiatives such as Making Cities Resilient by UNDRR, which encourages

Received December 25, 2025, Revised April 18, 2026, Accepted for publication April 22, 2026

cities to integrate resilience indicators (including the availability of evacuation spaces and the effectiveness of risk-based spatial planning) into their planning. A good example can be found in Japan, where urban planning in cities like Tokyo and Kobe systematically designates parks as evacuation parks equipped with water facilities, emergency toilets, logistic supplies, and helicopter landing sites to face the possibility of a major earthquake.. A case study in Thủ Đức, Vietnam, with the support of the World Bank, shows that a city master plan that considers risks can guide infrastructure investment and create public spaces that effectively absorb floodwater while becoming city assets. It emphasizes that integrating risk reduction into spatial planning does not hamper development; on the contrary, the city can grow more sustainably and safely while still providing a quality living environment for residents.

5. Conclusion

Recent literature and policies emphasize that public open spaces are an essential component in urban resilience strategies. With a clear conceptual definition of disasters, risks, and response phases, urban planners and policymakers can formulate comprehensive spatial planning policies: reducing exposure in vulnerable areas, enhancing the quality of open spaces for mitigation and evacuation, and ensuring communities are prepared and protected. The national legal framework (Law 24/2007, several BNPB regulations, Ministerial Regulation ATR 14/2022) provides a foundation for this integrative effort, while the international framework (Sendai Framework, UNDRR agenda) offers direction and global targets that align accordingly. Academic research supports that a holistic urban approach – integrating physical infrastructure, open spaces, and community empowerment – will produce cities that are more resilient to future disasters.

6. References

Alawi, M., & Chu, D. (2024). New approach to integrating disaster resilience into public open space planning and design. *Journal of Infrastructure, Policy and Development*, *8*(9). https://doi.org/10.24294/jipd.v8i9.5222.

Alawi, M., Chu, D., & Hammad, S. (2023). Resilience of Public Open Spaces to Earthquakes: A Case Study of Chongqing, China. *Sustainability (Switzerland)* , *15*(2). https://doi.org/10.3390/su15021092

Asnudin, A., Amar, A.A., Tutang, M. (2023). Alternative Analysis of Residential Construction Design in The Areas of (Palu, Donggala, And Sigi) Pasigala Post-Disaster September 28, 2018, *Jurnal Sauins dan Teknologi Tadulako*, https://jurnal.pasca.untad.ac.id/index.php/jstt/article/view/454/303

National Civil Service Agency, RI. (2020). State Gazette. Regulation of the Minister of Health of the Republic of Indonesia Number 4 of 2018, *151*(2), 10–17.

Development, S., Framework, T. S., Reduction, D. R., Framework, S., Goals, S. D., Goals, S. D., … Goals, S. D. (2015). *Implementing the Sendai Framework to achieve the Sustainable Development*

Received October 09, 2025, Revised April 15, 2026, Accepted for publication April 20, 2026

Goals.

French, E. L., Birchall, S. J., Landman, K., & Brown, R. D. (2019). Designing public open space to support seismic resilience: A systematic review. *International Journal of Disaster Risk Reduction*, *34*, 1–10. https://doi.org/10.1016/j.ijdrr.2018.11.001.

Indonesia, R. (2007). Law of the Republic of Indonesia No. 24 of 2007 About Disaster Management. In *Pravoslavie.ru*.

Jayakody, R. R. J. C., Amarathunga, D., & Haigh, R. (2018). Integration of disaster management strategies with planning and designing public open spaces. *Procedia Engineering*, *212*(2017), 954–961. https://doi.org/10.1016/j.proeng.2018.01.123.

Jayakody, R. R. J. C., Amaratunga, D., & Haigh, R. (2018). Plan and design public open spaces incorporating disaster management strategies with sustainable development strategies: A literature synthesis. *MATEC Web of Conferences*, *229*. https://doi.org/10.1051/matecconf/201822904001.

Kelman, I., & Glantz, M. H. (2015). Analyzing the Sendai Framework for Disaster Risk Reduction. *International Journal of Disaster Risk Science*, *6*(2), 105–106. https://doi.org/10.1007/s13753-015-0056-3

Minister of Agrarian Affairs and Spatial Planning/National Land Agency. (2022). Regulation of the Minister of ATR/BPN of the Republic of Indonesia Number 14 of 2022 concerning the Provision and Utilization of Green Open Space. *Regulation of the Minister of Agrarian Affairs and Spatial Planning/National Land Agency of the Republic of Indonesia Number 14 of 2022 Concerning the Provision and Utilization of Green Open Space*, (679), 1–13.

Minister of Agrarian Affairs and Spatial Planning/National Land Agency. (2022). Ministerial Regulation of ATR/BPN No. 14 of 2022. Regulation of the Minister of ATR/BPN of the Republic of Indonesia Number 14 of 2022 Concerning the Provision and Utilization of Green Open Space, (679), 1–13.

Mirza, F. (2015). Disaster Mitigation Approach of Urban Green Structure Concept In Coastal Settlement. *DIMENSI - Journal of Architecture and Built Environment*, *42*(2), 51–58. https://doi.org/10.9744/dimensi.42.2.51-58.

The, R., Jayakody, O. C., Conference, I., Resilience, B., Zealand, N., Access, O., & Rights, M. (2016). *University of Huddersfield Repository The Use of Public Open Spaces to Enhance the Coastal Urban Cities Resilience to Tsunamis*.

Winandari, M. I. R. (2018). Public open space for disaster mitigation in Tangerang housing estates. *IOP Conference Series: Earth and Environmental Science*, *106*(1). https://doi.org/10.1088/1755-1315/106/1/012021

Received December 25, 2025, Revised April 18, 2026, Accepted for publication April 22, 2026