

Enhancing Community Resilience in Padang's Coastal Slums through the Disaster Imagination Game (DIG)

Hakimullah Arif Iskandar^{1,2*}, Dowon Kim³, Muhammad Sani Roychansyah⁴, and Toshihiko Abe⁵

Corresponding author. Email: hakimullah.arif28@hotmail.com

Submitted: 2025-08-24 | Accepted: 2025-08-28 | Published: 31st August 2025

Abstract

Coastal slums in Padang, Indonesia, face severe exposure to earthquakes, tsunamis, and compounding hazards such as fires and tidal flooding. Despite the devastating experiences of past disasters, particularly the 2009 earthquake, these communities remain highly vulnerable due to limited infrastructure, dense housing, and restricted evacuation access. Addressing such conditions requires approaches that not only raise awareness but also actively involve residents in preparedness planning. This study explores the application of the Disaster Imagination Game (DIG) as a participatory method to strengthen community-based disaster risk reduction (CBDRR) in two subdistricts, Rimbo Kaluang and Flamboyan Baru. A community workshop was organized to engage residents in hazard mapping, evacuation route identification, and scenario-based disaster simulations. The DIG process revealed specific challenges, such as blocked alleyways and bottlenecks in Rimbo Kaluang, and recurrent tidal flooding that intersects evacuation paths in Flamboyan Baru. At the same time, it generated shared priorities across both communities, including the installation of evacuation signage, development of community-based early warning systems, regular drills, and reinforcement of non-engineered housing. Beyond enhancing disaster awareness, DIG fostered dialogue and trust between residents, community leaders, and government stakeholders, effectively bridging local knowledge with formal planning processes. The findings highlight DIG as a low-cost, adaptable, and scalable tool that can inform urban planning, slum upgrading programs, and local disaster preparedness policies. Integrating DIG into municipal planning frameworks offers a practical pathway to strengthen resilience in Indonesia's high-risk urban settlements.

Keywords: Disaster Imagination Game; community workshop; CBDRR; urban resilience; coastal slums; Padang.

¹Graduate Student, Double Degree Master's Program in Urban and Regional Planning, Universitas Gadjah Mada, Yogyakarta, Indonesia, and Master's Program in Advanced Architectural, Environmental and Civil Engineering, Ritsumeikan University, Kusatsu, Japan. E-mail: hakimullah.arif28@hotmail.com

²First Expert Spatial Planner, Department of Public Housing and Settlement Areas, Padang City Government, Indonesia

³Associate Professor, Department of Civil and Environmental Engineering, Graduate School of Science and Engineering, Ritsumeikan University, 1-1-1 Nojihigashi, Kusatsu, Shiga 525-8577, Japan.

⁴Associate Professor, Department of Architecture and Planning, Faculty of Engineering, Universitas Gadjah Mada, Jl. Grafika No. 2, Yogyakarta 55281, Indonesia.

⁵Associate Professor, Department of Architecture and Urban Design, Graduate School of Science and Engineering, Ritsumeikan University, 1-1-1 Nojihigashi, Kusatsu, Shiga 525-8577, Japan.

1. Introduction

Indonesia's geographical setting at the convergence of the Indo-Australian and Eurasian tectonic plates within the Pacific Ring of Fire makes it one of the most disaster-prone nations in the world. Earthquakes, tsunamis, volcanic eruptions, and coastal flooding occur with high frequency and intensity across the archipelago, with devastating consequences for communities, infrastructure, and livelihoods. Among the most exposed regions is West Sumatra, where the capital city, Padang, lies directly adjacent to the Sunda Megathrust and the Great Sumatran Fault. This geophysical context places Padang among the highest-risk urban centers in Indonesia, with scientists warning of the potential for a future megathrust earthquake exceeding magnitude 8.5 that could generate a catastrophic tsunami (Haridhi *et al.*, 2018). Historical records confirm this vulnerability, noting major seismic and tsunami events in 1797 and 1833, as well as the more recent 2004 Indian Ocean tsunami and the 2009 Padang earthquake, which together resulted in significant human and material losses (Reid and Mooney, 2022). Despite these recurring threats, disaster preparedness at the community level remains limited, particularly in coastal slums where overcrowded housing, non-engineered structures, poor drainage, and socio-economic constraints exacerbate vulnerability. National frameworks such as Indonesia's Disaster Management Law No. 24/2007 and the Sendai Framework for Disaster Risk Reduction 2015–2030 emphasize strengthening early warning, emergency response, and risk governance (UNISDR, 2015; BNPB, 2023), yet their translation into actionable strategies at the neighborhood level has been uneven. In Padang's coastal settlements, inadequate infrastructure and poorly planned urban growth severely constrain evacuation capacity, with narrow alleyways, blocked access paths, and limited open spaces leaving residents disproportionately exposed to hazard impacts.

These vulnerabilities are not only infrastructural but also socio-economic. Coastal slum residents are often engaged in informal and low-income occupations, with limited resources to invest in structural mitigation measures or emergency supplies. Many households lack sufficient disaster literacy, having little access to structured training or community-based preparedness initiatives. At the same time, the memory of past disasters, particularly the 2009 earthquake, underscores the urgency of improving community resilience. Without targeted interventions that integrate local knowledge and participatory planning, these communities remain locked in a cycle of high risk and limited adaptive capacity. In this context, enhancing preparedness in slum areas is not only a humanitarian necessity but also a key component of sustainable urban development and risk-sensitive planning in Padang. Although disaster awareness has gradually increased in Padang following repeated hazard events, the level of preparedness within slum communities remains low. Many households understand that they live in hazard-prone areas but lack the resources, spatial capacity, and institutional support to translate this awareness into concrete preparedness measures. For example, the absence of proper evacuation signage, weak structural housing, and limited disaster drills undermine the community's ability to respond effectively during a major earthquake or tsunami. Conventional disaster management approaches in Indonesia often rely on top-down strategies, where preparedness is designed and implemented by government agencies without sufficient engagement of the most vulnerable groups. These approaches frequently fail to address the specific constraints of informal settlements, where high density, poverty, and poor infrastructure require localized and tailored solutions.

This gap highlights the importance of participatory methods that not only communicate risks but also enable residents themselves to co-identify challenges and co-develop strategies. In this study, the core research problem is framed as follows: despite experiencing recurrent hazards, why do Padang's coastal slum communities remain poorly prepared, and how can participatory tools improve their resilience? To address this issue, the study formulates a guiding research question: How can the Disaster Imagination Game (DIG) workshop enhance disaster awareness and strengthen preparedness in Padang's coastal slums? This question directs the investigation toward the role of participatory simulation in both knowledge transfer and community empowerment, ensuring that residents are not passive recipients of plans but active contributors to disaster risk reduction.

The analytical foundation of this study is grounded in the principles of community-based disaster risk reduction (CBDRR) and participatory planning theory, both of which emphasize the role of communities as frontline actors in managing risk. The Sendai Framework for Disaster Risk Reduction 2015–2030 provides the global context, stressing the need to (i) understand disaster risk, (ii) strengthen disaster governance, and (iii) enhance preparedness for effective response (UNISDR, 2015). In line with these priorities, the study positions the Disaster Imagination Game (DIG) as a methodological tool for linking community participation with urban policy processes. DIG is a structured, low-cost tabletop exercise that guides participants through a sequence of pre-disaster mapping, hazard and evacuation route identification, scenario-based simulation, and reflection. This process encourages communities to visualize their environment under disaster scenarios, share local knowledge, and collectively discuss solutions. Its application in Rimbo Kaluang and Flamboyan Baru creates an interactive space where residents confront their everyday vulnerabilities while also considering potential evacuation pathways and coping strategies. Importantly, the workshops were not only designed as community exercises but also as platforms for dialogue with government agencies such as BPBD Kota Padang and Disperkim Kota Padang.

The logical framework of this research thus operates on two levels. At the community level, DIG builds disaster literacy, fosters collective awareness, and enhances preparedness through participatory learning. At the policy level, the outputs of DIG offer actionable insights that can inform urban planning instruments, including the RP2KPKP (Urban Slum Upgrading Program) and the RTRW (City Spatial Plan). This dual orientation allows the study to demonstrate how participatory tools like DIG can bridge the gap between grassroots realities and formal governance, advancing the broader agenda of risk-sensitive urban development in Indonesia.

2. Methods

The study focuses on two adjacent coastal neighborhoods in West Padang District: Rimbo Kaluang and Flamboyan Baru, both officially designated as slum settlements and located within the tsunami hazard zone. Their selection reflects their high exposure to seismic and coastal hazards, combined with dense populations and chronic socio-economic vulnerabilities. Rimbo Kaluang, designated under Mayor of Padang Decree No. 310/2025, covers 7.11 hectares with about 1,180 residents and 230 households, resulting in a density of 16,596 people per km². Administratively, the settlement comprises five RTs (RT 01–05) within RW 04 (Figure 2.a), consisting of tightly packed, semi-permanent housing along

narrow alleys and a drainage canal, with poor sanitation, limited road access, and unsafe electrical wiring, conditions that amplify risks from earthquakes, tsunamis, floods, and fires. Flamboyan Baru, classified under Mayor's Decree No. 519/2020, spans 3.56 hectares with 847 residents and 140 households, producing an even higher density of 23,802 people per km². It consists of one RT (RT 01) within RW 04 (Figure 2.b), where housing is largely self-built using temporary materials, with minimal drainage and sanitation facilities. Its low elevation makes it highly susceptible to tidal flooding and tsunami inundation, while the absence of evacuation shelters and signage further constrains preparedness.

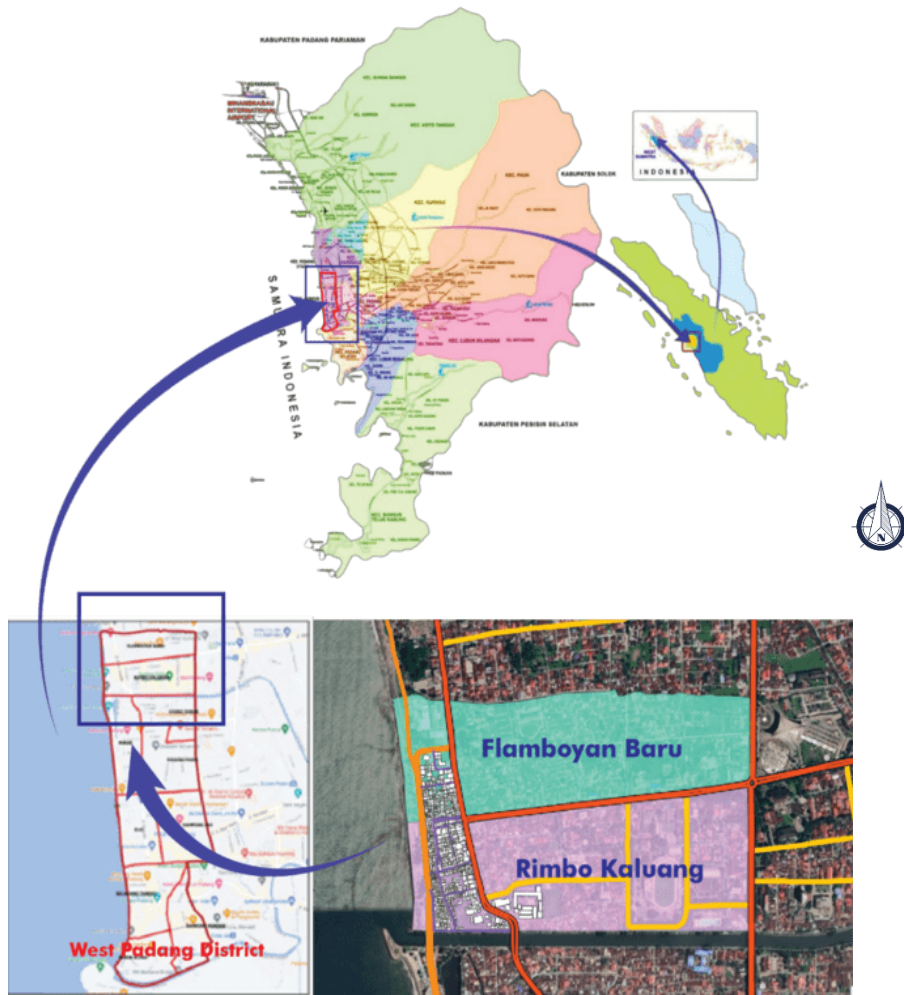


Figure 1. Location of Rimbo Kaluang and Flamboyan Baru Subdistricts
Source: Author Analysis, 2025



Figure 2. Location of Slum Area in: a. Rimbo kaluang and b. Flamboyan Baru

Source: Author Analysis, 2025

The research adopts a qualitative participatory approach centered on the Disaster Imagination Game (DIG). The DIG was originally developed in Japan in 1997 as a map-based disaster simulation exercise and has since been widely applied for disaster education and community preparedness (Tanaka *et al.*, 2019). Its adaptation in this study aimed to capture localized risk perceptions, foster collective learning, and identify community-driven priorities for disaster risk reduction (DRR). The design integrates field observations, participatory mapping, and facilitated group discussions, providing a comprehensive understanding of how communities perceive and respond to disaster scenarios. The DIG workshop involved community participants drawn from diverse groups, including household representatives, youth, women, and elderly residents. Local leaders from RT/RW units, community-based organizations, and NGOs also took part. Government stakeholders, such

as representatives from BPBD, Bappeda, and Disperkim Kota Padang, were invited to observe and engage in dialogue with residents. To ensure representativeness, participants were purposely selected to reflect the diversity of vulnerable groups within the community. Particular attention was given to the inclusion of women, elderly residents, and people with disabilities, as these groups often face disproportionate challenges in disaster situations. This approach was intended to capture a more holistic understanding of local vulnerabilities and capacities while ensuring that community voices were equitably represented.

In the Indonesian context, participatory approaches such as Participatory Rural Appraisal (PRA) and Focus Group Discussions (FGDs) have long been used to engage communities in development and disaster risk reduction planning (Chambers, 1994; Morgan, 1997). PRA emphasizes broad livelihood mapping, seasonal calendars, and problem ranking, while FGDs are useful for eliciting community perceptions and priorities in a structured group setting. However, these methods often lack a strong spatial and scenario-based dimension. The DIG differs in that it integrates participatory mapping with disaster simulation, enabling communities to visualize risks in their physical environment, identify evacuation constraints, and co-develop spatially explicit action plans (Kano *et al.*, 2023). This unique integration of mapping and simulation makes DIG particularly effective in dense urban slums, where settlement layouts and evacuation bottlenecks are critical to disaster preparedness.

The Disaster Imagination Game (DIG) workshop was implemented as a participatory spatial diagnostic tool and was structured into four sequential phases. In the first phase, participants conducted pre-disaster asset and risk mapping, where they identified key community resources such as mosques, schools, markets, and wells, alongside hazard-prone areas including flood-prone alleys, fire risk zones, and dead-end pathways. Using transparent base maps and colored markers, residents collectively visualized how local infrastructure and settlement conditions influenced their exposure to hazards. In the second phase, participants simulated a hypothetical earthquake, discussing likely impacts such as building collapse, fire outbreaks, and gas leaks. They identified specific risks in their neighborhoods, such as unsafe electrical wiring, the prevalence of semi-permanent structures, and the lack of firefighting facilities. Residents also noted that narrow alleyways and blocked access points could trap people during evacuation, compounding the danger of structural failure.

The next phase advanced to a tsunami evacuation planning exercise. Here, residents traced potential evacuation routes on maps, considering both inland destinations and elevated structures. The discussion revealed major challenges, including congested pathways, fences and walls obstructing movement, and the absence of official evacuation signage or designated gathering points. Participants expressed concern for vulnerable groups, particularly women, the elderly, and people with disabilities, who would face significant difficulties evacuating without additional assistance. Finally, the fourth phase focused on post-disaster recovery planning. In this stage, participants reflected on strategies for community recovery and continuity. They emphasized the importance of gotong-royong (mutual aid) as a social strength, identifying mosque courtyards as temporary shelters and youth organizations as vital for communication and coordination. However, while these informal mechanisms were seen as valuable, participants acknowledged the lack of institutional support, noting that no formal drills, training, or structured recovery planning had been provided by government agencies.

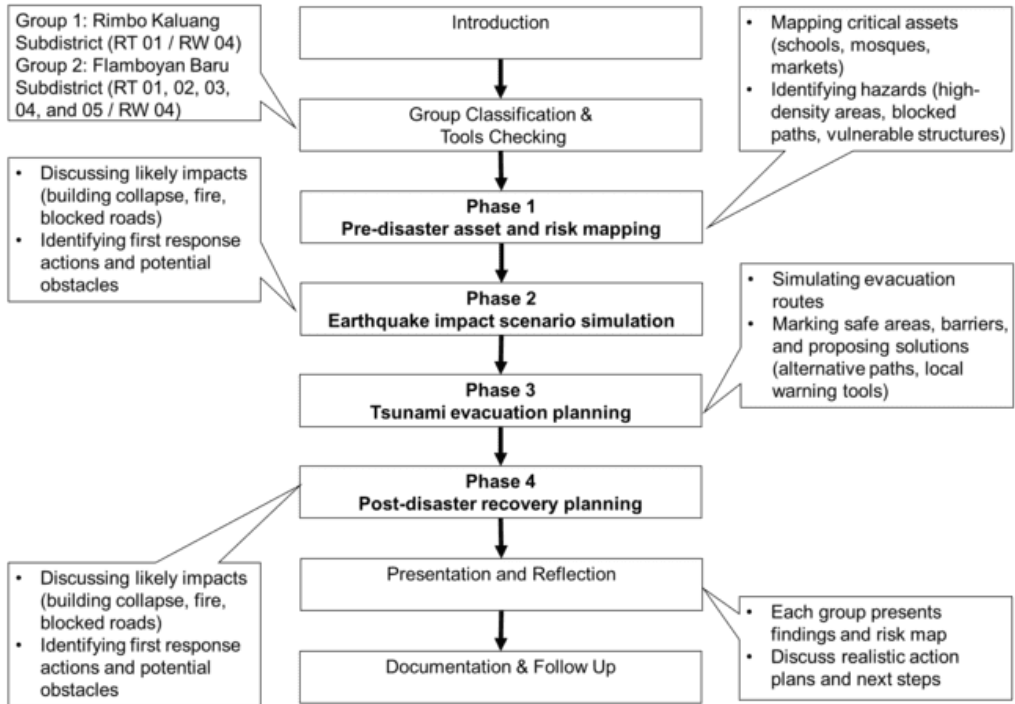


Figure 3. Workflow of Disaster Imagination Game

Source: Author Analysis, 2025

Data for this study were generated primarily through the outputs of the DIG workshop, which included annotated community maps, sketches, and group notes produced during each phase of the exercise. In addition, detailed field observations were conducted by the research team to capture non-verbal interactions, group dynamics, and spatial decision-making processes during the workshop. To complement these participatory activities, informal interviews were held with RT/RW leaders, youth representatives, and local government officials to validate workshop findings and provide additional perspectives on institutional arrangements for disaster risk reduction. The collected data were analyzed through a comparative and thematic approach. First, the results from each subdistrict were examined separately to identify settlement-specific vulnerabilities. This step allowed the analysis to respect the unique socio-spatial conditions of each community. Second, a cross-community synthesis was conducted to identify shared concerns and priorities, including the urgent need for evacuation signage, community-based early warning, and reinforcement of vulnerable housing. The analysis also considered the policy relevance of the findings, linking them to existing planning instruments. This ensured that the insights generated from the DIG workshop were not limited to academic reflection but also provided practical entry points for strengthening city-level disaster governance. By linking community-generated insights with formal planning frameworks, the study demonstrates how participatory methodologies can strengthen inclusive and risk-sensitive urban governance.

3. Result and Analysis

3.1. Workshop Approach and Implementation



Figure 4. Disaster Imagination Game Groups: a. Group 1 Rimbo Kaluang, b. Group 2 Flamboyan Baru

Source: Author Documentation, 2025

The Disaster Imagination Game (DIG) was applied as a participatory tool to engage residents of Rimbo Kaluang and Flamboyan Baru in jointly identifying disaster risks, recalling past experiences, and co-developing local preparedness strategies. As a disaster simulation and mapping exercise, DIG is designed to help communities visualize vulnerabilities and simulate emergency scenarios in a safe, structured setting. Its objectives include fostering community risk awareness, documenting local disaster memory, and promoting scenario-based planning for earthquake and tsunami events.

The workshop was conducted with participation from both subdistricts. In total, 51 individuals attended the session, including neighborhood leaders (RT/RW), youth representatives, women's groups, *Komunitas Siaga Bencana* (Disaster Preparedness Community), and local government officials from BPBD, Bappeda, Disperkim, and the West Padang District and subdistrict offices. The diversity of participants ensured the inclusion of multiple community perspectives and institutional voices. Participants were divided into two groups based on their subdistrict of origin (Rimbo Kaluang and Flamboyan Baru), each working on the same scenario but applying insights from their local contexts.

The workshop followed a structured, four-phase simulation process designed to facilitate spatial risk visualization, scenario-based learning, and collective reflection. Participants used printed base maps, transparent overlays, and markers to engage actively in hazard identification, evacuation planning, and recovery discussions. The four phases are summarized in Table 1.

Table 1. Disaster Imagination Game (DIG) Workshop Phases

Phase	Description	Key Outputs
Phase 1: Pre-Disaster Mapping	Participants worked with printed base maps, transparent overlays (kalkir), colored markers, and hazard legends to identify community assets (schools, mosques, markets) and areas vulnerable to fire, flooding, or structural collapse.	Community asset maps; hazard-prone zones identified.
Phase 2: Earthquake Impact Simulation	Residents simulated the effects of a major earthquake, highlighting collapsed buildings, blocked evacuation routes, and emergency response needs.	Risk maps showing structural collapse and access constraints.
Phase 3: Tsunami Evacuation Planning	Participants mapped potential evacuation routes, noted congested pathways, and designated temporary safe zones.	Evacuation route maps; identification of bottlenecks and temporary shelters.
Phase 4: Post-Disaster Recovery Planning	Residents proposed community-driven preparedness actions, including mosque loudspeakers as warning tools, neighborhood watch patrols, and clearer evacuation signage and shelters.	Action plans for early warning, evacuation, and community preparedness.

Source: Author Analysis, 2025

The DIG process encouraged active dialogue among residents and provided a platform for government stakeholders to directly engage with community concerns. Facilitators guided the discussions to ensure inclusivity, making sure that the voices of women, youth, and elderly participants were heard. The collaborative atmosphere fostered trust, encouraged knowledge sharing, and strengthened the sense of ownership over disaster preparedness outcomes within both subdistricts.

3.2. Key Insights: Rimbo Kaluang

The Disaster Imagination Game (DIG) revealed important spatial and social insights from the Rimbo Kaluang community regarding their disaster risks and capacities. In the Pre-Disaster phase, participants identified essential community assets including the Rimbo Kaluang Market, three mosques, an elementary school, and a public health post. These assets were mapped alongside key vulnerabilities. The neighborhood's high population density, coupled with haphazard building construction along narrow alleyways, was considered a major hazard. Several houses were noted to have electrical wiring exposed to rainwater or hanging across pedestrian paths, increasing the risk of fire and electrocution during a seismic

event. Informal housing located near riverbanks and drainage canals was highlighted as particularly prone to flooding and structural collapse.

During the Earthquake scenario, participants simulated a major seismic event striking the area. They predicted that several homes, especially those built with weak foundations and no earthquake-resistant design, would likely collapse. In addition, the community anticipated that narrow pathways would be blocked by debris, making evacuation and access for emergency responders extremely difficult. Power outages and fallen electrical poles were also seen as likely hazards. While mosque loudspeakers were frequently cited as a primary mode of communication, participants admitted that these were not coordinated as official early warning tools and might fail due to power loss. The lack of structured evacuation signage or designated assembly points was a common concern across the group.

In the Tsunami phase, participants mapped their anticipated evacuation routes and highlighted several dangerous bottlenecks. The bridge connecting the two sides of Rimbo Kaluang was considered both vital and vulnerable, its structural reliability during a disaster was questioned, and its location near flood-prone areas raised concern. With the area being low-lying and close to the shoreline, participants noted that tsunami waves could reach the neighborhood within minutes after a major offshore earthquake, leaving little time for evacuation. The absence of vertical evacuation structures or formally designated safe zones was considered a major gap. Residents expressed concern that, without visible signage or practice drills, panic would dominate in a real event. Narrow alleyways and dead ends were also mentioned as potential death traps, especially for elderly residents and those with limited mobility.

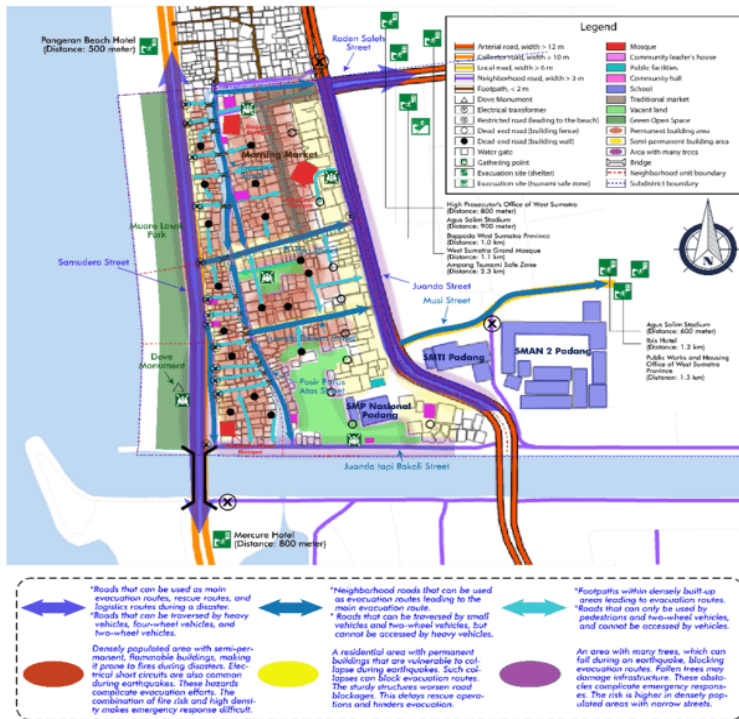


Figure 5. Evacuation Routes, Hazard Zones, and Spatial Vulnerability in Rimbo Kaluang

Source: Author Documentation, 2025

In the post-disaster phase, the group reflected on the resources and social structures that could support recovery. Community members emphasized the strong presence of women’s groups and youth organizations that could mobilize in the aftermath of a disaster. Women’s groups were seen as central to organizing emergency kitchens, managing shelters, and distributing aid, while youth were recognized for their role in spreading information quickly via mobile phones and assisting vulnerable residents. Despite this, participants acknowledged that these informal systems have little institutional support or integration into formal DRR plans. Several community members expressed a willingness to take part in evacuation drills, first aid training, and community-based preparedness campaigns if given consistent support and recognition by local authorities.

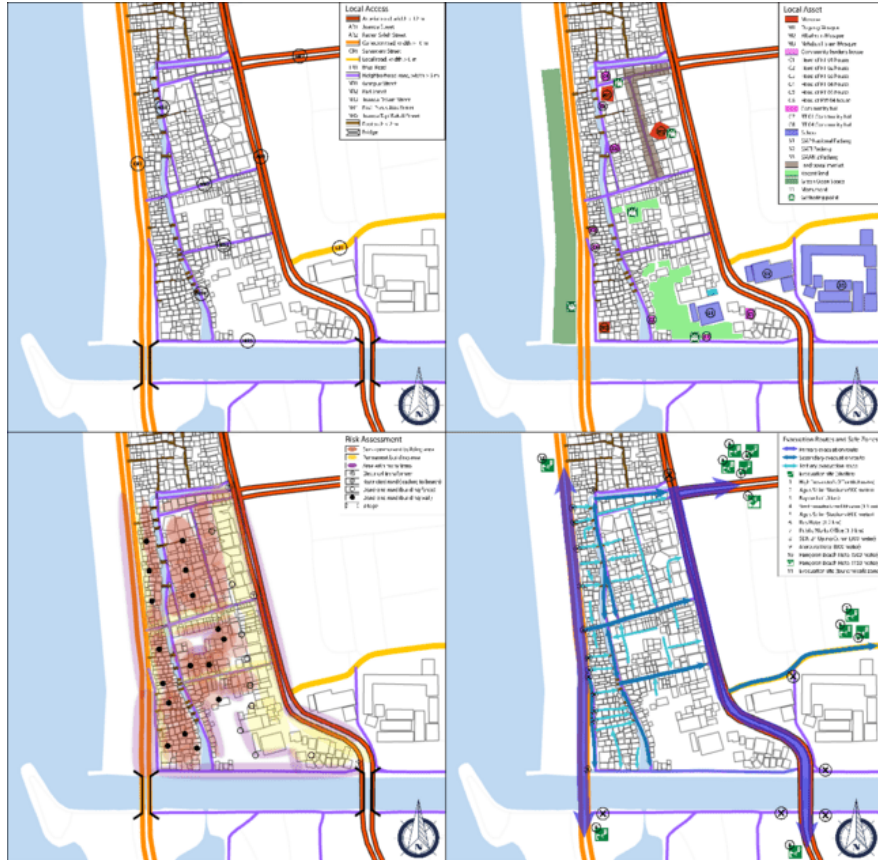


Figure 6. Rimbo Kaluang Key Insight Maps: a. Local Access Map, b. Local Assets Map, c. Risk Assessment Map, and d. Evacuation Routes and Safe Zones Map

Source: Author Documentation, 2025

3.3. Key Insights: Flamboyan Baru

The DIG workshop revealed that residents of Flamboyan Baru face a range of compounding disaster risks, particularly due to high settlement density, poor infrastructure, and limited formal preparedness systems. In the Pre-Disaster phase, participants identified several key community facilities, including two mosques, a traditional market, a school, and a public well frequently used by residents. These assets, however, are surrounded by highly congested housing areas with limited access points. Houses are built very closely together,

often with minimal separation, and are primarily constructed from semi-permanent materials. Participants raised concern over electrical installations running over rooftops and across alleyways, which they believed significantly increased fire risk, especially following an earthquake. One participant noted that “a small spark could quickly spread between rooftops because there’s no separation or space.”

In the Earthquake scenario, residents emphasized the potential for widespread structural collapse, especially around the market area and older housing clusters. The likelihood of secondary hazards such as fire and gas leaks were considered high due to unregulated electric cables and the use of gas stoves in confined spaces. Participants also highlighted the absence of fire extinguishers in public areas and the lack of accessible water hydrants or emergency equipment. Several expressed concern that emergency responders would struggle to access the site if alleyways were blocked. Furthermore, the community admitted that most residents were unaware of safe evacuation points or assembly areas. While mosque loudspeakers might be used to communicate during a disaster, participants noted there were no coordinated plans or rehearsed actions.

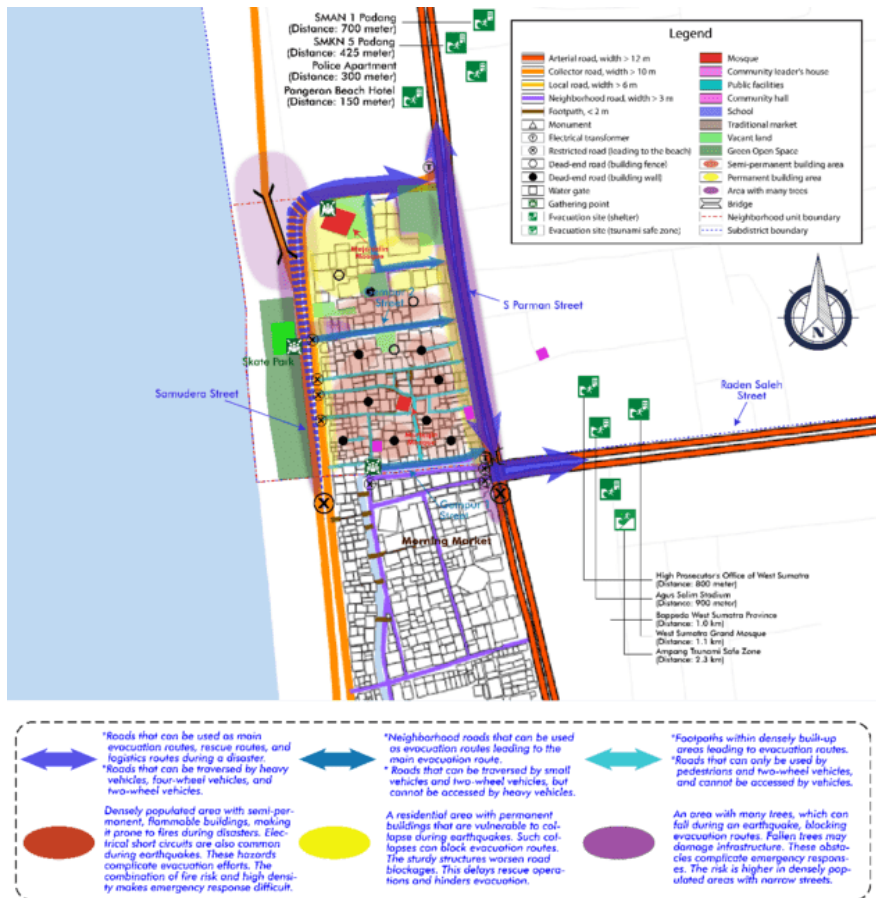


Figure 7. Evacuation Routes, Hazard Zones, and Spatial Vulnerability in Flamboyan Baru

Source: Author Documentation, 2025

The Tsunami simulation further exposed evacuation challenges. Although the subdistrict is not directly adjacent to the coastline, participants acknowledged that Flamboyan Baru is still vulnerable due to its location within a possible tsunami inundation zone. Narrow alleyways and maze-like building patterns were seen as major obstacles to evacuation. Without directional signage or designated gathering points, participants feared confusion and panic would dominate during a real emergency. Some community members stated that they would likely evacuate inland toward S. Parman Street, but this route is known to be congested and lacks pedestrian safety infrastructure. The workshop also surfaced concerns that certain vulnerable groups (such as children, people with disabilities, and elderly residents) would not be able to evacuate quickly without support, especially given the absence of organized assistance systems.

In the Post-Disaster phase, participants discussed recovery strategies and community strengths. Many emphasized the spirit of *gotong-royong* (mutual assistance) that typically mobilizes after a disaster. Mosque courtyards were identified as potential temporary shelters, and youth groups were seen as essential for information dissemination and logistical coordination. However, these informal strengths are not matched by institutional support. Participants noted that no formal evacuation drills had been held in their neighborhood in recent memory, and they had never received preparedness training from BPBD or other agencies. Some women’s groups expressed interest in first aid and emergency planning training, particularly in managing children and elderly family members during crises.



Figure 8. Flamboyan Baru Key Insight Maps: a. Local Access Map, b. Local Assets Map, c. Risk Assessment Map, and d. Evacuation Routes and Safe Zones Map

Source: Author Documentation, 2025

3.4. Cross-Community Comparison and Shared Priorities



Figure 9. Group Photo of Community Workshop Participants

Source: Author Documentation, 2025

The DIG workshops revealed that while Rimbo Kaluang and Flamboyan Baru face different physical and environmental conditions, both communities share a strong sense of vulnerability to earthquakes and tsunamis and similar priorities for disaster preparedness. Despite settlement-specific differences, both communities identified gaps in evacuation infrastructure, early-warning systems, and institutional support as critical challenges to reducing risk. The comparison highlights several key similarities and differences (Table 2).

Across both communities, shared priorities emerged as critical for immediate action. These included the installation of clear evacuation signage, the development of community-based early warning mechanisms, and the organization of regular evacuation drills that actively involve women, youth, and elderly residents. Residents also emphasized the need to reinforce non-engineered housing structures to reduce collapse risk during earthquakes and to designate mosque courtyards and open spaces as evacuation shelters.

The participatory reflections underscored that while community solidarity and gotong-royong remain strong social assets, these informal mechanisms require institutional reinforcement. Without formal training, resources, and government support, local capacities remain limited in addressing large-scale hazards such as tsunamis. The DIG thus demonstrated not only the specific challenges faced by each community but also the collective aspirations for more inclusive and supported disaster risk reduction strategies that bridge grassroots knowledge with formal governance.

These comparative insights align with broader principles of community-based disaster risk reduction (CBDRR) theory. Maskrey (1989) emphasizes that effective disaster mitigation depends on enabling communities to act as proactive agents rather than passive recipients of external assistance. Likewise, Kelman, Gaillard, and Mercer (2015) highlight that resilience emerges from the dynamic interaction between vulnerabilities and capacities. The cases of Rimbo Kaluang and Flamboyan Baru exemplify these principles: despite differing spatial conditions, both communities illustrate how grassroots knowledge, informal networks, and collective action can meaningfully complement formal disaster governance.

Institutionalizing these community strengths within planning and policy frameworks is therefore crucial for advancing risk-sensitive urban development in Padang.

Table 2. Comparison of Findings from Rimbo Kaluang and Flamboyan Baru

Aspect	Rimbo Kaluang	Flamboyan Baru	Shared Priorities
Main Hazards	Earthquake, tsunami, fire, flood	Earthquake, tsunami, tidal flooding, fire	Earthquake and tsunami as top concerns
Settlement Challenges	High density, semi-permanent housing, unsafe wiring, narrow and dead-end alleys	Low elevation, tidal flooding, minimal drainage, self-built housing, lack of signage	Poor housing quality; inadequate infrastructure
Evacuation Constraints	Blocked access due to fences/walls, bottlenecks in narrow alleys, limited vehicle entry	Absence of shelters, congested paths, tidal water blocking routes	Limited signage; insufficient evacuation routes
Community Strengths	Informal networks, mosque loudspeakers, youth groups for patrols	Neighborhood solidarity, use of informal communication channels, mosque courtyards as gathering points	Gotong-royong (mutual aid); reliance on mosques as safe spaces
Identified Needs	Firefighting facilities; route clearance; safer housing	Elevated shelters; drainage improvement; tsunami safe zones	Evacuation signage; early-warning systems; drills and training

Source: Author Analysis, 2025

3.5. Policy and Planning Implications

The results of the DIG workshops highlight the importance of participatory methodologies in enhancing disaster governance and community resilience. Residents of vulnerable coastal neighborhoods possess valuable spatial knowledge and lived experience of hazards, evacuation challenges, and coping strategies. Yet, this knowledge is rarely incorporated into conventional planning, which tends to prioritize infrastructure and top-down solutions. The DIG experience demonstrates how participatory tools can bridge this gap, translating local insights into inputs that meaningfully inform disaster management policies and urban development planning.

At the municipal level, DIG can complement the role of agencies such as BPBD, Bappeda, and Disperkim. Unlike conventional evacuation drills, which are often directive, DIG fosters dialogue and reflection by enabling residents to visualize risks in their own environment. Its low-cost and replicable design makes it well suited for integration into

community-based preparedness programs, ensuring that disaster literacy is strengthened across diverse social groups.

At the national level, institutionalization of DIG could be pursued through integration with the *Desa/Kelurahan Tangguh Bencana* (Disaster Resilient Village/Urban Resilient Neighborhood) program coordinated by BNPB. While the framework already provides a platform for community-based preparedness, its implementation often lacks standardized participatory tools for simulation and spatial risk visualization. Embedding DIG into this program would enhance the quality of community preparedness nationwide, provide a consistent methodology for diverse hazard contexts, and ensure that participatory approaches are mainstreamed into Indonesia's disaster governance system. By doing so, Indonesia could more effectively bridge grassroots experiential knowledge with formal planning and policy processes.

The findings also underline the need to recognize and support existing community-based resilience assets. Informal practices such as *gotong-royong* (mutual aid), the use of mosque courtyards as safe gathering spaces, and the mobilization of youth groups in communication and patrols are crucial for disaster response and recovery. By formally acknowledging these assets and providing targeted support, such as training, signage, or basic equipment, municipal agencies can build a more inclusive preparedness system that combines grassroots strengths with institutional resources.

Although DIG in this study was applied primarily to earthquake and tsunami scenarios, the method can also be adapted to address climate-related hazards such as recurrent flooding, tidal inundation, and heatwaves. By modifying the scenarios and mapping focus, communities could use DIG to visualize changing hazard patterns linked to climate variability, anticipate cascading impacts on infrastructure and livelihoods, and plan adaptive measures. Incorporating climate scenarios into DIG would thus expand its relevance beyond seismic risk, making it a flexible tool for multi-hazard community preparedness.

Beyond Padang, the DIG model holds potential for wider application in other hazard-prone urban settlements across Indonesia. Many coastal cities face similar challenges of overcrowding, poor infrastructure, and high exposure to earthquakes and tsunamis. Scaling up DIG in these contexts would strengthen Indonesia's national disaster risk reduction agenda while contributing to global frameworks such as the Sendai Framework for Disaster Risk Reduction and the Sustainable Development Goals.

In summary, the policy implications of this study are fourfold. First, institutionalization: DIG should be integrated into both municipal and national preparedness frameworks as a standard participatory tool. Second, recognition of local strengths: informal resilience mechanisms must be acknowledged and supported within official governance systems. Third, scalability: DIG can be replicated in other high-risk settlements, enabling Indonesia to strengthen community resilience at scale. Fourth, climate adaptation: DIG should be extended to address climate-related hazards, thereby supporting Indonesia's commitments to multi-hazard resilience and long-term adaptation strategies. Taken together, these implications position DIG not merely as an educational exercise but as a strategic planning instrument that links grassroots knowledge with broader resilience goals.

4. Conclusion and Recommendation

This study has demonstrated that the Disaster Imagination Game (DIG) is an effective participatory method for enhancing disaster risk awareness and preparedness in Padang's coastal slum communities. By engaging residents of Rimbo Kaluang and Flamboyan Baru in a structured, scenario-based process, the workshops enabled participants to visualize hazards, identify evacuation constraints, and propose recovery strategies. The results highlight important differences between the two settlements: Rimbo Kaluang faces severe evacuation bottlenecks due to its maze-like alleyways, semi-permanent housing, and blocked pathways, while Flamboyan Baru struggles with recurrent tidal flooding, fragile housing structures, and the absence of designated safe zones. Despite these differences, both neighborhoods shared common challenges, including the lack of evacuation signage, limited early warning systems, and minimal institutional support from municipal agencies.

The DIG process also revealed that while these communities are highly vulnerable, they are not passive victims. On the contrary, residents demonstrated strong local resilience assets, including practices of *gotong-royong* (mutual assistance), the use of mosque courtyards as temporary shelters, and youth groups engaged in neighborhood patrols and communication. These assets are deeply embedded in social networks and cultural traditions, providing an important foundation for disaster response and recovery. However, they remain largely informal and underutilized in formal disaster governance. Without structured recognition, institutional support, or resources, the ability of communities to rely on these mechanisms during large-scale disasters remains limited.

Equally important, the workshops served as more than just technical exercises—they became platforms for dialogue and trust-building between residents, RT/RW leaders, and municipal stakeholders such as BPBD, Bappeda, and Disperkim. These interactions underscored the value of participatory approaches in bridging the long-standing gap between community realities and formal planning. For many participants, it was the first time their perspectives were directly shared with local officials in a structured setting. This not only enhanced community ownership of disaster preparedness outcomes but also provided government actors with spatially detailed, community-driven data that can inform city-level planning.

Based on these findings, several recommendations can be drawn. First, municipal agencies should institutionalize DIG as part of their regular community preparedness programs. Its low-cost and flexible design makes it particularly suitable for replication across multiple neighborhoods in Padang, especially those with high exposure to seismic and coastal hazards. Second, community-based resilience mechanisms should be formally recognized and strengthened. By investing in training, signage, equipment, and basic infrastructure improvements, agencies like BPBD, Disperkim, and Bappeda can help transform existing informal practices into reliable components of the city's preparedness system. This approach ensures that grassroots strengths such as *gotong-royong* and mosque networks are not overlooked but rather reinforced. Third, DIG should be scaled up and adapted for wider use in Indonesia, especially in other hazard-prone coastal settlements. Doing so would not only strengthen local resilience but also contribute to the achievement of national disaster risk reduction targets and international commitments under the Sendai Framework for Disaster Risk Reduction and the Sustainable Development Goals.

In conclusion, the Disaster Imagination Game is more than an educational exercise; it is a strategic planning instrument that effectively links grassroots knowledge with institutional action. By enabling residents to actively participate in hazard mapping, evacuation planning, and recovery discussions, DIG fosters both awareness and ownership of disaster preparedness. At the same time, by engaging municipal agencies in the process, it ensures that local insights feed into broader governance structures. Taken together, these contributions offer a practical pathway to build resilience in vulnerable slum settlements and advance the broader vision of safer, more inclusive, and sustainable cities in Indonesia.

Acknowledgements

This research was made possible through the support of the residents and community leaders of Rimbo Kaluang and Flamboyan Baru, together with BPBD, Bappeda, Disperkim, the West Padang District Office, and the Rimbo Kaluang and Flamboyan Baru Subdistrict Offices. The author also thanks the faculty and staff of Ritsumeikan University and Universitas Gadjah Mada for their academic guidance and institutional support, and gratefully acknowledges Bappenas and JICA for supporting the double degree program that enabled this research.

References

- Abe, T. (2020). Regeneration of the cultural landscape of the fisheries city of Kesenuma through collaboration in machizukuri by multiple project-implementing bodies. In S. Satoh (Ed.), *Japanese machizukuri and community engagement: History, method and practice*. Routledge, pp. 185–194.
- Bappeda Kota Padang (2016). *Peninjauan Kembali RTRW Kota Padang Tahun 2010–2030*. Pemerintah Kota Padang.
- Basher, R. (2006). Global early warning systems for natural hazards: Systematic and people-centred. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 364(1845), 2167–2182. <https://doi.org/10.1098/rsta.2006.1819>
- BNPB. (2023). *RBI Risiko Bencana Indonesia: Memahami Risiko Sistemik di Indonesia (1st ed.)*. Pusat Data, Informasi, dan Komunikasi Kebencanaan BNPB, Jakarta.
- BPS Kota Padang. (2022). *Kota Padang dalam Angka 2022*. BPS Kota Padang, Padang.
- Chambers, R. (1994). Participatory Rural Appraisal: Challenges, potentials and paradigm. *World Development*, 22(10), 1437–1454.
- Disperkim Kota Padang. (2022). *Dokumen Rencana Penataan Permukiman Kumuh Perkotaan Kota Padang (RP2KPKP)*. Pemerintah Kota Padang, Padang.
- Haridhi, H. A., Huang, B.-S., Wen, K.-L., Denzema, D., Prasetyo, R. A., & Lee, C.-S. (2018). A study of large earthquake sequences in the Sumatra subduction zone and its possible implications. *Terrestrial, Atmospheric and Oceanic Sciences*, 29(6), 635–652. <https://doi.org/10.3319/TAO.2018.08.22.01>
- IPCC. (2014). *Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects*. Cambridge University Press, Cambridge, UK.

- Kano, T., Aydın, T., Kim, D., Okubo, T., Vatan, M., Polat, E. O., Kubota, A., Ünal, Z. G., Ito, M., & Kawamura, J. (2023). Simulating the Disaster Imagination Game (DIG) and developing the application in the Fırzağa neighborhood, Istanbul: A workshop with local volunteers. *Journal of Disaster Mitigation for Historical Cities*, 17, 61–67. <https://doi.org/10.34382/0002000231>.
- Kelman, I., Gaillard, J. C., & Mercer, J. (2015). Climate change's role in disaster risk reduction's future: Beyond vulnerability and resilience. *International Journal of Disaster Risk Science*, 6(1), 21–29. <https://doi.org/10.1007/s13753-015-0038-5>
- Keputusan Wali Kota Padang Nomor 310 Tahun 2025. *Lokasi Perumahan Kumuh dan Permukiman Kumuh*. Pemerintah Kota Padang, Padang.
- Keputusan Wali Kota Padang Nomor 519 Tahun 2020. *Lokasi Perumahan Kumuh dan Permukiman Kumuh*. Pemerintah Kota Padang, Padang.
- Lassa, J. A. (2015). *Roles of state and non-state actors in disaster risk reduction*. In *Rethinking Governance of Disaster Risk in the Pacific*. Springer, pp. 123–141.
- Maskrey, A. (1989). *Disaster mitigation: A community-based approach*. Oxfam, Oxford.
- McEntire, D.A. (2015). *Disaster response and recovery: Strategies and tactics for resilience*. Wiley, Hoboken, NJ.
- McNeill, L. C., et al. (2017). Expedition 362 summary. In McNeill, L. C., Dugan, B., & Petronotis, K. E. (Eds.), *Sumatra Subduction Zone. Proceedings of the International Ocean Discovery Program*, 362. <https://doi.org/10.14379/iodp.proc.362.101.2017>
- Morgan, D. L. (1997). *Focus groups as qualitative research (2nd ed.)*. Sage Publications.
- Peraturan Daerah Kota Padang Nomor 4 Tahun 2010. *Rencana Tata Ruang Wilayah Kota Padang Tahun 2010–2030*. Pemerintah Kota Padang, Padang.
- Peraturan Pemerintah Nomor 12 Tahun 2021. *Perubahan atas Peraturan Pemerintah Nomor 14 Tahun 2016 tentang Penyelenggaraan Perumahan dan Kawasan Permukiman*. Pemerintah Republik Indonesia, Jakarta.
- Reid, J. A., & Mooney, W. D. (2022). Tsunami occurrence 1900–2020: A global review, with examples from Indonesia. *Pure and Applied Geophysics*, 180(6), 1549–1571. <https://doi.org/10.1007/s00024-022-03057-1>
- Tanaka, S., Horiuchi, R., & Ueda, S. (2019). Enhancing community disaster preparedness through the Disaster Imagination Game (DIG): Case studies from Japan. *International Journal of Disaster Risk Reduction*, 39, 101135. <https://doi.org/10.1016/j.ijdrr.2019.101135>
- UNISDR. (2015). *Sendai Framework for Disaster Risk Reduction 2015–2030*. United Nations Office for Disaster Risk Reduction, Geneva.
- Wei, W., Mojtahedi, M., Yazdani, M., & Kabirifar, K. (2021). The Alignment of Australia's National Construction Code and the Sendai Framework for Disaster Risk Reduction in Achieving Resilient Buildings and Communities. *Buildings*, 11(10), 429. <https://doi.org/10.3390/buildings11100429>
- World Bank. (2019). *Strengthening the disaster resilience of Indonesian cities: A policy note*. World Bank Group, Washington, DC.

阿部俊彦. (2017). 気仙沼市内湾地区における防潮堤の計画とデザインの合意形成プロセス [Consensus building process of the seawall planning and design in the inner port area of Kesenuma City]. *土木学会論文集 D1 (建築計画学)*, 73(1), I_37-I_51. https://doi.org/10.2208/jscejaie.73.I_37