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What Can We Learn from Jakarta and Bekasi Floods in March 2025? Rapid Assessment and Policy Recommendations to Build Urban Resilience

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This working paper was developed in response to the March 2025 Jabodetabek flood to document its impacts and provide insights for strengthening urban resilience. It is part of a broader effort to bridge knowledge gaps, inform policy discussions, and support decision-making processes aimed at building more resilient urban communities. We extend our sincere gratitude to the residents of Taman Century, Pondok Gede Permai, and Pondok Mitra Lestari for sharing their firsthand experiences through interviews, which greatly contributed to this study. Their insights were invaluable in understanding the flood's impacts and response efforts. Funding for the research survey was provided by the Resilience Development Initiative (RDI).

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Abstract

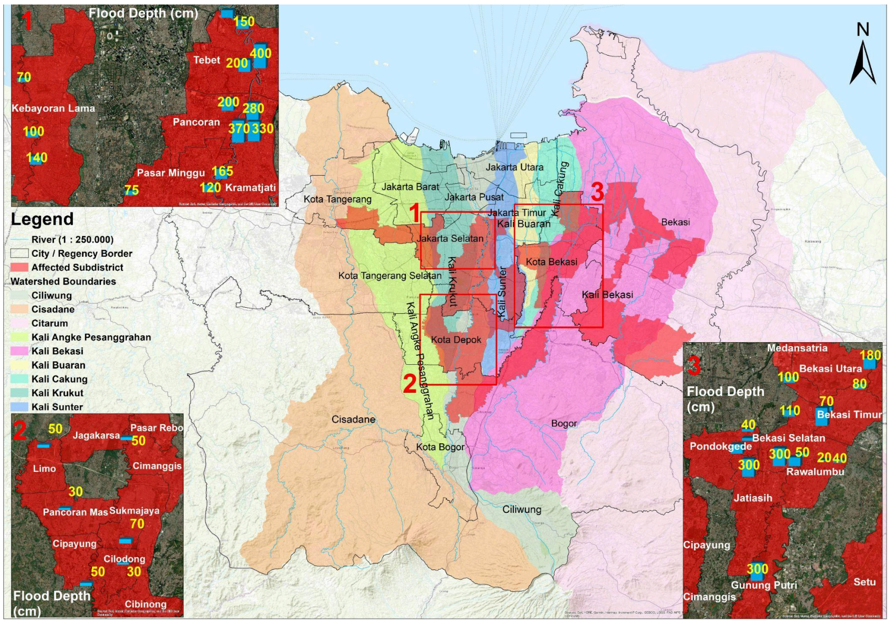
Widespread flooding across Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek) area, Indonesia, with water depths of 15–300 cm, remained as of March 5, 2025. Extreme rainfall in Bogor on March 2, 2025 triggered the flooding due to river overflows in Ciliwung, Cikeas, and Pesanggrahan. Field observations by the Multi-hazard Preparedness (MHP) team of the Resilience Development Initiative (RDI) in Bekasi highlight that some areas, such as Pondok Gede Permai, experienced water levels reaching close to four metres, submerging homes despite prior flood mitigation efforts like house elevation. The failure of the 3-metre flood barrier in this area exemplifies the inadequacy of existing flood defences. The flood has affected more than 120,600 people in six cities/regencies. Annual economic losses from floods in the region are estimated to reach approximately IDR 5 trillion or USD 300 million. The 2025 flood also revealed critical deficiencies in governance and disaster preparedness. The emergence of the Jabodetabek Flood in 2025 is not merely caused by the intensity of the rainfall but also due to inadequate flood management in the area. In line with the Build Back Better (BBB) approach, rehabilitation and reconstruction efforts during the post-disaster phase should prioritise long-term resilience. Therefore, the recommendations take a holistic approach, including improving data management and rapid assessment, strengthening land use regulations in upstream and floodplain areas, implementing Nature-based Solutions (NbS), deploying adaptive social protection (ASP) for vulnerable communities, enhancing infrastructure resilience, upscaling community-based disaster management, and strengthening stakeholder capacity for effective disaster response and preparedness.

Keywords: Flooding, Jabodetabek, Extreme Rainfall, Disaster Preparedness, Mitigation and Adaptation.

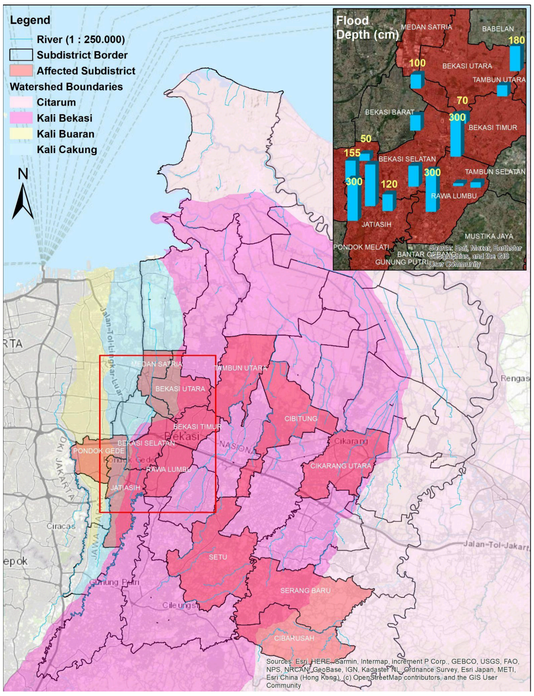
1. Introduction

Floods are common disasters experienced by many cities worldwide (Jonkman et al., 2024). Despite many solutions, floods and their impacts have tremendously kept happening. Jakarta Metropolitan Area (JMA), known as *Jabodetabek Mega* Urban Region, has had many flooding events in the past (see Table 1 for details). Floods are closely related to problems with spatial planning, especially in large catchment areas like Jabodetabek.

On 2 March 2025, extreme rainfall in the Bogor region, reaching 230 mm/day at Katulampa, triggered a rapid rise in water levels (Badan Meteorologi, Klimatologi, dan Geofisika, 2025). By 9 PM, the Katulampa Dam's water level reached 210 cm, prompting a Siaga I warning (Badan Pengelolaan Bencana Daerah Jakarta, 2025). The next day, March 3, continuous extreme rainfall triggered a flash flood in Puncak, Bogor. This led to the overflow of major rivers, including Ciliwung, Cikeas, Cileungsi, Pesanggrahan, and other tributaries, causing widespread flooding across Jabodetabek. Water depths ranged from 15 to 300 cm, severely affecting Jakarta and Bekasi (Badan Pengelolaan Bencana Daerah Jakarta, 2025). As of March 5, floodwaters remained in Jakarta, Bekasi City, Bekasi Regency, South Tangerang, Depok, Bogor Regency, and Bogor City, underscoring the prolonged impact of this extreme event.



(a)



(b)

Figure 1. Flood-affected subdistrict map in (a) Jabodetabek and (b) Bekasi City and Bekasi Regency
Source: Authors (2025), adapted from Regional Disaster Management Agency of Jakarta's (Badan Penanggulangan Bencana Daerah/BPBD) Press Release on March 5 and other supporting news

Given the scale and severity of the 2025 Jabodetabek flood, this study focuses on assessing its key impacts on affected communities and infrastructure, as well as identifying necessary findings and key recommendations to enhance urban resilience and mitigate future flood risks in Jabodetabek.

2. Methodology

This study employs a rapid mixed-methods approach to analyse the March 2025 Jabodetabek flood, integrating desk reviews, field observations, and geospatial analysis. The desk review involved collecting secondary data from various news outlets to assess flood extent and impacts alongside precipitation intensity data retrieved from satellite sources. This enabled a broader understanding of the rainfall patterns leading to the flooding event and provided context for validating field observations. Additionally, planning documents, reports from government agencies and humanitarian organisations were reviewed to supplement the findings.

Field observations were conducted in selected impacted areas, particularly in Bekasi, the worst affected areas, to capture on-the-ground conditions and community responses. These visits included structured interviews with affected residents to document their experiences, challenges, and perceptions of the flood's impact.. The information gathered from these interviews was cross-referenced with desk review findings to provide a comprehensive narrative of the disaster's socio-economic consequences.

A land use change analysis was performed using satellite imagery to assess long-term contributing factors to flood susceptibility. The Dynamic World land cover dataset, developed by Google and the World Resources Institute (Brown et al., 2022), was utilised due to its near-real-time global land cover predictions based on 10-m resolution Sentinel-2 imagery. The selection of this dataset was guided mostly by its temporal availability, which is crucial for assessing historical and recent land cover changes in the Jabodetabek region. Given the limited availability of continuously updated official land cover data in Indonesia, Dynamic World provided a viable alternative. Comparative assessments of global land cover datasets (Venter et al., 2022) indicate that Dynamic World has a global accuracy of 72%, making it a reliable choice for this analysis. Google Earth Engine (GEE) was used to process the dataset, which consists of nine classification bands representing different land cover types. To ensure high-quality aggregations, geometric median calculations (Roberts et al., 2017) were applied to derive annual land cover composites for 2017 and 2024. The classification was then restructured into five categories, water, vegetation, crops, built-up areas, and barren land, to enhance interpretability and alignment with flood impact assessments. Land cover change is estimated by identifying land cover class change from each pixel in 2017 to 2024. Afterwards, the land cover change dynamics are visualised using a Sankey diagram, qualitatively highlighting the makeup of the latest land cover (i.e., how much vegetation area in 2017 changed to built area in 2024).

The study framework integrating these methodologies is illustrated in **Figure 2**.

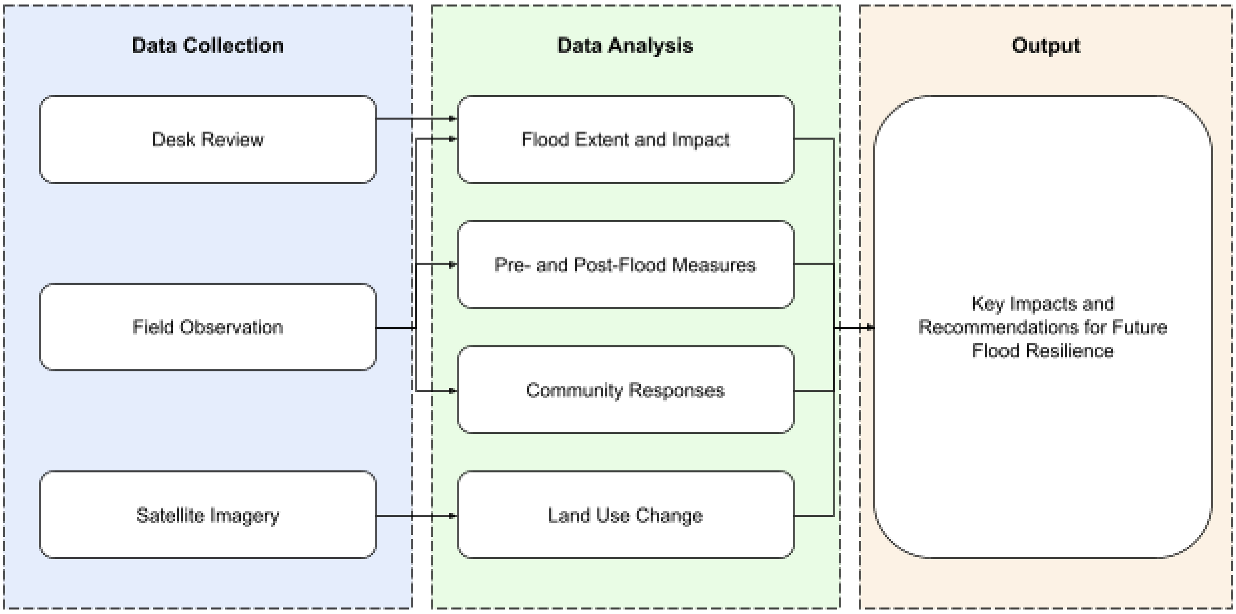


Figure 2. Study framework
Source: Authors (2025)

Given the rapid nature of this study, the findings remain preliminary and subject to further refinement. Nonetheless, key recommendations were sought to support informed decision-making.

3. Findings

The 2025 Jabodetabek flood event highlights persistent challenges in the region's flood management system, particularly in spatial planning, infrastructure resilience and governance effectiveness. Reports from affected communities, as published by numerous news outlets, indicate that the flood reached unprecedented levels despite lower recorded rainfall compared to previous major events. This aligns with a recurring pattern of severe flooding in Jabodetabek, observed in 2015 and 2020, suggesting a roughly five-year cycle. In 2015, flooding impacted 231,566 individuals, while in 2020, 83,406 people. The flood in early January 2020 was triggered by extreme widespread rainfall covering most of the Jabodetabek area. The intense precipitation led to severe inundation across multiple regions, with one Meteorology, Climatology, and Geophysical Agency (*Badan Meteorologi, Klimatologi, dan Geofisika/*BMKG) weather station in Halim Perdanakusuma recording an exceptionally high accumulated rainfall of 377 mm in a day (Aditiya, 2025). Meanwhile, the flood in early March 2025 was also caused by extreme but more localised rainfall, primarily concentrated in Bogor (**Figure 3)**. This extreme rainfall in the upstream area resulted in significant downstream water flow, with the Katulampa Dam in Bogor recording 230 mm of rainfall daily (BMKG, 2025). The 2025 flood, however, occurred despite lower rainfall intensity, indicating that factors beyond precipitation, such as declining drainage capacity, land use changes, and, perhaps, land subsidence, are exacerbating flood risks.

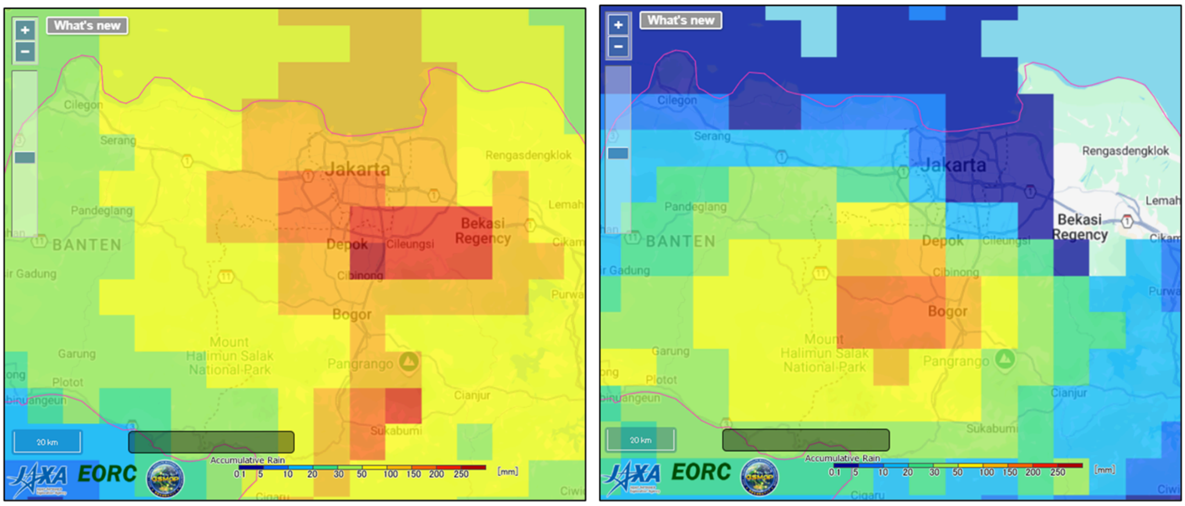


Figure 3. Spatial distribution of accumulated rainfall in one day before the flood events in January 2020 (left) and in March 2025 (right)

Source: Japan Aerospace Exploration Agency (JAXA)'s Global Satellite Mapping of Precipitation (GSMaP) in Kubota et al. (2020)

Based on data from the National Disaster Management Agency (*Badan Nasional Penanggulangan Bencana*/BNPB) as of March 4, 2025, the flood affected a significant number of people across various regions in the Jabodetabek area. The most impacted area was Bekasi City, where 61,233 residents were affected, followed by Bekasi Regency, with 51,320 people. In Jakarta City, floods impacted several areas in South, East, and West Jakarta, affecting 2,098 residents. Other affected areas include Tangerang Regency, with 4,157 people; Bogor Regency, with 1,399 people; and Depok, with 398 people (*Badan Nasional Penanggulangan Bencana*/BNPB and *Badan Meteorologi, Klimatologi, dan Geofisika*/BMKG, 2025). In total, the flood impacted more than 120,600 people across those six cities and regencies. Among those, 4,258 people in Jakarta and 5,000 people in Bekasi City were evacuated, according to data from the Regional Disaster Management Agency (*Badan Perencanaan Pembangunan Daerah*/BPBD) of Jakarta and Bekasi City Government (Hasanuddin, 2025; Hermansyah, 2025).

Additionally, the flood caused significant damage to roads and bridges, further disrupting transportation and access to affected areas. Several key infrastructures were affected, including the Kemang Pratama Bridge in Bekasi City, the bridge in Haji Muhi Street of South Jakarta, Saleh Danasasmita Road in Bogor City, and Jatiwangi Road in Bekasi Regency. In Bogor Regency, multiple bridges suffered damage, including a bridge on Hankam Street, one on Tugu Selatan, and a bridge on Cijulang Street, further complicating mobility and disaster response efforts in the region.

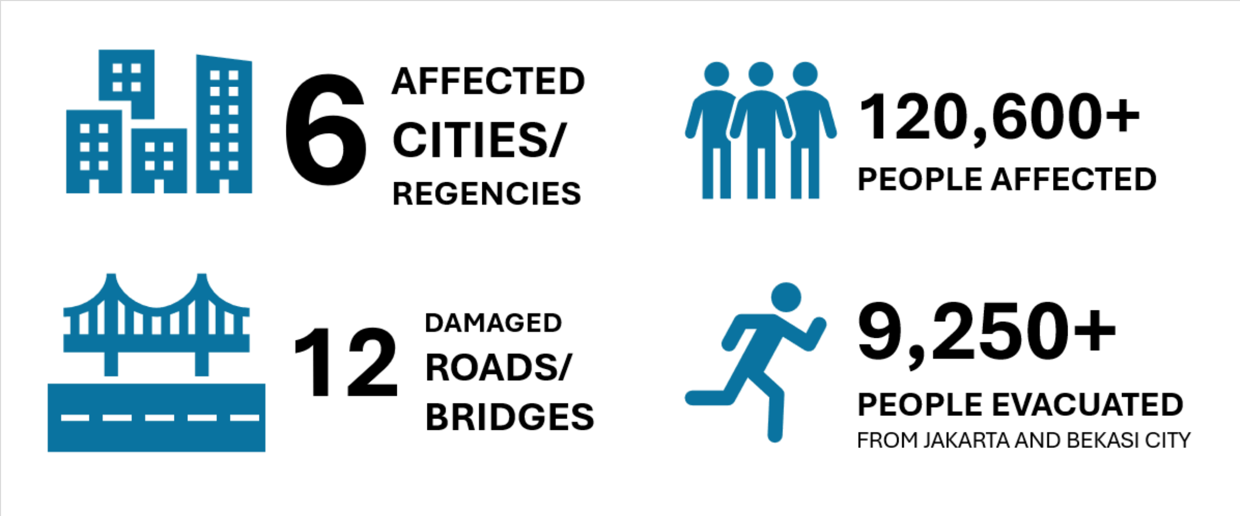


Figure 4. Summary of flood impacts
Source: Authors (2025), adapted from BNPB data as of March 4, BPBD and local government data as of March 5

The following **Table 1** provides a comparative analysis of major flood events in Jakarta and Jabodetabek, highlighting key factors such as causes, inundation area, rainfall intensity, evacuees, fatalities, and damages and losses.

Table 1. Historical major flood events in Jabodetabek modified from Sagala et al. (2013)

Variables	Jakarta Flood in 2007	Jakarta Flood in 2013	Jakarta Flood in 2015	Jabodetabek Flood in 2020	Jabodetabek Flood in 2025
Causes	Poor drainage system, heavy rain from Feb 1 to Feb 2, 2007	Widely distributed rainfall in upstream and downstream areas	Heavy rainfall in The Greater Jakarta Metropolitan on 8–10 February 2015	Widely distributed heavy rainfall in Jabodetabek from Dec 31, 2019 to Jan 1, 2020	Localised heavy rainfall in Bogor from Mar 1 to 2, 2025
Inundation Area	400 km^2	400 km^2	281 km^2	>156 km^2	To be calculated
Inundation Point	70	109 (Google Crisis Map)	52	160	> 60 (tentative)
Rainfall Intensity	Maximum 401 mm/day	Maximum 125 mm/day (widely distributed)	Maximum 277 mm/day	Maximum 377 mm/day	Maximum 230 mm/day
Evacuee (people)	398,000	335,000	231,600	>173,000	>9,250 (tentative)
Dead (People)	57	20	1	66	5 (tentative)

Variables	Jakarta Flood in 2007	Jakarta Flood in 2013	Jakarta Flood in 2015	Jabodetabek Flood in 2020	Jabodetabek Flood in 2025
Damages/ Losses	IDR 8 Billion	IDR 12.6 trillion	IDR 1.86 trillion per day	> IDR 11.4 trillion	IDR 5 Trillion (tentative)

Source: Adapted from Sagala et al. (2013), Wijayanti et al. (2017), Siswanto et al. (2017), Satu Data Jakarta (2020), and Lubis et al. (2022).

While past major floods in Jabodetabek (2007, 2013, 2015 and 2020) were associated with extreme rainfall events, the 2025 flood demonstrated that even less extreme precipitation could trigger severe inundation due to increased run-off from the upstream areas and the declining effectiveness of flood control infrastructure. Field observations in Bekasi highlight that some areas, such as Pondok Gede Permai, experienced water levels reaching close to four metres, submerging homes despite prior flood mitigation efforts like house elevation **(Figure 5)**. The failure of the 3-metre flood barrier in this area exemplifies the inadequacy of existing flood defences. Other critical infrastructures observed include:

- Perumahan Taman Century: Pumps intended to mitigate waterlogging proved ineffective against the rapid inflow, and flood barriers were breached due to excessive water pressure. The incomplete construction of some protective structures contributed to uncontrolled water seepage.
- Kemang Pratama Bridge: The collapse of the Kemang Pratama Bridge **(Figure 6)**, caused by erosion and sediment accumulation, disrupted mobility and emergency response. Piles of uncollected debris under the structure indicate poor river maintenance and waste management, further obstructing drainage capacity.
- Perumahan Pondok Mitra Lestari: Unregulated construction in disputed land near the river left a gap in flood defences, allowing water to inundate residential areas unchecked.

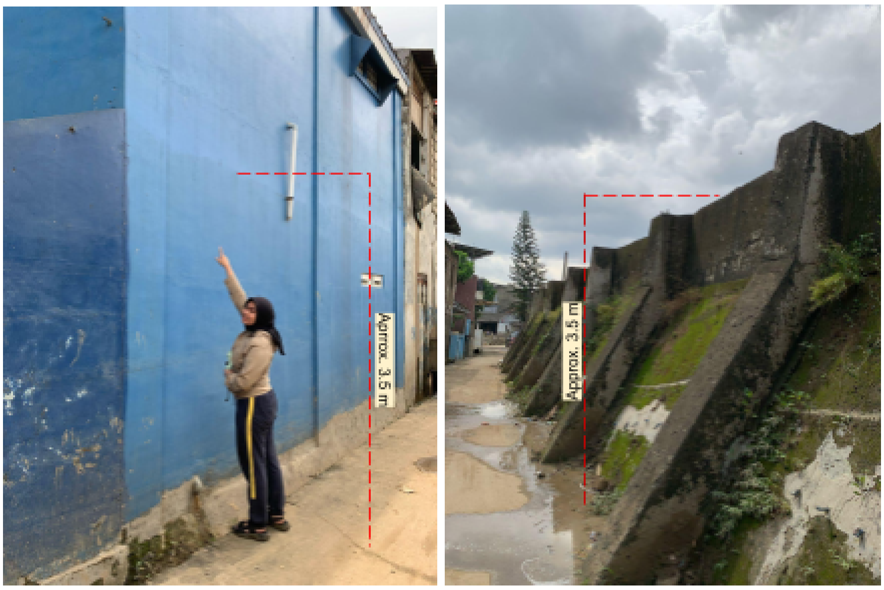


Figure 5. Observed flood mark on resident's house (left) and ~3.5 metres embankment (right) in Pondok Gede Permai, Bekasi
Source: Authors (2025)

Figure 6. Damage to Kemang Pratama Bridge in Bekasi caused by the 2025 Jabodetabek Flood
Source: Authors (2025)

Continued development in flood-prone areas has reduced natural flood absorption capacity. The conversion of green spaces into built-up areas has intensified surface runoff, increasing the likelihood of severe inundation. In upstream areas such as Bogor and Depok, large-scale deforestation has been carried out to accommodate new recreational developments, further disrupting the watershed's ability to regulate water flow. The removal of vegetation has accelerated soil erosion and sedimentation in river systems, diminishing their capacity to manage high water volumes during extreme weather events. These unmanaged and unmonitored land-use changes highlight the need for stricter environmental governance and integrated watershed management to enhance flood resilience in Jabodetabek.

Figure 7 shows the land cover of the Jabodetabek area in 2017 and 2024, with a visible increase in built area in the upstream Bogor Regency. The land cover change dynamics are further illustrated in **Figure 8**, highlighting the amount of newly converted classes in 2024 (right) and its corresponding contributing land cover classes from 2017 (left). Most notably, the diagram underscores the built area as the largest new addition, accounting for ~42,400 ha in Jabodetabek and ~19,700 ha in Bogor City and Bogor Regency. Furthermore, ~24,801 ha and ~14,178 ha vegetation area has been converted to built area. The rapid land conversion, particularly from vegetation to built areas, may reduce natural water absorption and increase surface runoff. These potentially contribute to a more severe flood in 2025 despite lower rainfall, as the rainfall is highly localised in Bogor City and Bogor Regency areas **(Figure 3)**.

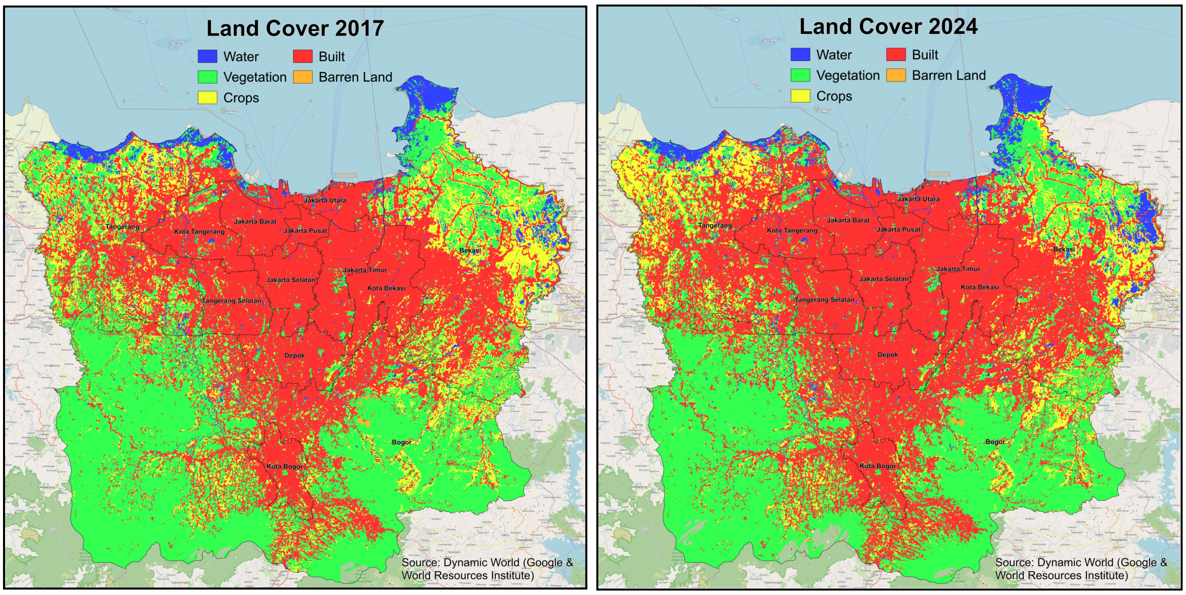


Figure 7. 2017 Land cover in Jabodetabek (left) and 2024 land cover in Jabodetabek (right)
Source: Adapted from Brown et al., 2022

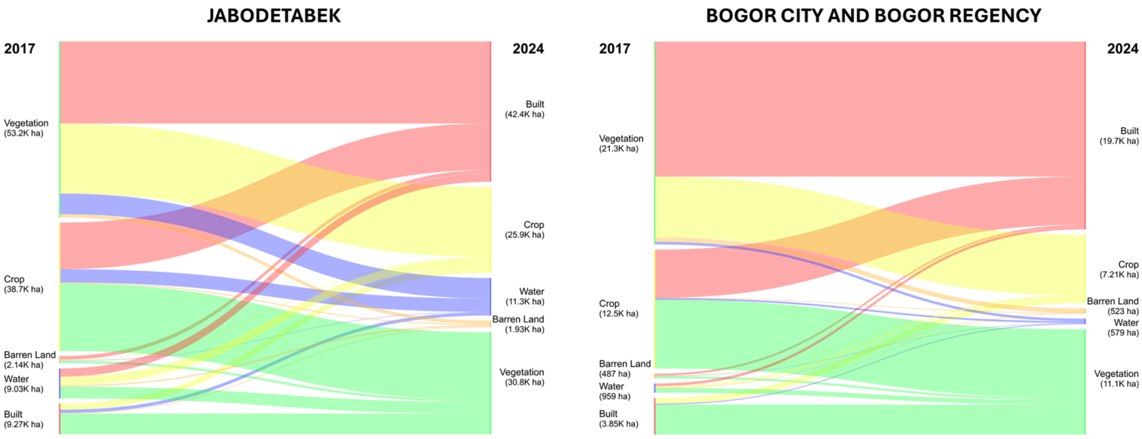


Figure 8. Sankey diagram of land cover change from 2017 to 2024 in 6A. Jabodetabek. 6B. Bogor City and Bogor Regency.
Source: Brown et al., 2022

The 2025 flood highlighted challenges in governance and disaster preparedness, particularly in early warning dissemination. Some communities reported not receiving official flood alerts and instead relied on informal networks, such as WhatsApp groups managed by local preparedness communities, to monitor rising water levels. A local community representative shared their experience:

> Usually, we receive information from KP2C [Komunitas Peduli Sungai Cileungsi-Cikeas / Cileungsi-Cikeas River Care Community], which is then shared informally through word of mouth and online platforms like WhatsApp. They also provided updates every 30 minutes.(Local community member at Pondok Gede Permai)

In numerous areas, search and rescue efforts faced challenges, with some residents reporting delays of over 24 hours due to limited resources, as reported by Metro TV (2025). In the immediate aftermath, communities organised their own relief efforts to support evacuation, food distribution, and temporary shelter. A local community member shared their experience:

> We called out for rice and water, but the evacuation team in the boat explained that their immediate focus was on evacuating older people, children, and those who were unwell. During the flooding, we struggled without food and water for two days and had no way to leave. (Local community member at Pondok Mitra Lestari)

Similarly, the distribution of emergency aid faced challenges, with some areas, such as Pondok Gede Permai, relying largely on community initiatives and private-sector donations. A local community member stated that "assistance is often provided by the communities around the PGP [Pondok Gede Permai] area. The help usually consists of food, drinks, floor cleaners, glass cleaners, basic necessities, and so on."

Efforts to strengthen flood defences and improve drainage maintenance had been discussed before the disaster, as mentioned in Jakarta Government Website, but many communities remained highly exposed when the flood occurred. Government-led river dredging efforts, for example, were scheduled after the event, reflecting ongoing concerns over sedimentation and flood risks. Additionally, Nature-based Solutions (NbS) initiatives in the area remain limited, as noted by a local resident.

> Nature-based approachshould not be the only solution. There are some absorption areas for water storage, but they don't fully address the flooding issue. They might help on regular days when the rainfall is manageable, but during major floods, they are not sufficient. What we hope for is an increase in water absorption areas, as many have been converted into residential zones. In addition, river maintenance, such as dredging the Bekasi River, has yet to be carried out. (Local community member at Pondok Mitra Lestari)

These challenges highlight the need for a more mitigation approach to flood risk management, ensuring that interventions are in place before disasters occur rather than primarily in response to them. While efforts have been made to mitigate the impacts on affected communities, gaps in emergency preparedness remain. Enhancing timely and effective response measures is essential to support recovery and reduce future risks.

> At the peak of the flooding, there were still no evacuation teams with rubber boats in our area. Many people, especially those with babies and older residents, were calling for help from their rooftops, hoping to be evacuated as soon as possible. (Local community representative at Pondok Gede Permai)

It is known that the Ministry of Social Affairs had spent IDR 3 billion for the assistance of providing food and medicine, although the details of its delivery mechanism are not explained (Safitri, 2025).

Beyond the immediate physical damage, the flood has also deepened financial and social vulnerabilities, further exacerbating economic instability for affected communities. Annual economic losses from floods in the region are estimated to reach approximately IDR 5 trillion or USD 300 million. Despite these substantial risks, insurance coverage for flood-related damages remains critically low (Anisah, 2025). A study focusing on East Jakarta residents (2024) revealed a limited understanding and uptake of flood insurance products, leaving many households and businesses financially vulnerable. This lack of financial protection prolongs recovery periods and exacerbates economic instability following flood events. Moreover, the government's disaster response funds have been consistently insufficient to cover large-scale recovery efforts, highlighting the need for robust risk transfer mechanisms. In addition to financial vulnerabilities, the 2025 flood has intensified socio-economic challenges, particularly among at-risk communities.

4. Discussions

While response measures, such as the collaboration between BNPB and BMKG in implementing weather modification operations upstream, have been quite effectively executed and claimed to reduce the burden downstream, greater emphasis on preventive strategies is crucial to mitigate future impacts and prevent recurrence (BMKG, 2025). Strengthening resilience requires improvements across multiple areas, such as improving age and gender-disaggregated displacement data collection and needs analysis mechanism, providing adequate resilient infrastructure to withstand future impacts, implementing nature-based solutions (NbS), and improving the land use regulation to avoid further loss of catchment area while also ensuring adaptive social protection (ASP) for the vulnerable communities, supported by advanced data management and comprehensive rapid assessment.

The emergence of the Jabodetabek Flood in 2025 is not merely caused by the intensity of the rainfall, but also due to inadequate water and flood management in the area. The strategy to convey assistance in emergency response situations has been mentioned in numerous regulations, such as the BNPB's Contingency Plan or the Ministry of Social Affairs' minimum service standard for disaster-affected communities. Hence, the immediate response should be based on the aforementioned regulations to ensure precise actions, including evacuation, can be initiated and fulfil local communities' needs. In addition, utilising the grassroots network of community-led groups could help to expedite the implementation of emergency response.

Furthermore, assistance for affected communities must be prioritised to support their recovery and reconstruction efforts. The physical loss of damaged houses and property is evident, therefore indicating the urgency of preparing a strategy to provide assistance in recovering and reconstructing the property. There is also a need for temporary solutions to damaged infrastructure, such as bridges and dikes, to minimise the impact on the wider economic system and prepare for the next floods. Considering the flood's wide coverage of impact, proper financial resources planning and optimising its delivery mechanism might be necessary. Given the extensive impact of flooding, all relevant stakeholders, especially the government, must ensure robust financial planning and an efficient delivery mechanism to support effective response and recovery (Hallegatte et al., 2019). Additionally, post-disaster rehabilitation and reconstruction should extend beyond immediate recovery and prioritise long-term resilience by integrating risk-informed planning, securing sustained funding, and strengthening institutional coordination (United Nations Office for Disaster Risk Reduction, 2015).

To conclude, this study provides a set of recommendations which are based on a holistic approach, encompassing both structural and non-structural mitigation and adaptation improvements:

a. Improve data management and rapid assessment for flood preparedness.

To improve flood response and mitigation, advancing data collection and a comprehensive database system is crucial, focusing on geographical features, infrastructure conditions, population impact (including displacement), and economic losses. These data support risk-informed and disaggregated data which serve as essential tools for disaster assessment and analysis, ultimately strengthening the resilience of communities, people, and assets (Fakhruddin et al., 2022). For example, improving the accuracy of river data and enhancing hydrological stream networks can be the first step in building a robust spatial data infrastructure (Kharisma & Sagala, 2018). Additionally, the dissemination of updated rainfall and water level measurements is essential to support preparedness. Strengthening monitoring systems and ensuring real-time data availability can support rapid assessments, enabling authorities to estimate economic damages more accurately and implement timely interventions. Enhancing early warning systems and integrating updated hydrometeorological data with decision-making processes will also improve preparedness, minimising risks to communities and critical infrastructure.

A lack of comprehensive data collection and analysis to accurately estimate economic losses from these flood events poses a significant challenge in disaster risk financing strategies (OECD, 2015). Detailed information on infrastructure damage, affected populations, business disruptions, and real-time hydrometeorological conditions is often insufficient or delayed. In addition, many regions in Indonesia lack hydrological data for flood hazard analysis (Sigit et al., 2023). In disaster risk financing, having accurate and timely loss estimates is crucial for allocating emergency funds, determining insurance payouts, and planning long-term recovery strategies. Budget planning, especially for disaster risk reduction, should also consider the characteristics of the potential hazards with different levels of severity (Mutiarni et al., 2021; Fahlevi et al., 2019). Therefore, improving data collection and analysis that specifically address local characteristics in a region will enhance financial preparedness, ensuring more effective and efficient responses to future flood disasters.

b. Strengthen the regulations of land use in the upstream region and restrict development in the riverbank and the floodplain zone.

The Jabodetabek Flood of 2025 was primarily attributed to increased rainfall and significant land-use changes in the upstream region of Puncak, Bogor, leading to excessive runoff. Studies by Hermawan (2019) have highlighted that runoff levels in this area are alarmingly high. Notably, over 2,000 hectares of land in Puncak have been converted, exacerbating the region's vulnerability to flooding. Our findings further indicate that built-up areas and crops have replaced approximately 21,300 hectares of vegetation cover in Bogor City and Bogor Regency. This condition underscores the urgent need to address the area's absorptive capacity decline. Thus, it also highlights the importance of spatial plan in securing the built up and non built up areas.

Strengthening land use regulations in upstream regions and restricting development along riverbanks and floodplain zones are critical measures to mitigate disaster risks such as extreme rainfall, floods, and landslides. There are instances where land use changes influence flood risk and coverage (Situngkir et al., 2014). Local governments play a pivotal role in integrating risk reduction, climate change adaptation, and sustainability into policies and governance frameworks, ensuring effective planning, resource allocation, and community engagement. Weak enforcement of land use regulations in upstream regions, such as Puncak, has significantly reduced water catchment areas, exacerbating flood risks in downstream regions like Jabodetabek. A notable example is the Hibisc Fantasy development project permit, which was initially permitted for 4,000 square meters but expanded to 21,000 square meters, far exceeding its approved limits. Such unauthorised expansions not only compromise the ecological integrity of upstream areas but also pose significant threats to communities and infrastructure downstream. This case exemplifies the consequences of inadequate regulatory enforcement and monitoring in environmentally sensitive regions. Addressing these challenges requires strengthening regulatory frameworks, enhancing monitoring mechanisms, and ensuring strict compliance with spatial plan and land-use policies to protect vital water catchment areas and mitigate disaster risks effectively.

c. Strengthen spatial plan and implement Nature-based Solutions (NbS) in the upstream region, watershed, and flood-prone areas.

Implementing NbS plays a crucial role in restoring the natural function of upstream areas and enhancing water retention, which is vital for flood mitigation in Jabodetabek (Sagala et al., 2021). One effective intervention is strip cropping on steep slopes, which Hermawan (2019) found to reduce runoff by 74.52%. Critical watersheds, especially Kali Bekasi, Kali Kukut, Kali Sunter, and Kali Angke Pesanggrahan, can be rehabilitated by implementing sustainable land-use practices, such as agroforestry and reforestation. These watersheds serve as natural buffers that regulate water flow, reduce erosion, and minimise sedimentation in downstream areas. However, a significant challenge arises from the extensive conversion of green spaces into built-up residential and commercial areas, limiting the effectiveness of these nature-based approaches. Addressing this issue requires integrating NbS with urban planning policies to protect remaining natural landscapes and restore degraded areas.

Integrating Sustainable Urban Drainage Systems (SUDS) in residential areas, alongside the Sponge City concept, offers a viable and sustainable approach to flood management in Bekasi and other urbanised areas in Jabodetabek. SUDS provide a cost-effective, long-term solution by slowing runoff, reducing flood risk, and minimising pollution (Sagala et al., 2022; Davis & Naumann, 2017). Key components of SUDS, such as constructed wetlands, retention basins, and bioswales, enhance water infiltration and reduce the burden on conventional drainage infrastructure. Meanwhile, the Sponge City approach, which has been successfully implemented in cities worldwide, increases water absorption and retention through green spaces, permeable surfaces, and rainwater harvesting systems. Another critical intervention is river normalisation, which aims to increase a river's capacity to store and drain excess water efficiently. River normalisation involves dredging, concreting, and constructing embankments to improve water conveyance and reduce flood risks (Tunas & Herman, 2019). In Jabodetabek, the Ciliwung, Cikeas, and Cileungsi Rivers require immediate normalisation efforts to manage high water overflows from the upstream region in Puncak, Bogor. This is aligned with the fact that the Ciliwung Watershed area is indeed experiencing a massive land use change to induce increased runoff (Sagala et al., 2013). While river normalisation enhances flood control, it should be implemented alongside ecological restoration strategies to maintain biodiversity and natural hydrological functions.

d. Deploy adaptive social protection (ASP) measurement as a safety net for the vulnerable community.

The Jabodetabek Flood 2025 underscored the critical need for an adaptive strategy to help vulnerable communities cope with the increasing complexity of disaster risks. In addition, the non-structural measurement will complement the over-emphasised intervention of structural mitigation from the local government (Sagala et al., 2013). Reports indicate this flood was even more severe than the 2020 event, highlighting a concerning trend. With climate patterns becoming more unpredictable, the link between extreme rainfall and flood events suggests an ongoing uncertainty that must be proactively addressed. Therefore, interventions must be designed to be as dynamic and flexible as the evolving risks.

Currently, social protection programmes tend to be reactive, providing assistance only after a disaster occurs rather than mitigating impacts in advance. To enhance preparedness, it is crucial to strengthen anticipatory action (AA), which enables timely intervention before a crisis escalates. A well-functioning early warning system is a key element of successful AA, allowing communities and authorities to act based on predictive data. In addition, Lassa et al. (2013) mentioned that aside from the EWS system itself, it is also important to build a feeling of trust among the local community with the emergency system. This involves long-term investments such as in training, community preparedness, drill and simulation. Moving forward, social protection programmes should be integrated with hazard forecasting, predetermined thresholds, and clear triggers to ensure a proactive response, reducing both vulnerability and long-term disaster impacts. Furthermore, these efforts can be reinforced by emphasising the crucial role of local communities and grassroots initiatives in advancing community-based disaster risk reduction, as well as the contribution of NGOs in providing essential assistance (Lassa, 2018).

e. Strengthen infrastructure resilience in flood-prone areas.

Building flood resilience requires a proactive and adaptive approach to infrastructure planning. To withstand extreme rainfall and prevent widespread inundation, infrastructure development in flood-prone areas must integrate the resilient infrastructure concept (Sagala et al., 2021). Resilient infrastructure standards must be enforced for new and existing projects. This ensures that large or complex projects conduct climate risk assessments and mitigation planning through planning tools such as Environmental Impact Assessment (AMDAL) and Strategic Environmental Assessment (KLHS) (Vallejo & Mullan, 2017). Strict enforcement of resilient infrastructure standards for new and existing projects is essential to minimize flood risks and enhance recovery capacity. The absence of disaster considerations in land-use planning has significantly increased flood risks in urban areas. Many residential developments in flood-prone zones were built without proper risk assessments, prioritizing economic growth over disaster resilience. Poor site planning and settlement patterns further increase vulnerability (Tran, 2015). Additionally, the lack of disaster-resilient building codes leaves many houses exposed, as they often lack elevated foundations, flood-resistant materials, or adequate drainage. Strengthening regulations and integrating adaptive housing measures—such as raised ground floors, water-resistant materials, and community-driven designs—can significantly reduce disaster impacts (Tran, 2015).

Improving flood protection and drainage systems is crucial in reducing vulnerabilities, as reinforced flood barriers, expanded retention basins, and efficient drainage networks can mitigate extreme rainfall impacts and reduce flood risks in vulnerable areas. However, existing infrastructure can still be overwhelmed, as seen in the case of the Katulampa Dam and embankments along the Bekasi River. Despite being strategically designed for flood mitigation, extreme rainfall exceeded its capacity, causing overflow that affected major cities. The situation was further exacerbated by an inadequate drainage system, which failed to effectively channel excess water, leading to severe runoff and prolonged inundation. While traditional flood protection remains highly effective in less intense flood scenarios, a study of

HCMC highlights that integrating small-scale solutions under the Sponge City approach enhances technical resilience, and when combined with conventional measures, offers greater flood reduction and redundancy (Scheiber et al., 2022)

Last but not least, there is an urgency to develop policies in metropolitan areas that provide a holistic approach to building resilient infrastructure connectivity. As a suburb of Jakarta that has strong linkages with cities in Jabodetabek, Bekasi City requires interconnected infrastructure for cross-scale solutions. This approach reflects the relationship between watersheds, groundwater systems, and economic mobility networks in the JMA. In addition, upstream and surrounding areas that have more blue-green spaces can be utilised to reduce flood risk and promote sustainable water management through blue-green infrastructure (BGI) (Yuanita & Sagala, 2025).

f. Upscaling Community-Based Disaster Management for Effective Response and Preparedness.

The affected community has repeatedly highlighted the involvement of local government, which has proven ineffective in addressing their needs. In light of this, community-based initiatives have played a crucial role in facilitating evacuation, restoring damaged homes and infrastructure (e.g., roads, drainage systems), and distributing aid. These efforts underscore the importance of community participation in disaster management, particularly during critical emergency response periods. Local disaster management agencies, such as BPBD (the Regional Disaster Management Agency) and Dinas Sosial (the Social Affairs Agency), have introduced initiatives like Destana (Disaster Resilient Villages) and KSB (Disaster Preparedness Groups) to mitigate disaster risks and impacts. Notably, 140 Destana groups have already been established in Bekasi Regency, with plans to form an additional 130 groups this year.

The CBDRM can play a pivotal role during emergency response, such as handling displaced communities (Saputra et al., 2025). When a disaster occurs, many people need to evacuate to a safe place, such as an emergency shelter or other sturdy public buildings. A community-based disaster management program needs to ensure that evacuations run smoothly and that everyone is able to survive. This requires advanced communication facilities and early warning systems so that information reaches the community quickly. Evidence from the local community, that some community members prefer to evacuate to family members' homes rather than a predetermined emergency shelter, indicates persisting gaps in emergency response coordination. To address this, community-based disaster risk management can help establish and spread contingency plans within the community, ensuring better coordination in the distribution of assistance during emergencies and clearer guidance on where people should go.

Nevertheless, reflecting on the event of the 2025 Jabodetabek Flood, community-based disaster management must be able to function optimally. This refers to their function of disseminating and sharing risk messages, as was conducted in the PGP Residence by the Cileungsi-Cikeas River Care Community. In the future, the conduct of information dissemination might be strengthened with sophisticated devices and adequate delivery mechanisms to improve evacuation time, the capacity to immediately cope with the risk, and better response in emergency situations. Moreover, community-based disaster management plays a crucial role not only in emergency response but also in the preparedness stage. This includes raising local risk awareness and conducting assessments of hazards and community capacities. These efforts can be strengthened through community-led initiatives to reduce risks, as direct involvement often fosters greater willingness and participation. In this context, there has been a proposal to relocate residents to mitigate river overflow risks and improve dam infrastructure. However, local authorities have yet to follow up on this top-down initiative.

g. Enhance stakeholders' capacity to ensure adequate disaster management approaches.

Capacity-building efforts play a crucial role in enhancing disaster resilience by equipping stakeholders with the necessary knowledge and skills to implement effective mitigation, response, and recovery strategies (Dharmadasa et al., 2023). Improving the capacity to implement Nature-based Solutions and Resilient Infrastructure can empower policymakers, urban planners, and community leaders to design and implement sustainable solutions that address the root causes of flooding and foster Urban Resilience. By understanding how to integrate green infrastructure, enforce land-use regulations, and develop adaptive urban planning policies, local governments and communities can reduce vulnerability to future disasters. Additionally, fostering cross-sector collaboration through capacity-building initiatives can ensure that best practices and innovative approaches are effectively integrated into disaster management frameworks.

Beyond physical resilience, strengthening financial preparedness and social safety nets is equally essential. Capacity building on topics such as Loss and Damage, Disaster Risk Financing and Insurance, Adaptive Social Protection, and Climate Disaster Displacement can help decision-makers and humanitarian organisations design mechanisms that safeguard vulnerable populations from long-term socioeconomic impacts (Larasati et al., 2025). Educating key stakeholders on financial risk transfer strategies, compensation mechanisms, and the implementation of inclusive disaster relief policies ensures that affected communities receive timely and sufficient support for recovery. By prioritising capacity-building in these areas, governments and organisations can create a more resilient, adaptive system that not only mitigates the risks of future disasters but also promotes sustainable development and social equity in disaster-prone regions like Jabodetabek.

5. Conclusion

The recent flooding in Jabodetabek underscores the urgent need to strengthen capacity at all levels for better flood resilience and disaster risk management. While response efforts have been quite effective, long-term solutions require stronger technical expertise, policy integration, and community engagement. The complexity of urban flooding demands a well-equipped workforce capable of risk assessment, adaptive planning, and cross-sector collaboration. Strengthening institutional capacity, flood monitoring and disaster preparedness will support more informed decision-making and proactive measures. Investing in continuous learning and knowledge exchange is essential to equipping stakeholders with the skills needed to navigate evolving flood risks.

In connection with that, the Resilience Development Initiative (RDI) commits to supporting capacity-building efforts by offering training in topics such as **Urban Resilience, Nature-based Solutions, Resilient Infrastructure, Loss and Damage, Disaster Resilience Financing, Adaptive Social Protection, and Climate Disaster Displacement**. Through these initiatives, RDI hopes to contribute to a shared understanding of disaster and climate challenges while empowering stakeholders with the knowledge and tools to build more resilient and inclusive communities.

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