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Implementation of Flood Risk Reduction in Jakarta

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Abstract

Jakarta faces a major risk of flooding. Therefore, a strategy is needed for massive disaster risk reduction. This study aims to analyze the implementation of flood risk reduction in Jakarta. The research method uses a descriptive qualitative approach with data collection through interviews, observations, and secondary data. The existing condition of the flood risk reduction system in Jakarta is built by strengthening early warnings that are developed based on the analysis of information collected from various parties. There are at least six ways used by BPBD to build a flood risk reduction system in Jakarta, namely: (1) the use of social media disseminated through the network of Regional Apparatus Organizations (OPD) and the community, (2) DWS, AWLR and AWS technology (3) SMS blasting system in collaboration with the Ministry of Communication and Information Technology (Kominfo) and using the Base Transceiver Station (BTS) network in flood-prone areas, (4) the use of volunteer radio networks, (5) the use of Simba and (6) Flood Monitoring System. Each of these methods has an important role in disseminating early warning information and helping communities to act immediately in the face of flood threats. These methods have reflected efforts to build preparedness in line with the Sendai Framework for Disaster Risk Reduction 2015-2030. The main focus of implementing these tools as instruments for data collection, risk information management, and access to location-based information as the basis for disaster risk reduction efforts.

Keywords: Flood, Disaster, Implementation, Risk Reduction, and Jakarta.

INTRODUCTION

Flooding is the most common type of disaster in Jakarta. Since the 17th century, flooding has been one of the main problems faced by Jakarta. As the center of gravity of Indonesia, Jakarta is faced with a high risk of flooding. The phenomenon of flooding in Jakarta is a classic problem that comes every year. Based on data from the Indonesian Disaster Information Data (DIBI) in 2022, floods are one of the dominant types of natural disasters that occur in the Jakarta area (BNPB, 2023).

Flooding as an anthropogenic (human-caused) environmental threat, provides catastrophic consequences and high risks that have a broad impact on humans and natural systems (Dalimunthe and Putri, 2016). Increased flood risk stems from the complex interactions of natural and anthropogenic factors, which go hand in hand with rapid changes in the socioeconomic system in the city of Jakarta (Budiyono et al, 2022). In addition, the potential flood exposure experienced by Jakarta is caused by several main factors, namely climate change, land subsidence, and socioeconomic and population changes (Anugrahadi et al, 2020; Lyons, 2015).

Jakarta Province has thirteen rivers, two canals and two floodways that flow into the north of Java Island. Most of northern Jakarta is below sea level, and there are depressions in some areas, making Jakarta highly vulnerable to flooding, especially during high rainfall. In 2020, extreme rainfall reached 377 mm per day, surpassing the previous record in 2007 of 340 mm per day. This increase in rainfall is one of the impacts of climate change. In addition, increased rainfall also has the potential to cause land movement that can lead to landslides (BPBD Jakarta, 2024). Floods have widespread and costly impacts due to the concentration of people and assets in flood-prone areas. Estimates of the impact of citywide flooding in Jakarta show that flood risk is estimated to cost up to USD 186 million per year. In fact, flood losses are projected to increase

further to USD 521 million per year by 2030 (UNFCC, 2023).

Flooding remains one of Jakarta's most frequent and damaging disasters. However, the high risk of flooding is not matched by an adequate early warning system (EWS). As noted by Wibowo (2023), despite efforts to integrate EWS with technology, many residents remain unaware of flood warnings or have become resigned to their vulnerability. Destryawan (2021) further emphasizes that the weakness of EWS contributes significantly to the number of victims and economic losses, as seen in the 2020 floods that resulted in 46 fatalities. This lack of preparedness underscores the urgency to improve not only the warning systems but also community awareness and responsiveness.

In addressing this issue, several studies offer valuable insights. Hidayat (2020) explores the role of Petabencana.id, highlighting its collaborative model between public and non-public actors in disseminating disaster information. While promising, the platform still faces challenges in financial transparency and private sector engagement, factors that could affect the sustainability of early warning initiatives. Wahyudi et al. (2021) focus on the usability of GIS-based platforms like Petabencana.id, demonstrating that user-centered evaluations significantly improve system effectiveness. This supports the argument that EWS tools must be intuitive and responsive to users' needs to be impactful. Ruslanjari et al. (2023) confirm the essential role of ICT in delivering early warning messages for hydrometeorological hazards. Meanwhile, Sulaeman (2021) reveals that real-time data visualization through Petabencana.id helps shape public behavior and engagement—an important step toward a more proactive and prepared community.

Other platforms such as JAKI, studied by Utomo et al. (2023), further illustrate the potential of technology in enabling rapid public access to flood information. The app's JakPantau feature provides real-time monitoring of flood-prone areas, making it a practical tool for both authorities and citizens. Government initiatives are also key. According to Taryana et al. (2022), the Jakarta Provincial Government has introduced integrated strategies, including emergency planning, waste management programs, and the J-FEWS early warning system, reflecting a growing institutional commitment to disaster preparedness.

Community participation is equally critical. Hilmy and Sya'ban (2023) highlight grassroots efforts such as waste management, drainage maintenance, and local biopore initiatives, all of which support flood mitigation. Finally, Guru and Santha (2013) show that Participatory GIS (PPGIS) can empower local communities and enhance flood risk communication, offering a people-centered model of disaster risk reduction highly relevant to Jakarta's urban context. Collectively, these studies reinforce the need for integrated, user-friendly, and participatory early warning systems, supported by institutional collaboration and community engagement, to effectively reduce flood risk in Jakarta.

By looking at the potential risks and impacts of these disasters, it is necessary to make concerted efforts to carry out prevention and preparedness in the context of flood disaster risk reduction. In addition to prevention and preparedness efforts, disaster detection efforts with early warning systems through technological equipment to monitor when and where disasters will occur are crucial. Early warning is an important tool that contributes to disaster prevention and preparedness for hazards and disaster threats that can improve disaster risk reduction. Therefore, this research seeks to examine the implementation of the flood disaster risk reduction program through the establishment of an early warning system in Jakarta.

RESEARCH METHODS

This research was conducted using a descriptive qualitative approach. Denzin & Lincoln (1994) provide the necessary methodology for a post-positivist approach, which involves qualitative methods. The post-positivist approach was chosen because it is interactive and in-depth. Post-positivism implies that the relationship between theresearcher and the object of study

is quite interactive and neutral, allowing the researcher to delve deeper while maintaining objectivity (Malik and Nugroho, 2016). Data collection in this study was carried out by in-depth interviews with informants from BPBD Jakarta using snawbal sampling technique. This research employed the interactive data analysis technique of Miles and Huberman (1992), where data processing occurs simultaneously and continuously throughout the data collection process, spanning data collection, data reduction, data presentation, verification, and conclusion drawing stages.

RESULT AND DISCUSSION

This research describes the implementation of flood disaster risk reduction through Petabencana.id as the object of research. Jakarta Province is a lowland with an average height of ± 7 meters above sea level. The total area of DKI Jakarta Province, based on data from the DKI Jakarta Provincial Development Plan 2023 - 2026 is 662.33 km. However, most of the area has a high level of flood hazard which is spread in almost every corner of the city of Jakarta (BPBD, 2024).

Based on data from DKI Jakarta Province in Figures 2022, the topographic area of the city of Jakarta is located in the lowlands with an average height of ± 7 meters above sea level. Of the total area, 40 percent of the Jakarta city area is in the form of plains whose land surface is 1-1.5 meters below sea level. In addition to having an area that is below sea level, Jakarta is drained by thirteen rivers, two canals and two flood ways. This means that almost half of Jakarta is below sea level and is prone to flooding.

Jakarta, as the center of gravity of Indonesia, has a high potential risk of flooding that occurs every year. There are many factors that cause flooding, ranging from technical factors such as meteorological, land cover, condition of river bodies and banks, siltation due to sediment, garbage, land subsidence, sea level rise, as well as non-technical factors such as social, economic, educational, and regulatory/policy implementation (Cahyono et al., 2020). Floods in Jakarta not only cause material losses, but also have the potential to threaten people's lives. Therefore, to face this challenge, the Jakarta Provincial Government, through the Regional Disaster Management Agency (BPBD) and related agencies, has developed various flood disaster risk reduction policies. These policies focus on disseminating information quickly and effectively to the community, so that they can prepare for and respond to flood situations properly.

The flood risk reduction system in Jakarta is built on strengthening early warnings that are developed based on the analysis of information gathered from various parties. Apart from BMKG, the flood information system has been developed with various sources. There are at least six ways used by BPBD to build a risk reduction system, namely: (1) the use of social media disseminated through the network of Regional Apparatus Organizations (OPDs) and the community, (2) DWS, AWLR and AWS technology (3) SMS blasting system in collaboration with the Ministry of Communication and Information Technology (Kominfo) and using the Base Transceiver Station (BTS) network in flood-prone areas, (4) the use of volunteer radio networks, (5) the use of Simba and (6) Flood Monitoring System. Each of these methods has an important role in disseminating early warning information and helping the community to act immediately in the face of flood threats.

First, social media has become one of the main communication platforms used by BPBD Jakarta to disseminate flood-related information to the public. In the digital era, social media such as Twitter, Facebook, Instagram, WhatsApp and 112 emergency calls make it easy for local governments to reach the public widely and in real-time. When heavy rainfall or flooding begins to hit some areas of Jakarta, BPBD mobilizes all resources and volunteer networks to receive

and disseminate information through their official social media accounts. The information conveyed includes early warnings, water level status, areas affected by flooding, and evacuation instructions.

Not only disseminating information, the various social media channels owned by BPBD function as a medium for receiving information directly from the community and volunteer teams spread to the village level. The use of social media also allows two-way communication between BPBD and the community. Residents at flood locations can report the latest situation, such as water levels, road conditions, and urgent needs. Reports from residents are then verified by BPBD and related agencies to ensure validation of the information.

In addition, BPBD Jakarta also utilizes WhatsApp groups involving volunteers at the RT and RW levels to receive and disseminate information more directly to residents. This network serves as a two-way communication channel, involving a network of volunteers and BPBD teams located in all locations up to the urban village level. The existence of this network of volunteers and BPBD teams ensures that important flood-related information can reach all levels of society, especially for those who do not have access to or are not active on social media. By utilizing social media, BPBD Jakarta is able to disseminate information quickly and widely, and involve the community directly in disaster risk reduction efforts. This creates synergy between the government and the community in dealing with the threat of flooding.

Second, to mitigate and reduce the impact of flood disasters, BPBD Jakarta has implemented a flood risk reduction system with advanced and integrated technology. The technology used includes DWS (Disaster Warning System), AWLR (Automatic Water Level Recorder), and AWS (Automatic Weather Station). Each of these tools plays an important role in strengthening vigilance and rapid response to potential flooding.

DWS (Disaster Warning System) is an early warning system directly controlled by Jakarta's BPBD. This system functions to provide fast and accurate information about water levels at various points in Jakarta that are prone to flooding. DWS utilizes sound as a means of communication to the community around locations that are detected to have flood potential. If there is a significant spike in water levels, DWS will issue a sound warning that can be heard in the surrounding area to give residents time to prepare and take mitigation measures. This technology is audio-based through loudspeakers. This technology is adopted from the system used in Japan, which is known as one of the countries with a highly sophisticated disaster warning system. These loudspeakers are installed on poles in areas that frequently experience flooding, such as riverbanks, basin areas, and areas that have a history of major flooding.

The system can be controlled centrally through the control center at the BPBD Jakarta office. The early warning system can be activated remotely and controlled by the BPBD team directly. If signs of flooding have been detected, the BPBD team can provide early warnings through voice appeals directly from the command post at the BPBD office. This audio-based early warning system is very effective in densely populated areas and in areas with limited infrastructure. The warning sound produced by this system is able to reach a considerable distance within a radius of approximately 5 KM, so that residents around the location can hear the warning clearly and take immediate action. In addition, the system is also designed to operate independently even if the communication network is disrupted, for example due to power outages or weakened cellular signals due to flooding. With this audio warning system, BPBD Jakarta can provide early warnings quickly and effectively, especially in areas most vulnerable to flooding. AWLR (Automatic Water Level Recorder) is a tool used to automatically monitor and record water levels in Jakarta's rivers. This tool is installed in a number of strategic locations, such as at sluice gates, main channels, and large rivers. The output produced from AWLR is in the form of continuously updated water level data, which is then analyzed to predict the potential for flooding. This data is very useful for BPBD and related agencies to take mitigation actions, such as opening floodgates or evacuating areas prone to submergence.

AWS (Automatic Weather Station) is a tool used to monitor real-time weather conditions, including wind direction and rainfall. AWS provides important data on the potential for heavy rains that can trigger flooding, as well as information on wind direction that can affect weather patterns and water flow in the Jakarta area. With the AWS, BPBD and related agencies can anticipate weather changes that can worsen flood conditions. Data from the AWS is used for short and long term disaster mitigation planning, as well as to provide early warnings to residents regarding extreme weather that can increase the risk of flooding. To date, there are 42 devices in the form of DWS, AWLR and AWS in Jakarta.

Third, the SMS Blasting system in collaboration with Kominfo and BTS in flood-prone areas. The SMS blast-based early warning system is another innovation used by BPBD Jakarta to disseminate information about potential flooding. SMS Blast is a strategy carried out by sending text messages en masse to a large number of recipients at the same time. This system works with the Ministry of Communication and Information Technology (Kominfo) and cellular operators, to send mass warning messages to people in flood-prone areas. The message dissemination process is done by utilizing the existing BTS (Base Transceiver Station) network in the area. When signs of flooding are detected, BPBD can send a warning SMS containing flood warning information and evacuation directions to residents in the affected area. This SMS can be received by all cell phone users in the area, both those with smartphones and simple cell phones so that this SMS blast system can reach all levels of society without exception.

Fourth, the use of volunteer network radios. In addition to modern technology, volunteer network radio is also an important tool in disseminating disaster information in Jakarta. This radio network involves volunteers at the RT, RW, and local community levels who are active in disaster management. In flood situations, this two-way radio is used to convey early warning information and monitor conditions in the field. Volunteer network radios have the advantage of effective two-way communication. Volunteers in the field can directly report the latest conditions to the BPBD team, such as water levels, road access conditions, and assistance needs in affected areas. Conversely, BPBD can give direct instructions to volunteers to disseminate warning information to local residents, as well as provide evacuation directions if needed.

Furthermore, the volunteer team in the field is equipped with a Megaphone at the disaster site. The use of megaphones at disaster sites is also an important part of BPBD's strategy in reducing the risk of flooding in Jakarta. Megaphones are used by field officers and volunteers to convey direct instructions to residents in flood-affected areas. This tool is particularly effective in densely populated areas, where direct communication is needed to direct residents to safer places or inform them of steps to take during flooding. With a loud and clear voice, megaphones allow instructions to be clearly heard by residents.

Fifth, BPBD Jakarta has developed a comprehensive information technology-based monitoring system to manage disaster-related information, the distribution of volunteers and teams in the field through an online monitoring platform called the disaster information system (Simba). This system not only provides information on disaster events, but also integrates weather forecasts for the Jabodetabek area with data from BMKG, so that rainy weather forecasts can be displayed directly on the Simba dashboard. This integration allows BPBDs to monitor weather conditions relevant to disaster preparedness more accurately and proactively.

In addition to weather forecasts, BPBD also monitors water levels in upstream rivers, with data updated hourly based on water level status levels. This information is one of the important references in providing early warning, ensuring that data related to flood risk is always current and relevant for quick decision-making. Data collected through the Simba dashboard is conveyed to the public and the BPBD network using various media, including social media and audio-based DWS. This DWS system allows announcements from BPBD to be delivered directly to communities living in flood-prone areas.

Sixth, the Jakarta Flood Monitoring system. In the effort to reduce flood risk and

disseminate disaster-related information, BPBD has a more established and adaptive network of BPBD volunteers, speed of information delivery, as well as data accuracy and regional mapping. By adopting the Petabencana.id system that uses a GIS-based geolocation system, BPBD has successfully built a map system up to the neighborhood level through Pantau Banjir Jakarta. In addition, it is supported by a strong network of volunteers including Regional Apparatus Organizations (OPD), sub-districts, villages, and volunteers at the RT / RW level in stages.

BPBD Jakarta collaborates with the Cipta Karya Agency in developing a separate platform called https://pantaubanjir.jakarta.go.id/peta-informasi-banjir as an integrated information center that functions to monitor flood conditions in Jakarta down to the RT level. Through this platform, information regarding flood points can be accessed in real-time and presented comprehensively, allowing the public to see the distribution of inundation, road access, and the status of affected areas.

In addition, BPBD Jakarta's position is further strengthened by volunteers, who are tasked with monitoring and relaying real-time conditions on the ground to BPBD, enabling faster and more accurate data validation. BPBD sees that internal networks allow the information dissemination process to be more structured and coordinated. Not only that, this internal network is also faster, more detailed and relevant, because it comes directly from officers and volunteers who have been trained. With these strengths, BPBD considers its current flood risk reduction system more capable and accurate in responding to disaster information needs.

BPBD Jakarta plays an important role in flood risk management in Jakarta through various programs and multiple warning systems. Referring to some of the key priorities of the Sendai Framework for Disaster Risk Reduction 2015-2030, BPBD proactively implements the Sendai Framework in disaster risk reduction policies in DKI Jakarta. The Sendai Framework establishes a deep understanding of risk as the main basis for disaster risk reduction. The efforts made by BPBD Jakarta in implementing the Sendai Framework show a diverse and innovative approach in understanding and managing disaster risks. The use of technology such as DWS, AWLR, AWS, Simba, as well as communication approaches such as social media, SMS blasting, and volunteer network radio show the integration between technology and community participation in dealing with disasters in line with the Sendai Framework mandate. On the other hand, the Sendai Framework emphasizes the importance of data collection, risk information management, and access to location-based information as the basis for disaster risk reduction efforts. It aims to identify potential hazards, understand vulnerabilities, and plan appropriate responses. BPBD DKI Jakarta implements various efforts to realize these goals through various technologies and integrated communication approaches.

CONCLUSION

The existing condition of the flood risk reduction system in Jakarta is built by strengthening early warnings that are developed based on the analysis of information collected from various parties. There are at least six ways used by BPBD to build a flood risk reduction system in Jakarta, namely: (1) the use of social media disseminated through the network of Regional Apparatus Organizations (OPD) and the community, (2) DWS, AWLR and AWS technology (3) SMS blasting system in collaboration with the Ministry of Communication and Information Technology (Kominfo) and using the Base Transceiver Station (BTS) network in flood-prone areas, (4) the use of volunteer radio networks, (5) the use of Simba and (6) Flood Monitoring System. Each of these methods has an important role in disseminating early warning information and helping communities to act immediately in the face of flood threats. These methods have reflected efforts to build preparedness in line with the Sendai Framework for Disaster Risk Reduction 2015-2030. The main focus of implementing these tools as instruments

for data collection, risk information management, and access to location-based information as the basis for disaster risk reduction efforts.

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