Jurnal Planologi
Vol. 22, No. 1, April 2025
Available: http://jurnal.unissula.ac.id/index.php/psa

E-ISSN: 2615-5257
P-ISSN: 1829-9172

Analysis of Community Adaptation to Flood Disaster in Kaliabang Tengah Urban Village, North Bekasi, West Java Province

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ABSTRACT

Kaliabang Tengah Urban Village, North Bekasi, is an area that is routinely affected by flooding every year, with a frequency of 2-3 times per year and a flood depth of between 20 cm to 1 m. The purpose of this study is to examine the form of active adaptation of the Kaliabang Tengah urban village community to flooding, including physical adaptation, emergency response, and post-flood recovery. The method used is descriptive. The sample in the study consisted of 97 households selected using the slovin formula. The sampling technique used was proportional random sampling. The results showed that the majority of individuals raised the floor of their homes between 50 cm and 1.5 m as an adaptation measure against flooding. During emergency response, people evacuated to higher ground, and after the flood, they worked together to clean the roads and drains. The analysis shows the need for policies that support community adaptation, such as increasing the capacity of evacuation sites and building evacuation routes to speed up recovery after flooding.
Keywords: *Community Adaptation, Flood, Bekasi City*

ABSTRAK

Kelurahan Kaliabang Tengah, Bekasi Utara, merupakan wilayah yang rutin terdampak banjir setiap tahunnya, dengan frekuensi 2-3 kali per tahun dan kedalaman banjir antara 20 cm hingga 1 m. Tujuan penelitian ini mengkaji bentuk adaptasi aktif masyarakat Kelurahan Kaliabang Tengah terhadap banjir, mencangkup adaptasi fisik, tanggap darurat, dan pemulihan pasca banjir. Metode yang dgunakan adalah metode deskriptif. Sampel yang ada di penelitian berjumlah 97 KK yang dipilih melalui penerapan rumus slovin. Teknik pengambilan sampel yang digunakan adalah Proportional Random Sampling. Hasil penelitian menunjukkan bahwa mayoritas individu meninggikan lantai tempat tinggal antara 50 cm hingga 1,5 m, sebagai langkah adaptasi terhadap banjir. Selama tanggap darurat, masyarakat mengungsi ke tempat yang lebih tinggi, dan setelah banjir, mereka bergotong royong membersihkan jalan dan saluran air. Analisis menunjukkan perlunya kebijakan yang mendukung adaptasi masyarakat, seperti meningkatkan kapasitas tempat pengungsian dan membangun jalur evakuasi untuk mempercepat pemulihan setelah banjir.
Kata Kunci: Adaptasi Masyarakat, Banjir, Kota Bekasi

1. INTRODUCTION

Based on data from the National Disaster Management Agency (BNPB), flooding is the most frequent natural disaster in Indonesia from 2009 to July 2023, with a total of 11,679 incidents. During the last three years (2020-2022), as many as 1,457 educational facilities and 386 health facilities were damaged by floods. In addition, around 131,458 houses were also damaged during this period (BNPB, 2023).

Flooding is defined as a natural phenomenon or the result of adverse human activities. These natural phenomena include heavy rainfall, reduced overflow capacity of rivers, and blockage of tributaries on the banks of main rivers. Flood-related research continues to develop with different methodologies and approaches, as disaster research is currently an important research focus, especially in Indonesia, which is a flood-prone country (Dahlia et al., 2018).

Among cities in Indonesia, Bekasi City is one of the cities prone to flooding. Flooding in Bekasi City can be classified into two categories: localized flooding and runoff flooding. Localized flooding is caused by high rainfall rates in the area, resulting in high rainfall over a long period of time. This overwhelms the capacity of the drainage infrastructure to accommodate the increased volume of water, thus causing flooding. Meanwhile, runoff flooding occurs due to heavy rainfall in other areas that causes the Bekasi River to overflow, resulting in the formation of puddles that then flood the surrounding area Kaliabang Tengah Urban Village is one of the flood-prone areas in Bekasi City (Pangerang, 2021).

The results of interviews conducted in Kaliabang Tengah Urban Village, North Bekasi, particularly in RW 06 and RW 012, show that the community often experiences flooding. The main cause of flooding is high rainfall and a poor drainage system, which results in high water runoff around rivers and waterways. This condition is exacerbated by the accumulation of garbage and mud that clogs the waterways.

Flooding is a recurring phenomenon, particularly in RW 06 and RW 012. The most significant incident occurred in 2007, which was the most destructive natural disaster ever recorded because the depth of the flood reached around 120 cm. As a result, the local government deployed rubber boats. In addition, it is necessary to evacuate the residents in the area to ensure their safety and well-being.

According to data from the National Disaster Management Agency (BNPB), West Java recorded more than 300 flood events, making it one of the provinces with the highest frequency of flooding in Indonesia. Kaliabang Tengah Urban Village, North Bekasi, is a frequent phenomenon as the area experiences flooding almost every year, especially during the rainy

season. Flooding in Kaliabang Tengah is often exacerbated by high rainfall and an inadequate drainage system, which causes water to quickly pool in settlements. With this high risk, community adaptations, such as raising the floor of the house, evacuating to higher ground, and community service after the water recedes, are important steps that demonstrate the community's efforts to cope with recurrent floods (BNPB, 2023).

According to Syahputra & Indrawati (2017), adaptation refers to self-adjustment to the environment, which can involve internal individual changes (autoplastic) or environmental modifications (allostatic). Passive adaptation occurs when individuals adjust to the environment without altering it, whereas active adaptation involves efforts to influence the environment. Measures such as levee construction and increasing community awareness are components of the adaptation process aimed at enhancing capacity in managing flood risks (Inayatul Y dan Djaka, 2020).

Community adaptation to flood disasters is crucial in reducing negative impacts such as casualties, infrastructure damage, and economic losses. Measures such as constructing elevated houses, preparing evacuation routes, and conducting disaster response simulations play a significant role in expediting evacuations and enhancing community preparedness in the face of flooding (Anggraini, 2018).

Previous research on community adaptation to flooding, such as that conducted by Maryono (2020), tends to prioritize structural solutions, such as house elevation and levee construction. Meanwhile, Sunimbar & Angin (2022) highlights how communities adapt to flooding by building houses on stilts or elevating buildings to protect themselves and evacuating to safer locations during floods. After the flood, people cleaned their houses of garbage and mud and repaired the damage. Happy et al (2022) found that communities have developed disaster response groups (Destana) to provide information and assistance to flood-affected communities. In addition, they have constructed “people's stage” which serves as an evacuation point for goods so that they are not submerged in water during floods.

Based on previous research, this study fills the gap by exploring the community's active adaptation patterns in the face of flooding, which has not been widely discussed in the specific context of North Bekasi. The research study on community adaptation is divided into three main stages: before, during, and after the flood, with different strategies at each stage.

2. DATA AND METHODS

This research uses a descriptive methodology that explains systematically, factually, and accurately about the data obtained from the research. Descriptive technique is a research approach that requires direct observation of events and phenomena, then conveys the findings descriptively. Researchers then present this information using descriptive analysis (Rusandi & Rusli, 2021). This research examines the community's active adaptation patterns with a descriptive approach to explore their responses to flood disasters.

Data collection for this research was conducted through field surveys, utilizing interview techniques with the community, supplemented by questionnaires and documentation. Interview guidelines were used to concentrate on the research problem and objectives during the interview process (Rukajat, 2018). According to Sugiyono (2016), Interview is a data collection technique used when researchers want to conduct a preliminary study to identify problems that must be researched. In addition, interviews are also applied when researchers want to get more in-depth information from respondents, especially when the number of respondents is limited or relatively small.

Table 1. Interview Instrument Grid

Variable	Indicator	Sub-Indicator	Instrument
Adaptation	Active Adaptation	1. Forms of activities carried out by the community before the flood.	Interview Guidelines
		2. Forms of activities carried out by the community during floods.	
		3. Forms of activities carried out by the community after the flood.	

Source*: Modified Ayustiana, 2021.*

In this study, the research population was all household heads affected by flooding in Kaliabang Tengah Urban Village, North Bekasi, as shown in (Table 2):

Table 2. Sample Distribution Data

No	RW	KK	Sampling
1.	RW 06	2.000	56
2.	RW 012	940	41
	Jumlah	2.940	97

Source*: Population Retrieved RW 06 and RW 012 Kaliabang Tengah Urban Village, 2024.*

The sampling technique used in this study is Proportional Random Sampling. According to Yunus (2016), proportional random sampling is a key element in sample selection, involving the determination of sample size based on the proportion of members in different sub-populations. This approach ensures that the sample is proportional and representative. In this study, the technique was applied to ensure that the number of respondents was proportional to

the The proportion was determined based on the number of household heads in flood-affected RT. The research sample consisted of 97 households distributed across RW 06 and RW 012, as shown in (Table 2).

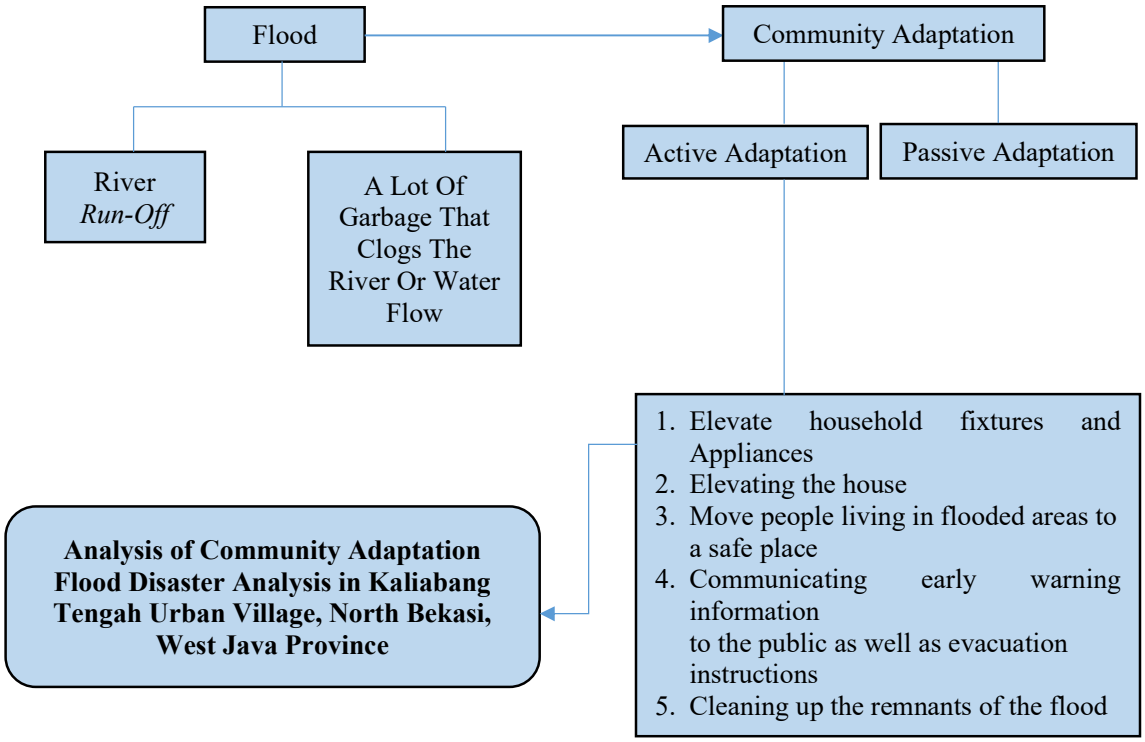

Figure 1. Research Flow Chart

The research stages were carried out through data collection with interviews. After data collection, the next stage was to analyze how the community in RW 06 and RW 012 in Kaliabang Tengah Urban Village actively adapted to their environment during flooding. Finally, conclusions were drawn by summarizing the main findings, identifying adaptation patterns, and evaluating the effectiveness of community strategies in dealing with floods, as shown in (Figure 1).

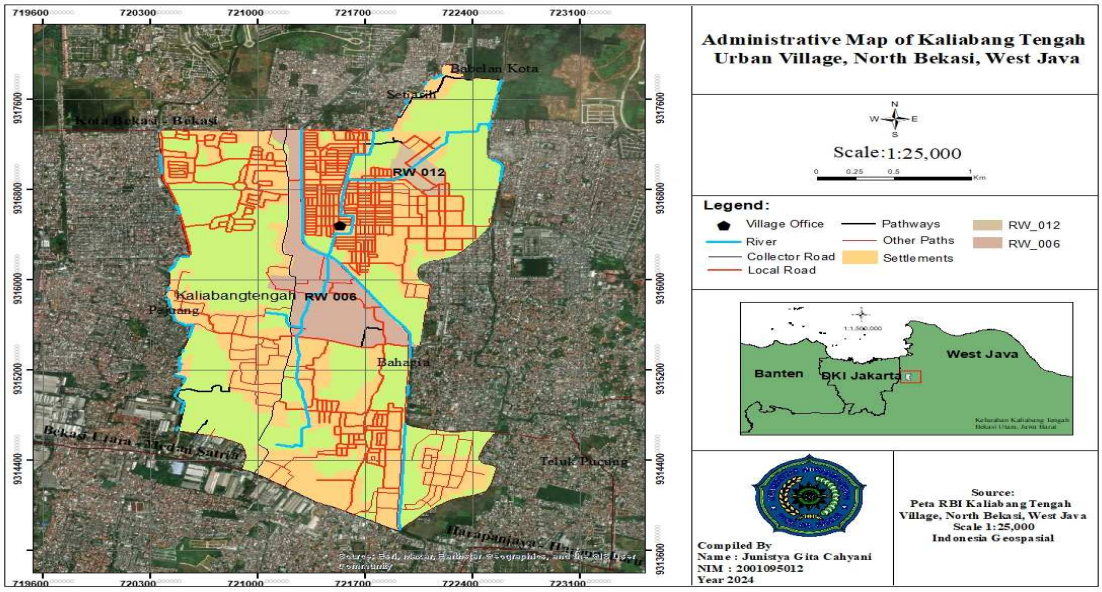

Figure 2. Administrative map of Kaliabang Tengah Urban Village, North Bekasi, West Java Province

The research location is in Kaliabang Tengah Urban Village, North Bekasi, West Java. Kaliabang Tengah is an expansion of Kelurahan Pejuang in 1978. Astronomically, Kaliabang Tengah is located between 6°17' to 20" N and 107°00' to 57" E. It is bordered to the north by Setia Asih Village, Tarumajaya Subdistrict, Bekasi Regency; to the east by Bahagia Village, Bebelan Subdistrict, Bekasi Regency, and Perwira Village, North Bekasi Subdistrict, Bekasi City; to the south by Harapanjaya Village, North Bekasi Subdistrict, Bekasi City; and to the west by Pejuang Village, Medan Satria Subdistrict, Bekasi City, as shown in (Figure 2).

3. RESULT AND DISCUSSION

3.1 Form Of Physical Condition Adaptation

a. Garage Elevation

The results showed that as many as 76% of RW 06 and RW 012 communities have raised their garages shown in (Figure 3) up to 1 meter as an active adaptation to protect vehicles and valuables from the impact of flooding that often occurs due to heavy rains. This step reflects the community's awareness of the importance of reducing economic losses due to disasters. The data suggests that technical regulations setting garage height standards based on flood risk levels need to be developed by the government to ensure their effectiveness in reducing vehicle damage. Education on safe garage elevation methods and construction standards should also be strengthened to prevent unwanted structural impacts.

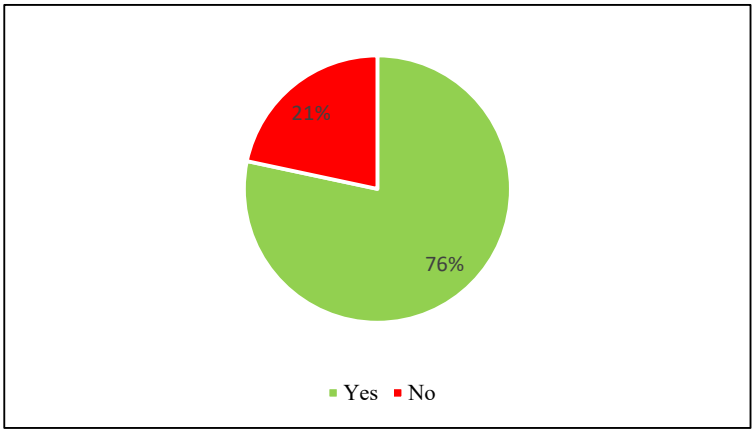

Figure 3. Garage Elevation by the Community in RW 06 and RW 012
Source*: Research results, 2024*

b. House Floor Elevation

The results showed that as many as 88% of the community in RW 06 and RW 012 raised the floor of their residence shown in (Figure 4) to a height between 50 cm and 1.5 meters, as shown in (Figure 5). This reflects the community's efforts to reduce losses due to recurrent flooding and considers raising the floor of the house as a long-term solution that is more effective and cost-effective than repairing damaged houses.

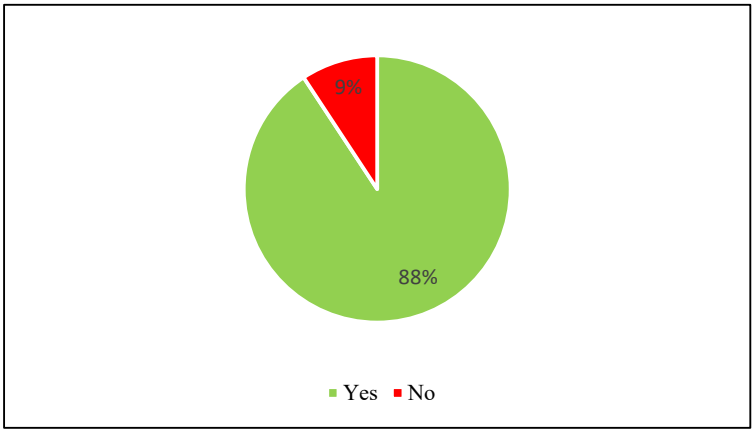

Figure 4. House Floor Elevation in Communities in RW 06 and RW 012
Source*: Research results, 2024*

Figure 5. House Elevation in RW 06 and RW 012
Source: *Research results, 2024*

Kencana & Yuliastuti (2016) emphasizes the importance of local actions such as raising the floor of the house to reduce the impact of flood disasters. The data obtained in this research on active adaptation in the RW 06 and RW 012 communities of Kaliabang Tengah Village provides input for government policies to determine technical standardization regarding the minimum floor height based on flood elevation data should be applied to ensure its effectiveness in reducing the risk of damage due to inundation. Supervision of construction quality is also needed so that floor elevation does not disrupt building stability and remains in harmony with the neighborhood drainage system. This policy should be combined with improved water management to create a more flood-resilient residential environment.

c. Use of Bars or Blocks

The results showed that as many as 62% of the communities in RW 06 and RW 012 used bars or blocks to prevent water from entering their settlements during floods as shown in (Figure 6). This result illustrates a quick and creative form of active adaptation, where wooden planks are used as barriers to prevent water from entering the house during flood periods shown in (Figure 7).

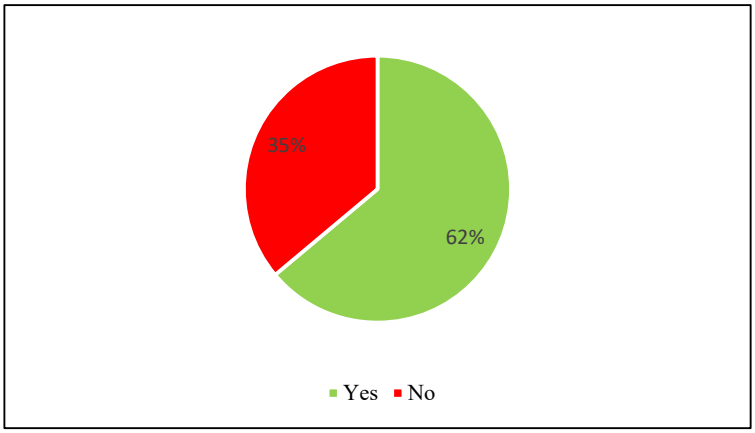

Figure 6. Use of Bars or Blocks to Block Water Entry in RW 06 and RW 012
Source: *Research results, 2024*

Figure 7. Example of the Use of Bars or Blocks in RW 06 and RW 012
Source: *Research results, 2024*

According to Yuniartanti (2018), the use of wooden boards as flood barriers is a form of active adaptation to the limitations of existing formal infrastructure and resources. Although this action is temporary, it demonstrates the community's ability to innovate in the face of disaster. However, to ensure more sustainable resilience, the government needs to standardize the design, materials and installation methods should be established to ensure their effectiveness and resistance to flood water pressure. Socialization on proper installation techniques and regular maintenance are also needed to keep the water barriers functioning optimally. This policy should be integrated with drainage

infrastructure planning and early warning systems to improve the overall flood resilience of settlements shown in (Figure 8).

Figure 8. Government's Water Inlet Barrier Embankments in RW 06 and RW 012
Source: *Research result, 2024*

d. Make Bathroom Drainage Channel Closure

The results showed that as many as 76% of the communities in RW 06 and RW 012 shown in (Figure 8) on average have used stainless sewers for bathroom drainage covers as an active adaptation effort to prevent waterlogging and for flood water not to enter the house, as shown in (Figure 9). According to Rachmayani (2015), Proper drainage, especially in the bathroom, is very important to prevent the accumulation of water that can cause flooding.

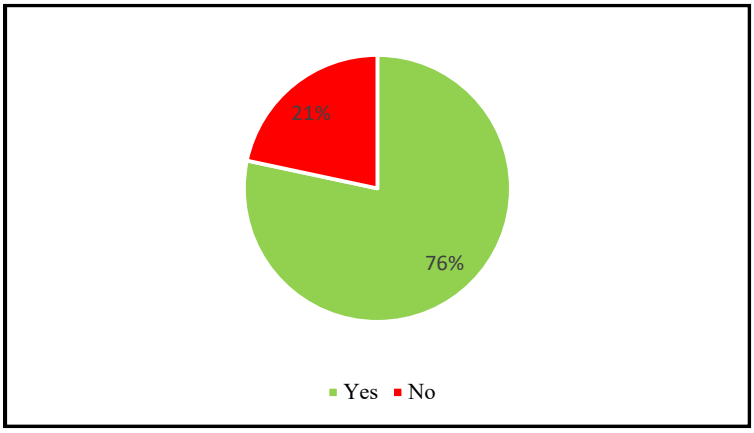

Figure 8. Use of Bathroom Drainage Channel Covers in RW 06 and RW 012
Source: *Research Results, 2024*

Figure 9. Drainage Channel Covers Sed in RW 06 and RW 012
Source: *Research results, 2024*

Based on interviews with residents of RW 06 and RW 012, the following drainage channel covers have been identified as potentially suitable for use full drainage channels, drainage channel covers, and channel covers made of concrete or metal. These tools have been selected in order to prevent water in the drainage channel in front of the house from entering the house through this drainage channel. The data obtained provides important input for government policies to standardize materials, such as the use of corrosion-resistant stainless steel, and designs that allow water flow without the risk of blockage should be implemented to ensure their effectiveness. Socialization on the importance of maintenance and installation according to standards also needs to be strengthened so that the function of the drainage cover remains optimal.

3.2 Forms of Adaptation to Emergency Response Conditions

3.2.1 Community Evacuation Aspect

a. Community Evacuation

The results showed that 90% of the community in RW 06 and RW 012 evacuated as shown in (Figure 10). The data obtained provides important insights into the active adaptation of the community in facing flood disasters, especially related to evacuation procedures and community understanding of disaster risk reduction efforts. The data obtained shows that most of the people in RW 06 and RW 012 evacuate to their neighbors' houses or higher locations,

indicating an active adaptation to the threat of flooding. However, the ignorance of some communities about the need for temporary shelters or house reconstruction as part of disaster adaptation is an important concern. This suggests that government policies need to focus on improving education and more intensive socialization on the importance of adaptation and evacuation infrastructure that is appropriate to local conditions.

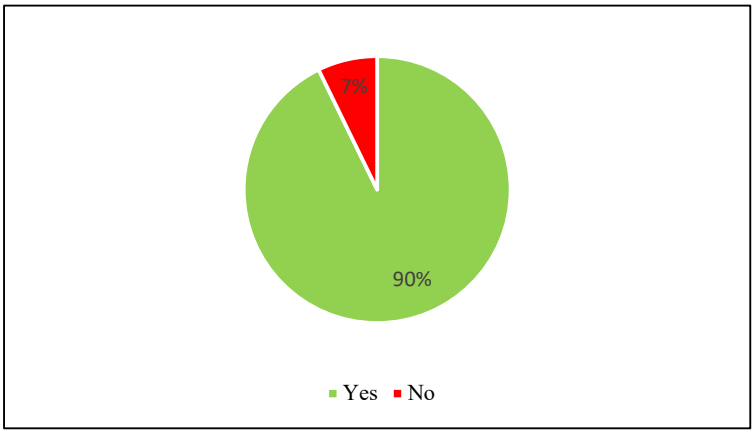

Figure 10. Community Evacuation in RW 06 and RW 012
Source: *Research result, 2024*

According to (Rahman et al., 2022) , a good understanding of community capacity and adaptation in the face of disasters is critical in reducing risk. While active adaptation by communities by evacuating to higher ground reflects a good understanding of the flood situation, it does not fully mitigate potential long-term losses. Therefore, localized evacuation procedures, including the establishment of safe routes and assembly points, should be developed to reduce the risk of loss of life. In addition, regular training for communities as well as the provision of emergency transportation facilities should be prioritized so that evacuations can be carried out in a more coordinated manner. The use of technology, such as early warning systems and digital-based evacuation applications, should also be optimized to improve community preparedness.

b. Map or Evacuation Route

The results showed that 93% of the communities in RW 06 and RW 012 did not have maps and evacuation routes as shown in (Figure 11). Narulita et al., (2023) suggested in their research to use a participatory approach in mapping evacuation routes by involving the community and RT/RW heads. This climate literacy-based mapping has proven effective in increasing community awareness and active adaptation to flood threats. Therefore, government policies in creating evacuation maps should be based on accurate spatial data and contain

information on safe routes, gathering points and emergency post locations. In addition, the installation of direction boards in strategic locations and the integration of digital maps in disaster applications must be strengthened to facilitate access to information. Regular evacuation socialization and simulations are also needed to ensure that people understand the paths to take when flooding occurs.

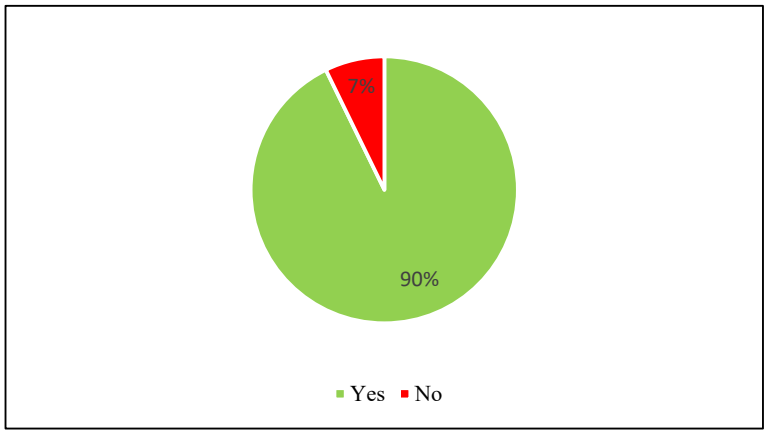

Figure 11. Provision of Maps or Community Evacuation Routes In RW 06 and RW 012
Source: *Research result, 2024*

c. Equipment or Items to Bring During Evacuation

The results provide an insight into the community's flood coping habits, where 92% of individuals in RW 06 and RW 012 shown in (Figure 12) transported essential items during the evacuation process, such as identification documents, cash, medicines and kitchen utensils. The data highlights the importance of more structured active adaptation efforts to ensure that communities can evacuate more effectively and safely. This leads to a policy recommendation for the government to establish a standardized policy on the equipment or items that must be carried during a flood evacuation to ensure the safety and survival of people in evacuation centers. These guidelines should include a list of essential items, such as important documents, clothing, emergency food, drinking water, medicines, as well as communication tools, tailored to the needs of each family. In addition, evacuation education and simulation programs should be strengthened so that people are accustomed to preparing emergency supplies systematically. The government can also distribute disaster preparedness bags with basic supplies to help people who are not adequately prepared.

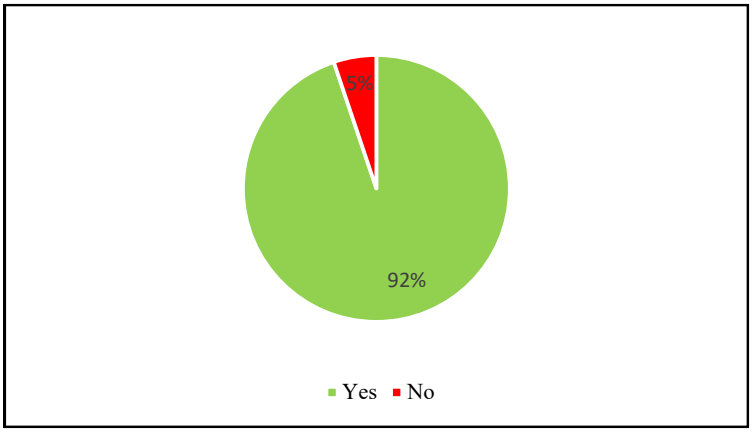

Figure 12. Equipment or Items Carried During Evacuation in RW 06 and RW 012
Source: *Research result, 2024*

d. First Aid Kit or Medicines

The results of this study show that as many as 57% of people in RW 06 and RW 012 did not bring first aid kits and medicines during flood evacuation as shown in (Figure 13), as an effort to maintain personal and family health during the evacuation period. The community's awareness of the importance of medical preparedness in dealing with potential health problems that could arise in the midst of a disaster. Based on interviews, they brought common medicines such as paracetamol, cough medicine, and other medical supplies such as bandages and antiseptics. The data obtained is an input for government policy that needs to standardize the contents of first aid kits, including basic medical equipment, essential medicines, as well as special needs for vulnerable groups such as the elderly and children, must be implemented to ensure community preparedness. In addition, the distribution program of first aid kits through disaster preparedness posts and education on their use needs to be strengthened so that people understand the importance of medical aspects in emergency conditions. The government can also establish emergency medical teams at each evacuation site to provide health assistance for people who do not have medical equipment.

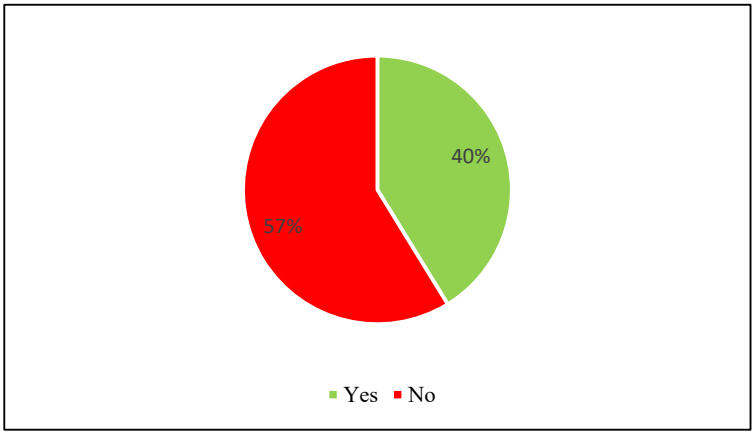

Figure 13. First Aid Kit or Medicines Carried During Evacuation in RW 06 and RW 012
Source: *Research result, 2024*

e. Basic Needs During Flooding

The results showed that as many as 55% of people in RW 06 and RW 012 were unable to fulfill their basic needs during floods as shown in (Figure 14), including clean water, nutritious food, sanitation, and safe shelter. The data highlights the importance of government policies to strengthen policies to provide basic needs during floods by ensuring quick, equitable and sustainable distribution of logistics. Food reserves, clean water, sanitation equipment, and shelters should be set up in strategic locations that are easily accessible to affected communities. The establishment of logistics granaries at the neighborhood level and community involvement in relief management are also important to increase community resilience to crises.

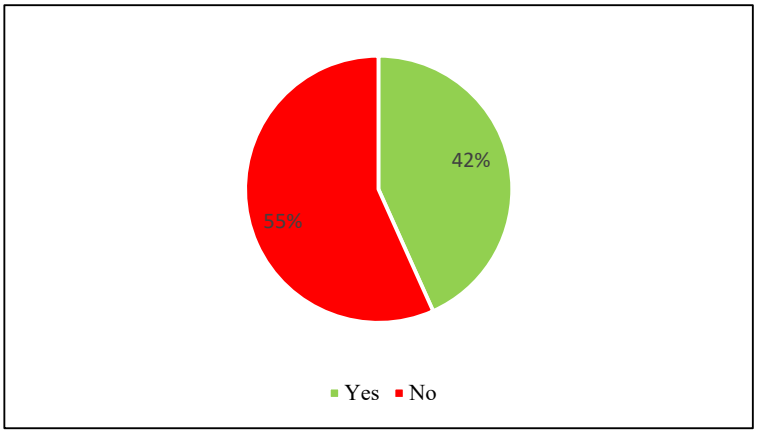

Figure 14. Provision of Basic Needs During Floods in RW 06 and RW 012
Source*: Research Result, 2024*

f. Emergency Phone Number

The results show that as many as 65% of the communities in RW 06 and RW 012 have emergency contact information shown in (Figure 15), including the numbers of RT/RW, Kelurahan, Puskesmas, and Fire Department. The data underscores the importance of government policies to provide a list of important contacts, such as rescue teams, health facilities, and evacuation posts, through various media, including information boards in strategic locations, disaster applications, and early warning-based short messages. In addition, periodic socialization needs to be strengthened so that people understand the procedures for using emergency numbers effectively in crisis situations. The government can also integrate community-based communication systems to ensure information is still delivered despite network disruptions.

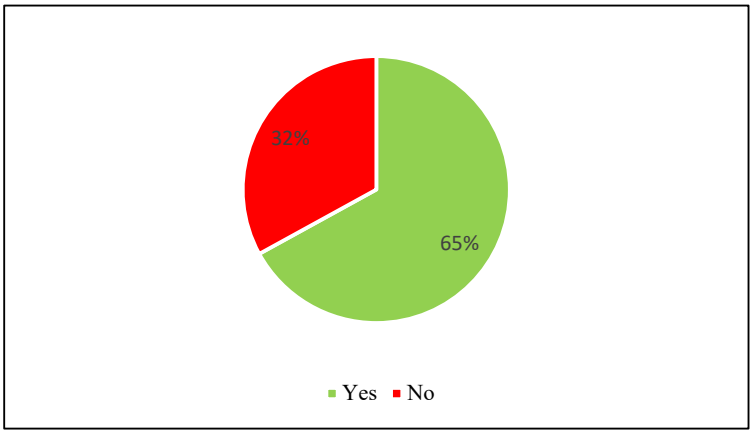

Figure 15. Storage of Emergency Phone Numbers During Flooding in RW 06 and RW 012
Source: *Research result, 2024*

3.2.2 Aspects of the Official Flood Warning System

a. Sources or Official Parties Related to Flood Disasters

The results show that as many as 59% of residents in RW 06 and RW 012 do not have a reliable source for flood-related information as shown in (Figure 16), although some communities rely on Mr. Soroso as the main observer who conveys signals through kentongan and uses technology such as weather apps and WhatsApp groups. The data highlights the importance of government policies needing to ensure the availability of official flood-related sources or parties that communities can access quickly and accurately to reduce disinformation and improve preparedness. The establishment of official information centers at the local level with the support of technology, such as disaster applications and SMS-based early warning systems, should be optimized so that the public gets real-time data on flood status, evacuation routes, and safety procedures. In addition, collaboration

with mass media and local communities needs to be strengthened to ensure widespread and reliable information dissemination.

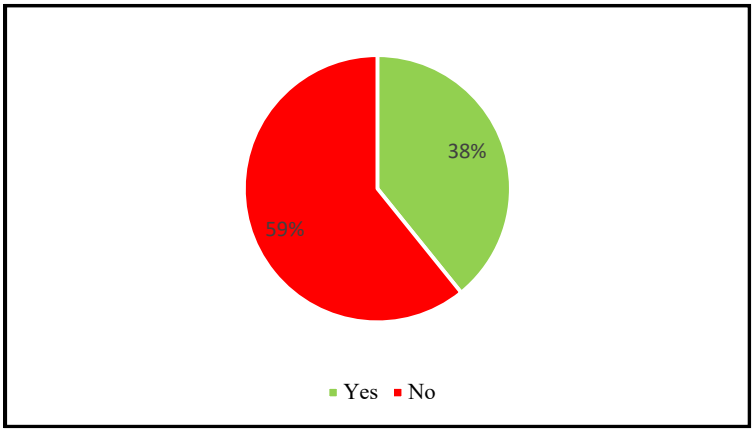

Figure 16. Sources or Official Parties Related to Flooding in RW 06 and RW 012
Source: *Research result, 2024*

b. Flood Warning Equipment

The results showed that 91% of the communities in RW 06 and RW 012 did not have adequate flood early warning system equipment as shown in (Figure 17), although they still rely on local wisdom such as kentongan to signal the arrival of floods as shown in (Figure 18). This practice reflects community adaptation that uses simple but effective methods, as described by Susanto (2016), in anticipating disasters.

Figure 17. Flood Warning Equipment in RW 06 and RW 012
Source: *Research result, 2024*

Figure 18. Flood Warning Devices, Namely Kentongan, in RW 06 and RW 012
Source: *Research result, 2024*

The data obtained indicates the need for government policies to determine the installation of water level detection devices, warning sirens, and rainfall sensors must be expanded and integrated with application-based communication systems or short messages so that information can be received in real-time. In addition, community training in understanding and responding to early warnings should be conducted regularly to improve the effectiveness of disaster mitigation. The government also needs to collaborate with academics and related institutions to develop warning technologies that are more precise and appropriate to local geographical conditions.

3.3 Forms of Post-Flood Adaptation

a. Mutual Cooperation

The results of the research on post-flood cleaning show that the entire community of RW 06 and RW 012 are involved in the cleaning activities. This routinely conducted activity involves the spirit of mutual cooperation and is geared towards cleaning roads, gutters, and sewers on a monthly basis. Based on the interview results, this activity is driven by the accumulation of dirt due to flooding and pollution caused by garbage. Hence, collaborative efforts are made collectively to address these issues, as shown in (Figure 19). According to (Septian et al., 2022), apart from cleaning, mutual cooperation is also seen in the renovation of houses to anticipate flooding. Although some communities have difficulty building higher houses due to limited resources, mutual cooperation remains key in their active adaptation. Adaptation theory suggests that this kind of collaboration strengthens community resilience to disasters.

Figure 19. Mutual Cooperation Activities in RW 06 and RW 012
Source: *Research results, 2024*

Recommendations for the government related to the implementation of mutual cooperation in the community to clean up the garbage carried from the flood can provide facilities and infrastructure, such as cleaning tools, temporary disposal sites, and waste transportation fleets, must be optimized to accelerate the environmental recovery process. In addition, strengthening the role of the community through educational programs on post-flood waste management. The government also needs to establish a coordination system with related parties, such as cleaning services and environmental organizations, to ensure the effectiveness and sustainability of this program.

4. CONCLUCION

Flooding is a regular occurrence every year, including in Kaliabang Tengah Urban Village, North Bekasi, especially in RW 06 and RW 012. Therefore, the local community applies various adaptations to overcome the threats posed by the disaster. This research examines the forms of adaptation of the Kaliabang Tengah Urban Village community to flooding, covering physical adaptation, emergency response, and post-flood recovery.This research identifies patterns of active community adaptation to flooding in Kaliabang Tengah Urban Village, reflecting the need for more structured policies in disaster adaptation. Policies to increase drainage capacity and provide evacuation routes are strategic steps that must be considered.

To strengthen active adaptation to flooding, it is necessary to improve flood control infrastructure through optimizing the drainage system and building evacuation routes that are

integrated with community needs. This can be done by allocating a special budget for drainage improvements, building embankments in vulnerable areas in RW 06 and RW 012, and providing evacuation routes equipped with signs and emergency facilities. In addition, community education on active adaptation techniques, such as raising the floor of the house and risk-based environmental management, is crucial in raising community awareness. This program can be realized through community-based training, regular socialization by local officials, and collaboration with educational institutions in developing disaster adaptation modules. This recommendation includes providing incentives for flood-resistant house renovations, logistical support for community-based adaptation activities, and policy development that integrates infrastructure development with disaster adaptation strategies. Further studies are needed to analyze the effectiveness of adaptation policies that have been implemented and to develop a community-based risk simulation model to improve community resilience to future floods.

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