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Flood Risk Reduction: A Government and Community Collaboration Perspective in Urban Communities

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Abstract

Flooding is the responsibility of the government, so it is necessary to anticipate it together with the community through social participation. This paper aims to analyse the role of the government in anticipating floods and to analyse the forms of community social participation in anticipating floods. The research method used is mixed research, qualitative quantitative design (explanatory sequential). Data collection used participant observation techniques, in-depth interviews, questioners, and documentation studies. The data was analysed quantitatively then qualitative research was conducted and the results were verified and ended with a conclusion. The results of the research obtained (1) the role of the government, among others: (i) preparing an early warning system, (ii) preparing evacuation facilities and infrastructure, including evacuation routes, and (iii) forming structural and non-structural flood volunteer teams. (2) Forms of community social participation include: cleaning and increasing the depth of waterways such as sewers and canals, raising the concrete walls of waterways, raising the foundations of houses, and organising the residential environment. The conclusion of this research is that the government's role in flood mitigation in Makassar municipality focuses on things that prevent flooding. Forms of community social participation as a form of flood mitigation such as cleaning waterways, raising the walls of sewers and canals and so on.

1. Introduction

Flooding that occurs in urban communities with the problems it causes is an impact of the environmental crisis that occurs (Arifin *et al*., 2021), rapid development of housing facilities and infrastructure (Anriani *et al*., 2019)

and the amount of land conversion (Monsaputra, 2023), and population development (Harahap, 2013; Indahri, 2017). These causal factors are the effects of development policies that do not consider environmental and human aspects (Anriani *et al*., 2023). As a result, it will damage the environment and other ecosystems, whereas ecosystem chaos actually causes misery for living things, especially humans (Kafrawi, 2019). However, material and non-material losses can be reduced through mitigation and community involvement in anticipating floods. Through disaster risk reduction (DRR) programmes, the losses caused by disaster events can be reduced even though the losses remain. Disaster Risk Reduction (DRR) is a series of efforts undertaken systematically to analyse the risks of disaster impacts on human life and livelihoods (Comfort, 2012; Kundzewicz & Menzel, 2005). Mitigation is one of disaster risk reduction through the development of various physical infrastructure such as the provision of Early Warning systems and community participation as a form of collaboration with the government (Paton *et al*., 2000; Spiekermann *et al*., 2015).

So far, existing studies have not responded to the aspect of the involvement of peripheral communities living in Hallway and those living in housing in mitigating floods as a form of collaboration. Existing studies do not see the difference in their involvement. The tendency of existing studies can be mapped as follows. First, studies that emphasize analyses on structural mitigation (Dinia Putri & Syafei, 2022; Fahlevi, 2019; Syafei *et al*., 2017) say that structurally flood mitigation includes building gutters, raising roads, warning residents, building polder, sluice gates, emergency dikes, pump houses, or creating evacuation shelters, preparing buoys and logistics. This structural mitigation is adapted to the situation where the flood occurs, what should be built and what does not need to be built. Secondly, studies that tend to emphasise analyses on community involvement (Ajami *et al*., 2016; Halim, 2018; Sagala *et al*., 2014a; Syah Achmad, 2012) who said that the community made various efforts to prevent flooding such as raising the floor of the house to avoid sea water entering the house, raising the house, building a barrier at the door, determining their own evacuation route, namely their house and the mosque. This community involvement is also adapted to the flood terrain situation and available community resources.

This paper addresses the shortcomings of existing studies that do not map the characteristics of peripheral communities by area and involvement in anticipating floods. Their understanding of flooding influences their actions in responding to floods and their environmental conditions. Disaster risk reduction through flood mitigation Flood mitigation carried out by the Makassar municipality government still refers to the central government's instructions that are adjusted to local conditions, such as building reservoirs and dredging rivers. This structural mitigation is also supported by community involvement in anticipating floods through various programs. In line with that, three problems are proposed as follows (1) How is the role of the government in anticipating floods in Makassar municipality? (2) How is the form of community social participation in Makassar municipality in anticipating floods? The answers to these problems provide an in-depth understanding as a basis for formulating flood management program policies. This research is based on the argument that flooding problems can be anticipated quickly if there is cooperation between the government and the community. The government carries out its duties and roles based on its authority and the community carries out its duties based on its knowledge so that both of their roles become stronger.

2. Literature Review

2.1 Disaster Risk Reduction

Disaster Risk Reduction is understood as a series of efforts undertaken systematically to analyze the risks of disaster impacts on human life and livelihood. It is also an approach in identifying, evaluating, with the aim of reducing risks caused by disaster events. In carrying out this approach, it is implemented with a series of planned and systematic steps in analyzing and addressing the sources of disaster, including hazard enabling conditions, vulnerability reduction, land management and disaster preparedness. It is intended to reduce hazardous risks in social, economic, and environmental aspects (Bello *et al*., 2021). Disaster risk is the potential loss due to disasters such as life, property, health, assets, livelihoods, public services, etc. that occur to a community at a certain time. The definition of disaster risk illustrates the concept that disasters are the result of risky conditions that occur continuously. Disaster risk consists of various types of potential losses that cannot be predicted. Therefore, through adequate knowledge of previous disasters and patterns of population and socio-economic development, disaster risk can be predicted and calculated through mapping of potential losses (Twigg, 2009). Community-based flood risk reduction is something that needs to be implemented to minimize the impact that will occur due to flood disasters. In addition, the community is the first element that responds to flood disasters and is an active actor in improving their lives after a flood. Thus, the community has a very big role in this flood risk reduction program (Pancasilawan, 2020).

One of the community-based flood risk reduction measures is through mitigation. Flood mitigation is a series of efforts to reduce the risk of flooding, both through physical development and awareness and improvement of the ability to face the threat of flooding. Mitigation is defined as an effort aimed at reducing the

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impact of disasters, and is a series of efforts to reduce disaster risk, both through physical development and awareness and improvement of the ability to face the threat of disasters (Robbani *et al*., 2020). The stages of flood mitigation are (1) The stage before a flood disaster occurs in the form of activities carried out is to increase preparedness to face the threat of flood hazards. (2) preparation of supporting facilities and infrastructure and human resources. (3) The stage when a flood occurs. (4) The stage after the flood occur (Kundzewicz & Menzel, 2005; Rosmadi *et al*., 2023; Rustinsyah *et al.*, 2021).

2.2 Perspectives of Collaboration

Collaboration in DRR efforts is very important, including firstly local authorities and people in authority in the local scope who play an important role to strengthen local or regional cap municipality in DRR throughout Indonesia. Disaster risk reduction by utilizing local resources, especially communities, can be done with the support of a thorough understanding of stakeholders, and a number of institutions, related to disasters and their various impacts (Hasna & Darumurti, 2023; Mulyadi & Maulana, 2021). Collaborative mechanisms have several principles that result in the actors having the same vision and mission. These principles include discovery, definition, reflection, and determination that create shared meaning, discussion with stakeholders, and decision-making because of collaborative mechanisms. There are many forms of collaboration such as Triple Helix, Quadruple Helix, and Penta Helix, whether in dealing with natural disasters, or fighting the Covid-19 outbreak (Isa Elfianto *et al*., 2023). Penta Helix as a collaborative or multi-stakeholder technique is a strategy that brings together government, businesses/corporations, universities, communities, and the media to solve problems and develop programs by involving different sectors in sharing roles.

Penta Helix focuses on collaboration between government and social stakeholders. (Windiani, 2020). The aim is to raise awareness of Indonesian society and create a disaster-aware culture. Penta Helix is needed to establish supervisory cooperation, secure facilities, and infrastructure, disseminate information, and mitigate disasters. The flood disaster left the victims socially helpless and functional, which required Penta Helix cooperation with the following roles: (a) Government: protection and policy making. (b) Business (Company): contributing to community sustainability through CSR. (c) Community: identifying the needs of the victims after a disaster. (d) Academia: publishing the development of community outreach concepts in disaster emergency response management. (e) Media: disseminate information and further socialisation of handling (Pasaribu *et al.*, 2023). Disaster management in Indonesia has been implemented through participatory approaches and community participatory risk management based on the National Disaster Management Law in 2007 (Osti & Miyake, 2011).

2.3 Social Participation

Social participation is a process of voluntary involvement of people in community organizations/activities where they involve themselves with several types of individuals and activities that are carried out regularly. Community participation or participation in development is understood as the actualization of the willingness or ability of community members to contribute to development (Muryani *et al*., 2021; Nkombi & Wentink, 2022). Increasing community participation is a form of active community empowerment that is orientated towards achieving development results. Community participation that can be provided is money participation, property participation, labour participation, participation in the decision-making process, skills participation, representative participation, idea participation, and social participation. Furthermore, there are five indicators of community participation, namely (1) contribution, (2) organization, (3) community role and community action, (4) community motivation, (5) community responsibility.

These forms and indicators will be used as a reference in looking at community social participation towards flood risk reduction in the research location. One of the community-based flood risk reduction measures is through mitigation. Flood mitigation is a series of efforts to reduce the risk of flooding, both through physical development as well as awareness and improvement of the ability to face the threat of flooding. Mitigation is defined as an effort aimed at reducing the impact of disasters, and is a series of efforts to reduce disaster risks, both through physical development and awareness and improvement of the ability to face the threat of disasters. (Robbani *et al*., 2020). The stages of flood mitigation are (1) The stage before a flood disaster occurs in the form of activities carried out is to increase preparedness to face the threat of flood hazards. (2) Preparation of Supporting Facilities and Infrastructure and Human Resources. (3) The stage when a flood occurs. (4) The stage after the flood occurs (Kundzewicz & Menzel, 2005; Rosmadi *et al*., 2023; Rustinsyah *et al*., 2021).

3. Methodology

This research uses a qualitative-quantitative mixed method with an Explanatory-Consequential design (Creswell, 2013; Tashakkori & Teddie, 2010). This means that the researcher used quantitative methods first and then qualitative methods. Through the quantitative method, the researcher describes the respondents'

answers in a frequency tabulation (Sugiyono, 2019). The location of this research is Makassar municipality. The research participant is the head of Regional Agency for Disaster Management (BPBD) Makassar municipality as a qualitative informant (Oetomo, 2015) and 198 people as quantitative respondents selected by Stratified Random Sampling (Sugiyono, 2019) from 5 sub-district areas using the Cochran Formula. Through qualitative methods, the researcher: (1) describe the socio-cultural characteristics of Makassar municipality, (2) describe the interview results.

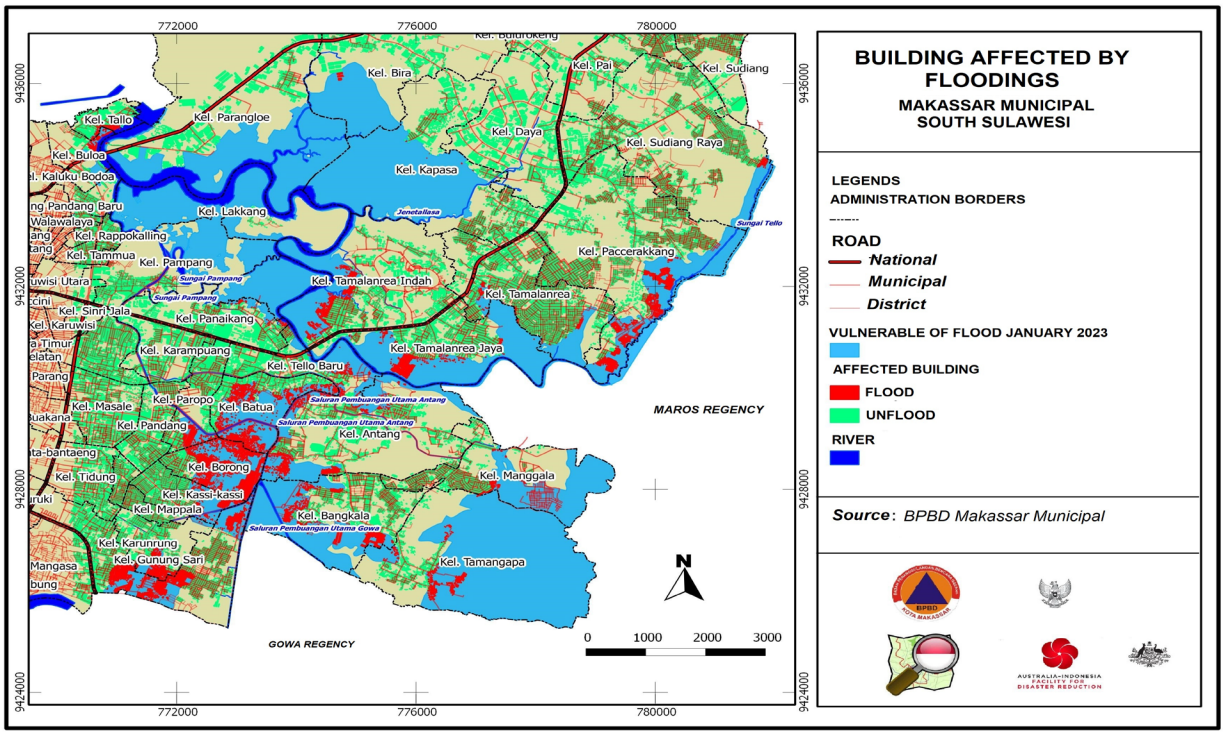

Fig. 1 *Flood areas in Makassar municipality*

Table 1 *Characteristics of respondents*

No.	Demographic items	Frequency	%
1.	Age		
	• 31-40	34	17,17
	• 41-50	78	39,39
	• 51-60	86	43,43
2.	Gender		
	• Male	119	60,10
	• Female	79	39,89
3.	Job		
	• Staff	27	13,63
	• Businessmen	71	35,85
	• Trader	34	17,17
	• Teacher/Lecturer	29	14,64
	• Household assistant	37	18,68

4. Findings and Discussion

4.1 The Government's Role in Flood Disaster Risk Reduction

Structurally, the government's role in flood risk reduction involves (i) setting up an early warning system, (ii) preparing evacuation routes and facilities, and forming flood volunteers. The government's role through The Regional Agency for Disaster Countermeasure (BPBD) is vital in flood mitigation. In carrying out its duties, The Regional Agency for Disaster Countermeasure performs it in a structural way or coordination between related government institutions. This structural method emphasizes all government efforts in handling the impact of

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disasters. This means that government efforts are preventive in nature with the intention of minimizing the risks posed by flooding. The flood in Makassar municipality in February 2023 was the biggest flood in the last 20 years. The flooding caused huge losses as water inundated the roads up to the level of an adult's knee. Shops and shopping centers were flooded and suffered losses. Economic and social mobility was halted for several hours. Housing in the municipality center was flooded, there were no services in offices, traffic jams on the roads, and so on. The massive flooding showed that there was a problem in the government's flood management. The large number of losses due to flooding shows the unpreparedness of the community to anticipate flooding and this unpreparedness is caused by the malfunctioning of the early warning system prepared by The Regional Agency for Disaster Countermeasure. Although an early warning system was already in place in each neighborhood in the form of bamboo bells, the February flood was so fast that it had a huge impact. For communities on the outskirts, the flood did not cause material losses because they had anticipated it from the beginning. But for people in the municipality center, it caused material losses, especially since there was no early warning.

Table 2 *Government provides early warning system*

Community Groups	Government provides early warning system				
	Strongly Agree (%)	Agree	Neutral	Disagree	Strongly Disagree
Hallway communities	83 (41,91)	89 (44,94)	9 (04,54)	11 (05,05)	6 (03,03)
Housing Communities	88 (44,44)	77 (38,88)	22 (11,11)	3 (01,51)	8 (04,04)

The early warning system in Makassar City is the responsibility of the government. The early warning system is in each sub-district to facilitate coordination between residents and the Regional Agency for Disaster Countermeasure (BPBD) and sub-district authorities. The early warning system is in the form of bamboo bells that are installed in each neigbourhood group (RT) head's house and sounded simultaneously when there is an imminent danger, whether the danger of flooding or robbery, or brawls between groups of young people and so on. The Early warning systems began to be discussed several years ago and were only limited to issues because development had not yet caused problems that threatened the lives of urban residents. After the Covid-19 pandemic ended in 2020/2021, we began to feel the social environmental impacts due to population density, housing development, urban land conversion, highway construction in suburban areas as an effect of urban expansion. The most pronounced environmental impact is flooding everywhere due to land conversion. Flooding is a major threat to urban communities that can suddenly appear at any time. After many years of flooding with the losses caused, the government finally came up with a policy to anticipate floods and their impacts by using an early warning system.

In the last 5 years since the intensity of flooding increased and caused many losses, the early warning system in Makassar has been introduced to Makassar residents from 2018/2019 - 2022/2023, especially for residents who live in peripheral areas, this was acknowledged by almost all respondents (94.44%), as many as 7.57 who were neutral, and 11.11% who did not acknowledge. In general, this indicates the existence of an early warning system and its familiarity with the community (Table 2). The existence of such early warning systems helps people to organize strategies to avoid the impact when there is danger around them. If the rain lasts for several hours, flooding is likely to occur, and they have to save their belongings to a safe place. However, if the intensity of the rain is low and it is likely to cause inundation only then they just watch the effects without the need to save their belongings.

Table 3 *Community response to early warning system*

Community Groups	Community response to early warning system				
	Strongly Helpful	Helpful	Neutral	Unhelpful	Strongly Unhelpful
Hallway Communities	75 (37,87)	98 (49,49)	25 (12,62)	0 (0)	0 (0)
Housing Communities	55 (27,77)	107 (54,04)	32 (16,16)	4 (02,02)	0 (0)

Community responses differed regarding the early warning system. In the Hallway community, there were 173 respondents or 87.37% who stated that the government assistance was very helpful to them and 12.62% or 25 people stated that they were neutral. For people living in housing or settlements, there were 162 people or around 81.81% who were very helpful, there were 32 people or 16.16% who were neutral and 4 people or 2% stated that it did not help. In addition to setting up an early warning system, another government responsibility is to prepare evacuation facilities or a safe place for residents to evacuate. This is very important and urgent

considering that urban land is no longer empty and has become privately owned. In this case, the government needs to be present to provide a sense of security for residents affected by the disaster.

Table 4 *Government prepares evacuation routes and facilities*

Community Groups	Government prepares evacuation routes and facilities				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Hallway Communities	79 (39,89)	83 (41,91)	23 (11,61)	9 (4,54)	6 (03,3)
Housing Communities	59 (29,79)	119 (60,10)	7 (03,53)	2 (01,01)	11 (05,55)

Preparing evacuation routes and facilities is one of the government's next tasks in saving its citizens from floods. Evacuation takes the form of moving residents from affected areas to safe places that are easily accessible for assistance. In addition, the government also prepares several facilities and infrastructure to help mobilize residents in flood-affected locations. Starting from boats to floating bridges. Its function is to facilitate the evacuation of residents during a flood. In addition, public kitchens, health clinics with doctors, nurses, psychiatrists, and so on have also been prepared in the evacuation areas. However, the existence of these evacuation facilities must be complemented by residents' knowledge of evacuation routes (evacuation maps) and this must be done with continuous socialization until the community memorizes the evacuation implementation mechanism. In the Hallway community, 162 people (81.81%) recognized it as the government's duty and had done so, 23 people or 11.61% were neutral and 7.57% disagreed. In urban communities, 13 people (6.56%) disagreed, 7 people (3.53%) were neutral, and 178 people (89.89%) said it was the government's duty and responsibility.

The existence of evacuation routes and facilities in evacuation centres received mixed responses from the community. Evacuation facilities are very urgent and urgent when flooding occurs. Evacuation routes have been prepared by the government while the most important evacuation facilities that the community needs are facilities for shelter or shelter in the form of shelter tents in addition to public kitchens and the availability of health facilities in the form of health volunteers, medicines and medical supplies.

Table 5 *Community response to evacuation routes and facilities*

Community Groups	Community response to evacuation routes and facilities				
	Strongly Helpful	Helpful	Neutral	Unhelpful	Strongly Unhelpful
Hallway Communities	108 (54,54)	90 (45,45)	0 (0)	0 (0)	0 (0)
Housing Communities	76 (38,38)	83 (41,91)	30 (15,15)	9 (04,54)	0 (0)

Basically, the characteristics of Hallway communities and people living in residential areas are different. These different characteristics result in different responses to flooding related to evacuation routes and facilities provided by the government. For people living in Hallway, all respondents (100%) stated that government evacuation routes and facilities helped them, while for people living in residential areas, 80.30% stated that they helped, 15.15% stated that they were neutral, and 4.54% said that they did not help. Those who stated that it was not helpful were those who could save themselves and did not rely on government assistance while those who were neutral were those who could and could not save themselves and cope with flood hazards.

Another important role of the government is to form flood volunteers in each region. They are tasked with assisting the government in the event of a sudden disaster and they are ready to rescue threatened residents as soon as possible. These volunteers have complete evacuation equipment such as inflatable boats, emergency tents, emergency buoys, emergency extinguishers and others as first aid.

Table 6 *Government forms flood volunteers*

Community Groups	Government forms flood volunteers				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Hallway Communities	69 (34,84)	96 (48,48)	15 (07,57)	10 (05,05)	8 (04,04)
Housing Communities	88 (44,44)	77 (38,88)	22 (11,11)	3 (01,51)	8 (04,04)

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The existence of flood volunteers is very important in assisting the government and affected communities. These flood volunteers can be formed structurally or non-structurally. This group has a high sense of awareness when there is a threat of disaster and can immediately move to help the community. Volunteers can come from various institutions such as Indonesian Red Cross (PMI) volunteers, Ansor-Banser volunteers, the Indonesian Islamic Student Movement (PMII) volunteers, youth volunteers from various political parties, student volunteers and so on. Their presence coincides with the disaster. For the Hallway community, 83.33% agreed with the existence of volunteers, 7.57% or 15 people said they were neutral, and 18 people or 9.9% disagreed with volunteers. In contrast to the housing community, there were 5.55% or 11 people who disagreed, 11.11% or 22 people were neutral, and 83.33% who agreed. This number is the same as the number of Hallway communities who also agree with the existence of volunteers. Thus it can be said that the existence of volunteers is very urgent for the survival of the community. Therefore, the existence of these volunteers needs to be seen how much it benefits the survival of the community? This is outlined in Table 7.

Table 7 *Community response to the existence of flood volunteers*

Community Groups	Community response to the existence of flood volunteers				
	Strongly Helpful	Helpful	Neutral	Unhelpful	Strongly Unhelpful
Hallway Communities	97 (48,98)	68 (34,34)	14 (07,57)	14 (07,07)	5 (02,52)
Housing Communities	79 (39,89)	87 (43,93)	21 (10,60)	7 (03,53)	4 (02,02)

In the Hallway community, the community's response to the existence of flood volunteers varies as well as the response of people living in settlements. In the Hallway community, there were 97 people (48.98%) who stated that the existence of flood volunteers was very helpful, 68 people (34.34%) said it was helpful, 14 people or 7.57% were neutral, 14 people (7.07%) said it was not helpful, and 5 people or 2.52% stated it was very unhelpful. This situation is not much different from the community in settlements, where 79 people or 39.89% said they were very helpful, 87 or 43.93% said they were helpful, 21 people (10.60%) said they were neutral, 7 people or 3.53% said they were not helpful, and 4 people or 2.02% said they were very unhelpful.

4.2 Community Social Participation

Based on the results of interviews, observations and related literature searches, the results of qualitative research were obtained to complement quantitative research on the social participation of local communities as a form of collaboration with the government to face flood hazards, as follows.

4.2.1 Cleaning Sewers and Canals

Waterways in various forms include sewers, then canals, and rivers. These three types of waterways are classified based on their level as well as a series of water journeys until they are discharged downstream. Almost all housing estates in the eastern part of Makassar municipality, which are built on former swamp and paddy fields, can certainly experience flooding in the rainy season at an alert level. This situation has been understood by the local community, especially regarding anticipatory steps in the form of flood mitigation as a form of their social participation.

Fig. 2 *Cleaning sewers in one corner of Makassar municipality*

One form of environmental participation that residents do is cleaning waterways such as sewers, canals, and small rivers in the centre of the city. This activity is carried out by housing residents almost monthly, depending on the social situation of residents who want to do community service. In addition, this activity is also coordinated by each neigborhood group (RT) head, assisted by the local mosque management. The neighbourhood that he lives in, especially the back part, has subscribed to flooding every year. When the flood comes, Block AF, Block AD will certainly sink, so many residents evacuate first. To anticipate this, the head of neigborhood group (RT) asked his residents to do something according to their ability and for the common

good. The easiest and lightest action they can take is to clean waterways such as sewers, water canals, and small rivers at the back of the housing estate.

Since the formation of a flood volunteer team by The Regional Agency for Disaster Countermeasure (BPBD) in collaboration with local youth in 2019, the impact of flooding has been reduced. Residents no longer leave their homes to evacuate as the flooding only lasts a few hours and recedes. Even if there are items that need to be saved, they don't have to bother because they are handled immediately by the volunteer team or the SAR team who are on standby with their equipment.

4.2.2 Raising the House Foundation

Another measure taken by residents exposed to flooding is to raise the foundation or ground floor of their houses. They had to do this because of the following: (1) the housing is located on former swamp land, (2) the quality of their houses, especially the floor, is not very good and water easily emerges from below. This situation was recognised by one resident as a form of affirmation that the housing environment is not safe and tends to cause feelings of worry, especially before the rainy season. The neighbourhood is strategically attractive and promising but that was 15 years ago when it was first built and houses were still in short supply. Today, however, the development of urban sprawl has changed everything as housing developments around the neighbourhood have increased. There was swamp filling in the vacant land next door into a new housing site. This has led to the loss of rainwater catchment areas especially in the rainy season. It also leads to siltation of canals and rivers so that water takes longer to settle and inundate housing estates.

4.2.3 Raising the Waterway Wall

Another activity of housing residents in the eastern suburbs of Makassar related to environmental adaptation is raising the concrete walls of existing waterways. This is intended to prevent collapse or landslide of the side of the water channel or canal due to heavy water flow and increase the water capacity in the canal. In this activity, the local community did not do it themselves but was initiated by the city government through a structurally direct mechanism. The community is merely a volunteer, especially in supervising the activities. The work of raising the concrete walls through new additions and piling is purely government work through structural mechanisms. This means that the government is fully responsible for the completion of activities including the provision of materials. The community only initiates and supervises and voluntarily supports these activities for the common good. Another resident who was involved in the activity said that the handling of the drains was accelerated because flooding occurs not only during the rainy season but also outside of it. The cause is flooding from Maros district. It is also exacerbated by siltation in the downstream part of the BTP river so that water does not flow into the Tallo river, which is the drain to the sea.

(a) **(b)**

Fig. 3 *(a) Atmosphere of canal reinforcement wall installation to prevent landslides; (b) Cleaning of water channels leading to large sewers*

4.2.4 Organising a Residential Neighbourhood

The most common activity that communities can do as an initial mitigation measure is to improve the environment around their housing complex. Some of the activities that residents undertake include the improvement of residential streets through the installation of paving blocks so that the alleys become clean and beautiful, cleaning up garbage and cutting grass and shrubs, and decorating paving block roads with decorations,

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painting fences, and so on. Alleys that have been damaged to the point that they are unfit for use are repaired by casting them. The casting was financed by the mayor and done by the local community.

(a)

(b)

Fig 4. (a) *Street colouring and hallway beautification; (b) The community held community service together*

The activities carried out as described above show the efforts and forms of responsibility of residents towards their environment. As told by several residents, there are various ways that residents of their housing to anticipate or adapt to flooding, one of which is cleaning the sewers around the housing. The sewer is located outside the housing, but if it is covered with rubbish or grass and bushes, the water will overflow and disturb the residents. The same situation was also told by an informant in one of the housing complexes in Tamalanrea that the amount of rubbish scattered in his complex contributed to the occurrence of waterlogging that could last up to 24 hours. This happens because the rubbish clogs the sewers of each house. Incidentally, most of the residents in his neighbourhood are employees who have weekends off while the garbage accumulates almost every day. Therefore, the neighbourhood associations in the area collect environmental cleanliness funds and garbage funds that are handled by special officers. Based on this description, it can be explained that the conditions of the physical environment and the social environment are factors that contribute to the adaptation actions taken by residents.

In peripheral urban areas, which are then called 'urban', the physical environment generally has land characteristics consisting of swamps, and rice fields. It is inevitable that when urban expansion occurs and settlements must be built in these areas, it will have a long-term adverse impact on the lives of the residents. The adverse impacts that are likely to occur in general include: groundwater is less hygienic, prone to flooding, potentially sinking land and moving houses if foundations are not solid, potentially compromised health of residents, and so on (Angraini *et al*., 2020; Anriani *et al*., 2023; Hidayat *et al*., 2022). The situation that cannot be denied is the occurrence of land conversion from swamp ecosystems and rice fields ecosystems to housing and settlements automatically causes damage to the previous ecosystem. One of the disorders in question is health problems (Rahma *et al*., 2021).

Regarding flood disasters, many things are the responsibility of the government and are structural mitigation while the community waits for these actions. In the aspect of environmental adaptation of the local community, various actions can be taken as a result of this research (Tuan Pah Rokiah Syed & Ismail, 2011). The most basic action is to clean the waterways around housing. This action is also carried out by communities in other places based on their environmental situation, such as the research on community adaptation to Rob flooding in Semarang City where residents raised their houses, made barriers at the door, and so on (Syafei *et al*., 2017; Waskitaningsih, 2012). Research on community participation in Samarinda City in dealing with flooding by strengthening and elevating houses (Fahlevi, 2019). Research on the adaptation strategies of coastal communities in Bangkalan to Rob flooding by building simple embankments, building walls, and raising floors (Syah Achmad, 2012).

Looking at the results of the above research, it can basically be explained that the community actually has a local knowledge-based adaptation system both individually and collectively communal based on communal characteristics and the environment concerned (Weichselgartner & Pigeon, 2015). In this system, the community has a common fate, namely that they are both in a threatened condition and they want to get out of the problem together so that the communal system is what makes the community able to survive in any condition in the face of flood disasters, especially in Makassar municipality. At least the first step they take is to hold adaptation creativity to the flood environment. This adaptation creativity will make the community resilient in facing all threats. This is also explained in some research that communities can be resilient in facing disasters because they have a social system that is adaptive in various situations and together with the

government collaborate, where the government provides development budgets and infrastructure while the community provides labour and other resources (Ajami *et al*., 2016; Asti, 2009; Danianti & Sarifuddin;, 2015; Sagala *et al*., 2014b). The provision of facilities and infrastructure can only be done by the government because of its authority as the role owner and the community who has the resources. In this role, there is a meeting point between the government and the community in the form of collaboration so that the community is placed back in its position with its local knowledge while the government continues to carry out its function as a community protector (Djalante *et al*., 2011).

5. Conclusion

Based on the discussion above, it can be concluded that the government has a major role in disaster risk reduction with the community both structurally and non-structurally such as (i) providing an early warning system, (ii) preparing an evacuation system, and (iii) forming a flood volunteer team. The forms of community social participation in anticipating floods include (i) cleaning drains, sewers, canals, and rivers, (ii) raising house foundations, (iii) raising the walls of waterways, (iv) organising the residential environment. At the same time, individuals have a capability called adaptability to be able to do various basic things. It is this basic characteristic of individuals that allows them to have the creativity to get out of various conditions that threaten their lives, including the threat of flood disasters.

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