

Increasing the Preparedness through Participatory Action Research in the Implementation of the Disaster Resilient Village Program in Madegondo Village

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Abstract: Climate change is increasing the frequency of floods in Indonesia, thereby triggering the need for effective disaster management down to detailed levels such as the Destana Program. Madegondo Village, Sukoharjo Regency experiences floods every year. It has become the focus of research to improve community preparedness using the Participatory Action Research (PAR) method with Focus Group Discussion (FGD) as the main technique. This research revealed that Madegondo Village is vulnerable to tornadoes, fires, and dengue fever. Risk analysis indicates a moderate level of danger in affecting human, economic, infrastructure, environmental, and socio-political assets. Furthermore, the creation of flood disaster risk maps, the Disaster Risk Reduction Forum, and disaster management plans were also carried out based on community participation. An early warning system was also developed via telephone and WhatsApp based on data from Kaliwingko and Bengawan Solo River.

Keywords: Flood, Preparedness, Disaster Resilient Village, Participatory Action Research

INTRODUCTION

Floods and climate change in Indonesia have a significant impact on the water sector and national hydrometeorological disasters. Investigations carried out in various regions have revealed that climate variations cause an increase in rainfall which culminates in increasing the intensity of flood events (Luas, Yamamoto; Takahiro, 2021; Pratama et al., 2022). The impact of flooding is not only destructive but also hampers access to health facilities as a result of damage to transportation infrastructure (Ikhwalı et al., 2023). Furthermore, it is expected to

experience a continuous increase in flood and drought incidents in the coming years. This of course requires adaptive steps to counteract the damaging impacts of this disaster (Klipper et al., 2021). Moreover, climate change is also indicated by decreasing water resources and increasing the danger of flooding in the next few decades (Achmad et al., 2023). Comprehensive and detailed disaster management is expected to be able to reduce the impact of flood events as much as possible down to grassroots administrative units such as villages or sub-districts.

Flood disaster management at the Indonesian village/district level involves stakeholder collaboration (Ratnasari & Wildawati, 2022), community involvement (Amin & Hashim, 2014; Fadhilah et al., 2022; Haksama et al., 2018; Mahbubah et al., 2021), dissemination of knowledge (Wilis et al., 2023), and adaptation strategies (Ying et al., 2023). The collaboration between stakeholders has formed disaster response teams with various functions, contributing to effective disaster management (Pradipta et al., 2023).

The government's disaster resilient village (Destana) program aims to increase preparedness by emphasizing community participation in disaster management through local organizations, even though there are barriers to knowledge of disasters (Bekti, 2023; Herbanu et al., 2023). Therefore, creativity and government support are needed (Isnaini, 2022; Subiyakto et al., 2023) and community participation in increasing knowledge. For example, posyandu cadres are important in disseminating disaster information and increasing community preparedness through education and simulations (Damayanti & Alif, 2023). In addition, research shows a strong correlation between public knowledge level and flood disaster preparedness, highlighting the importance of awareness in disaster-prone areas (Windartik & Rahmawati, 2023).

Destana is an initiative that aims to build village capacity in facing disaster threats. This program is based on the Regulation of the Head of the National Disaster Management Agency (BNPB) Number 1 of 2012, which outlines the principles of community-based disaster risk management.

Destana encourages villages to have independent capabilities in recognizing disaster threats, organizing community resources, and responding and recovering from disaster impacts quickly (Rahman Nugroho et al., 2020). The approach is participatory, mobilizes local resources, and emphasizes community empowerment as the main actor in reducing disaster risk. The program supports transparency, accountability, and multi-threat partnerships, as integration to sustainable development and across sectors.

The differences in the conditions of each village/sub-district in Indonesia mean that destana is not always a priority. Villages/subdistricts experiencing the same disasters annually will focus on disaster management in their area. Madegondo Village, Grogol District, Sukoharjo Regency has a frequent flood disaster. These floods occur more than once a year and occur when heavy rain falls for a long time or the river overflows due to accumulated rain in the upstream area of the river. Conditions during flooding can disrupt community activities to the point of being paralyzed which requires serious attention.

Based on the results of the pre-research, it is considered necessary and important to carry out community empowerment through the Destana Program in Madegondo Village, Grogol District, Sukoharjo Regency. This is because the sub-district experiences flooding more than once every year with an impact that can paralyze community activities. The aim to be achieved in this research is to increase community preparedness through a Participatory Action Research approach in the Destana Program in Madegondo Village, Grogol District, Sukoharjo Regency. So, Madegondo Village

can be more independent in dealing with floods before, during, and after the disaster.

LITERATURE REVIEWS

Preparedness is a multifaceted concept that is important for society in managing threats and disasters effectively. This involves proactive action and planning before an event occurs to reduce damage and avoid human suffering (Heino et al., 2022). Preparedness includes factors such as community knowledge, attitudes, and behavior, as well as disaster education through formal and informal activities to increase understanding and skills in dealing with various types of disasters (Shafi et al., 2018). Preparedness is an active, ongoing, and anticipatory process, which aims to minimize the impact of a crisis through proactive strategies and actions (Staupe-Delgado & Kruke, 2018). Overall, preparedness involves a comprehensive approach that includes planning, resources, education, and ongoing adaptation to respond to disasters threats effectively.

Destana is a community-based disaster risk reduction program implemented in disaster-prone areas to increase resilience and preparedness for natural disasters. Destana aims to minimize the negative impacts of disasters by empowering local communities through various initiatives such as establishing disaster risk management forums, increasing disaster awareness, and increasing disaster response capabilities (Wicaksono et al., 2022). The program involves a mix of quantitative and qualitative methods to assess vulnerability, disaster risk, and community preparedness, emphasizing the importance of legislation, planning, institutional capacity, funding, capacity development, and implementation

of disaster response (Nugroho et al., 2023). The establishment of Destana contributes to the development of a resilient and independent society, reducing the risks posed by various disasters such as floods, landslides, fires, and strong winds (Ratnasari & Wildawati, 2022). In addition, the Destana program collaborates with local governments and organizations to create sustainable disaster management models and improve disaster risk reduction efforts. Furthermore, the achievement of the destana program by BNPB Perka Number 1 of 2012 has the indicators shown in Table 1.

Table 1 . Disaster Resilient Village Achievement Indicators.

Category	Indicator
Legislation	1. Policies and regulations in sub-districts regarding disaster management/disaster risk reduction
Planning	2. Disaster Management Plan (RPB), Community Action Plan (RAK), and contingency plans
Institutional	3. Subdistrict Disaster Risk Reduction Forum (FPRB). 4. Village disaster management volunteers 5. Collaboration with other parties outside the sub-district
Funding	6. Disaster emergency response fund 7. Funds for Disaster Risk Reduction (PRB)
Capacity Development	8. Training for sub-district governments 9. Training for disaster volunteer teams 10. Training for village residents 11. Involvement and participation of residents in the sub-district volunteer team

Category	Indicator
	12. Involvement of women in sub-district volunteer teams
	13. Subdistrict Disaster Risk Assessment (KRB).
	14. Maps, evacuation routes, and refugee camps
	15. Disaster early warning system
	16. Implementation of structural mitigation to reduce disaster risk
	17. Forms of Community Economic Resilience
	18. Health protection for vulnerable groups (pregnant women, breastfeeding, elderly, children, people with disabilities)
	19. Management of natural resources in the context of reducing disaster risk
	20. Protection of society's productive assets

Source: BNPB Perka Number 1 of 2012

RESEARCH METHODS

This research method uses Participatory Action Research (PAR), which is an approach that emphasizes the involvement of individuals experiencing problems in conducting systematic research to produce new knowledge and encourage social change (Cornish et al., 2023). This research emphasizes the participation and action of affected community members for the formation of the destana. Participation includes taking part in creating disaster documents, while action is carried out through follow-up to these documents. Through PAR, researchers try to understand problems by trying to change them collaboratively and through reflection. The PAR process involves the community which then develops and addresses their problems

together. In the context of PAR, Focus Group Discussion (FGD) is often used as the most common method in participatory toolkits (Grimwood, 2022).

FGD allows a diverse group of participants to discuss and interact in a safe environment, facilitated and recorded by a team of facilitators and note-takers. In this case, FGD is not only a tool that is considered efficient and informative in research but is also expected to be able to support increasing community preparedness for disasters with the implementation of destana, especially for stakeholders.

The main objective of this research is to increase community preparedness through FGD in the Destana Program. In this case, the facilitators educate and encourage the community to actively participate in the Destana Program because, the community will play a greater role in legislation, planning, institutions, funding, and capacity development.

RESULTS AND DISCUSSION

1. Condition of Madegondo Village

Madegondo Village is a sub-district in Grogol District, Sukoharjo Regency, Central Java Province, Indonesia. Madegondo sub-district experienced the impact of significant changes from the development of the Solo Baru area. This sub-district is located in a strategic location, which is traversed by the Solo – Sukoharjo road. The topography and geography of Madegondo Village are lowlands with two main rivers; the Kaliwingko River and the Bengawan Solo River. In general, most of the land uses in this sub-district are residential areas, rice fields, and open land. The condition of Madegondo Village community is quite advanced and prosperous. The community

has public facilities such as health, education, social, cultural, sports, entertainment, communication and information. They also have a high awareness of the environment, such as waste management, saving water, and reforestation. They live in harmony and maintain traditional values and local culture, such as still using "kenthongan" to communicate when having siskamling.

2. Flood Disaster in Madegondo Village

The flooding in Madegondo Village, Grogol District, Sukoharjo Regency, had two main causes. The main cause is the overflow of the Kaliwingko River due to high-intensity rain which is a significant factor causing flooding in Madegondo Village. The flood depth can be more than one meter and cause quite serious impacts on residents. Besides that, the high flow of the Bengawan Solo River also contributed to flooding which affected several villages in Grogol District, including Madegondo Village.

This condition is exacerbated by the flat topography and low elevation so floods often occur. This will certainly increase community adaptation to floods. However, community knowledge and preparedness still need to be improved to reduce community dependency on the Regional Disaster Management Agency (BPBD) together with SAR, TNI-Polri, PMI, and volunteers for flood management can be carried out more effectively and efficiently.

3. Madegondo Village Disaster Threat Study

Disaster threat studies are carried out through FGD, where all information and considerations come from the community

and are facilitated by facilitators. Based on the FGD results, disasters that have occurred in Madegondo Subdistrict are presented in Table 2. Furthermore, the study of disaster threats is classified in Table 3 which has been narrowed down based on disasters that frequently occur and have an impact (Kumalawati et al., 2020).

Table 2. History of the Madegondo Village disaster.

Threat Type	Variety of Threats
Geological threats	Earthquake
Hydrometeorological Threats	Floods, extreme weather, tornadoes
Biological threats	Dengue fever, covid-19
The threat of technological failure	fires
Environmental threats	River pollution due to factory waste, land pollution due to rubbish,
Social threat	-

Source: Results of researchers' FGD, 2024

Table 3 . Study of disaster threats in Madegondo Village.

Variety of Threats	Possibility Happen	Estimate d Impact	Total
Flood	5	3	8
Tornado	4	3	7
Fire	2	3	5
Dengue fever outbreak	4	2	6

Source: Results of researchers' FGD, 2024

In this assessment, a scale of values from 1 to 5 is used. In the criteria for possibility of occurrence, the values are 5 (very certain), 4 (almost certain), 3 (possible), 2 (slightly likely), and 1 (uncertain). Furthermore, the impact estimation criteria have meanings of 5 (very severe), 4 (severe), 3 (moderately severe), 2 (mild), and 1 (not severe).

Based on Table 3 which contains a study of disaster threats in Madegondo Village, the most threatening threat to Madegondo Village is flooding. This is because floods have the highest total value. A value of 5 for the probability of occurrence means that it is very certain to occur and a value of 3 for the estimated impact means that the impact is quite severe. Furthermore, flood characteristics based on the FGD results are shown in Table 4 through a description of the flood threat.

Table 4 . Description of the characteristics of flood threats.

Character	Information
Cause	<ol style="list-style-type: none"> 1. High rainfall 2. Narrowing of the river body 3. Shallowing of the riverbed 4. Garbage buildup 5. Dense settlements 6. Lack of catchment areas 7. The pump capacity is inadequate
Destructive Factors	Floodwaters, rubbish and disease outbreaks
Warning signs	Heavy rain for 2-3 hours without stopping, EWS on Bacem Bridge
Time Interval	2 hours
Present Speed	2-3 hours
Frequency	3 - 4 times throughout the rainy season
Period	Rainy season, September-February every year
Duration	2-3 days
Intensity	Flooding with a height of around 1 - 1.5 m which affected around 600 families or 2,400 people
Position	Madegondo sub-district, northern and southern parts

Source: Results of researchers' FGD, 2024

4. Flood Disaster Risk Analysis

The analysis is carried out by identifying sub-district risk assets, and by estimating the impact of losses in terms of type and nominal. Next, each risky asset is subjected to a vulnerability and capacity analysis to obtain a risk assessment per asset. The following are the results of the Madegondo Village disaster risk assessment (Table 5).

Based on the results of the disaster risk assessment, it is known that Madegondo Village has a moderate risk of the threat of flooding with assets consisting of 5 risk assets, namely: human (high-low risk level), economic/financial (high-low risk level), physical/infrastructure (medium-low risk level), nature/environment (medium-low risk level) and social politics (low-risk level). After conducting an assessment, the total value of asset losses for the flood disaster reached Rp. 1,742,000,000 and around 910 people became victims such as injuries, illness, being unable to work, and so on. So, it is necessary to carry out disaster risk reduction based on sub-district communities to reduce the impact of asset losses and casualties if a disaster occurs in Madegondo Sub-district.

5. Flood Disaster Risk Mapping

Participatory mapping was chosen to carry out disaster risk assessment because it was felt to be very suitable for Madegondo Village. The main aim is to increase public knowledge in understanding important locations and disaster evacuation routes. Participatory mapping starts with building an agreement between the community and the Disaster Risk Reduction Forum Team (FPRB). It is guided by facilitators on the characteristics of flood threats (Figure 1).

The contents are the map that was prepared, namely flood-prone areas, evacuation routes, refugee camps, and public kitchens.

Figure 1. Making participatory flood disaster risk maps by the community, FPRB, and facilitators.



Source: Activity documentation, 2024

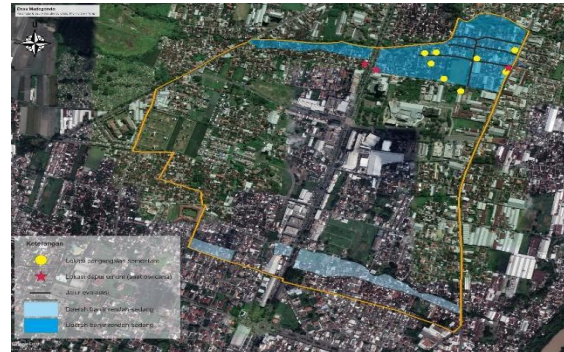
The preparation of a participatory flood disaster risk map was carried out using aerial photo imagery originating from Google. Next, the facilitator gave directions to the community and the Disaster Risk Reduction Forum (FPRB) to jointly limit the area of flood disaster threat.

On this map, the flood area is divided into 2 levels, namely low-medium level (in the south) and medium-high level (in the north).

The map also displays evacuation routes, refugee camps, and public kitchens. Evacuation routes are arranged by prioritizing main routes/roads that can lead away from the threat of flooding.

Apart from that, the preparation of refugee camps and public kitchens is based on the community's experience every year when floods occur. The following are the results of the participatory flood disaster risk map in Madegondo Village (Figure 2).

Figure 2. Madegondo Village Participatory Flood Disaster Risk Map.



Source: Results of researchers' FGD, 2024

6. Flood Disaster Management Plan

The Madegondo Village flood disaster management plan begins with the formation of the FPRB formation. FPRB was formed so that Madegondo Subdistrict has an official team or institution through the village/subdistrict government in disaster management at the village/subdistrict level.

Sub-district disaster management institutions actively participate in all disaster phases (pre-disaster, emergency response, and post-disaster). At least, FPRB has an organizational structure consisting of advisors, supervisors, people in charge, and a management board which includes a chairman, deputy chairman, secretary, treasurer, Prevention & Planning Sector, Organization & Institutional Sector, Mitigation and Preparedness Sector, and Training & Capacity Development Sector Public.

A disaster management plan which includes pre-disaster, disaster, and post-disaster phases prepared through FGD is one of the disaster management plans that must be implemented. The results of the discussion of the Madegondo Village disaster management plan for flood disasters are in Table 6.

Table 5. Analysis of Flood Disaster Risk in Madegondo Village

Risky Assets	Estimated Form of Risk Against Assets			Vulnerabilities (Cause Assets risky)	Available capacity	Level Risk (T/S/R)
	Forms of Risk	Amount	Nominal (in million)			
Man	Die	-	-	-	-	R
	Disabled	-	-	-	-	R
	Wounds	10	-	-	There is a health team ready when a flood occurs.	S
	Sick	100	-	Outbreaks of dengue fever, diarrhea, and flu. Dirty refuge	There is a health team ready when a flood occurs.	S
	Loss of ability/Skills	-	-	-	-	R
	Evacuate	400	-	Roads and houses were flooded	There are several evacuation locations available.	S
	Can not work	400	-	Roads and houses were flooded	Using a boat for transportation	Q
	Can't go to school	-	-	Roads and school equipment were flooded.	Using a boat for transportation	Q
Economics/Financial	Loss of income/work wages	400	400	Roads and work equipment were flooded	-	Q
	Loss of a job	0	-	-	-	R
	Loss of working capital	50	250	Entrepreneurial equipment is flooded	-	Q
	Crop failure	10	80	The rice fields were flooded	-	Q
	Damage/loss of property object	0	-	-	There is a security system	R
	Damage/loss of important documents	0	-	-	Residents have adapted to flooding	R
	Additional expenses family	600	600	Damage/cleaning of houses and the environment	Residents have adapted to flooding	S
Physical / Infrastructure	House damaged/lost	0	-	-	-	R
	Home dysfunction	400	400	Drainage damage and house cleaning	Residents have adapted to flooding	S
	Damage to clean water pipe networks	0	-	There is a PDAM pipe	PDAM pipes are installed very well	R
	Damage to electricity and telephone networks	0	-	There are electricity, telephone, and internet networks	The network infrastructure has already anticipated flooding	R
	Damage to the sewer network	5	10	The aqueduct is very old	The main water channel is still safe	S

Risky Assets	Estimated Form of Risk Against Assets			Vulnerabilities (Cause Assets risky)	Available capacity from damage due to flooding	Level Risk (T/S/R)
	Forms of Risk	Amount	Nominal (in million)			
	Workplace damage	0	-	-	-	R
	Damage to public facilities	0	-	-	-	R
	Impaired functioning of roads and bridges	0	-	-	-	R
	Damage to embankments or dams	0	-	-	-	R
Nature/Environment	Pollution of water/air/soil	2	1	Floods carry rubbish and cause odors	There are cleaning aids such as all-purpose soap	S
	Damage/loss clean water source	2	1	Shallow well water is murky during floods	Relatively deep well water is safe from pollution due to flooding	S
	Damage to agricultural land	0	-	-	-	R
	Impaired irrigation function	0	-	-	-	R
	Forest/peat/swamp damage	0	-	-	-	R
	Border damage river	0	-	-	-	R
	Damage/loss of food sources	0	-	-	-	R
	Plant functional disorders (aesthetics)		-	-	-	R
Social politics	Disturbance to community harmony	0	-	-	-	R
	Disturbances in the functioning of social organizations	0	-	-	-	R
	Disturbances/barriers to citizen participation	0	-	-	-	R
	Disruption of family relationships	0	-	-	-	R

High (T): When the capacity is insufficient to deal with or resolve vulnerabilities so that the need for resources from outside the village or sub-district is greater than the resources within the village or sub-district.

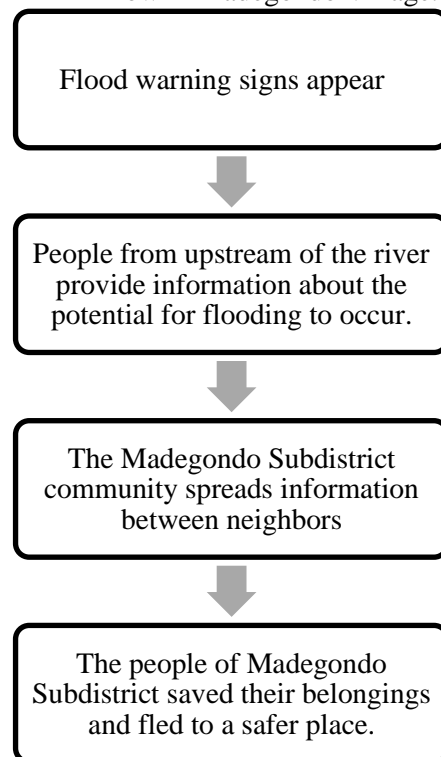
Risky Assets	Estimated Form of Risk Against Assets		Vulnerabilities (Cause Assets risky)	Available capacity	Level Risk (T/S/R)
	Forms of Risk	Amount Nominal (in million)			
Medium (S): When the capacity is not yet fully capable of dealing with or resolving vulnerabilities so that assistance is still needed from outside the village or sub-district.					
Low (R): When the capacity of the village or sub-district is fully capable of dealing with vulnerabilities and does not require support from outside the village or sub-district.					

Source: Results of researchers' FGD, 2024

7. Early Warning System

Madegondo Subdistrict does not yet have integrated and modern early warning system equipment such as CCTV which can be accessed directly and automatically to provide disaster information as early as possible. Early warning for disasters in Madegondo Village is based on communication tools such as cell phones/smartphones and radio communications. Information such as floods, for example, is obtained from residents who are upstream of the river. They warned of flooding through direct communication such as telephone, SMS, or social media such as WhatsApp. People in flood-prone areas will respond by saving their property and evacuating to safer places. The following is the flow of community-based early warning in Madegondo Village which is shown in Figure 3.

Figure 3. Community-based early warning flow in Madegondo Village.



Source: Results of researchers' FGD, 2024.

Table 6. Madegondo Village flood disaster management plan.

No	Activity	Objective	Indicator Achievements/Success
Pre-disaster phase is when there is no potential for a disaster to occur (prevention, mitigation, and capacity building)			
1	Submission of disaster management planning activities to Musrenbang	Including RPB activities in development planning	RPB activities are included in the development plan
2	Disaster awareness outreach	Increase public awareness	Socialization of RPB

No	Activity	Objective	Indicator Achievements/Success
3	Arrangement of river banks	Implementation of river bank arrangement	Implementation of river bank arrangement
4	River bed dredging	Reducing river overflows due to sedimentation	Basic dredging carried out river
5	Formation of a standby team disaster	Provide energy skilled in disaster management	<ul style="list-style-type: none"> - Establishment of a disaster preparedness team - Establishment of an organizational structure for the disaster preparedness team - Availability of statutes/rules for disaster preparedness teams - There is a disaster preparedness team activity program - Holding regular monthly meetings of the disaster preparedness team
6	Evacuation and PPPK training	Improve the skills of disaster preparedness teams and public	<ul style="list-style-type: none"> - Implementation of evacuation and PPPK training which was attended by the disaster preparedness team and the community - The disaster preparedness team understands and can practice evacuation and PPPK correctly
7	Disaster simulation	<ul style="list-style-type: none"> - Improve the skills of the disaster preparedness team and the community - Test the preparedness system - Improve contingency plans 	<ul style="list-style-type: none"> - The simulation was carried out with the participation of the disaster preparedness team and the community - People know how to save themselves
8	Procurement of equipment disaster	Providing equipment needed for disaster management	Availability of equipment disaster management
9	Waste bank management	<ul style="list-style-type: none"> - Reduce waste - Improve the economy 	Waste management
Pre-disaster phase, when there is a potential for a disaster to occur (preparedness)			
1	Disaster preparedness socialization	Increasing community preparedness in facing the floods	The community is aware and alert to the threat of flood disasters
2	Early Warning System (EWS) activation	Ensure EWS system Work	The EWS system works when a disaster occurs
3	Monitoring flood threats	Know the situation source of flood threat	People are more alert
4	Preparation of refugee posts	Refugee posts are ready to be used if flooding occurs	The refugee post is ready and suitable for use

No	Activity	Objective	Indicator Achievements/Success
Emergency response phase			
1	Activate the early warning system	Residents know that a disaster will occur and do an evacuation	Residents know information about disasters before they occur
2	Evacuate	Residents rescued themselves, assets, and other valuables.	All residents were evacuated
3	Activate post shelter	Residents can save themselves to find a place and have their needs met	Displaced residents healthy and have their needs met
4	Manage evacuation logistics	Victims who are displaced can have their needs met	All victims have their needs met
5	Securing disaster locations	The location of the disaster where the residents left remains safe & the evacuation post is safe	No crime occurred at disaster locations and refugee camps
Post-Disaster Phase			
1	Socialization regarding mental recovery	Reducing trauma and mental recovery of affected residents	The mental health of the affected residents has returned to positive
2	Reconstruction/re habilitation	Repair damaged infrastructure for residents	Damaged infrastructure can reused
3	Activity recovery	Normalization of activity refugees	Refugee activities are ongoing normal

Source: Results of researchers' FGD, 2024

CONCLUSION

Madegondo sub-district, which routinely experiences annual flooding, requires the implementation of a disaster resilient sub-district. Participatory assessment through FGD shows that this sub-district is facing the threat of floods, tornadoes, fires, and dengue fever outbreaks, with flooding as the main threat. The moderate disaster risk of flooding includes five risk assets: human, economic (financial), physical (infrastructure), natural (environment), and socio-political. Estimated asset losses due to flooding reached IDR 1,742 billion, with the potential to affect 910 people.

The disaster management plan includes the formation of FPRB and strategies in four phases: no potential disaster, potential disaster, during a disaster, and post-disaster. The community-based early warning system uses information from the upper reaches of the Kaliwingko and Bengawan Solo Rivers which is then disseminated via telephone, SMS, or WhatsApp.

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