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Improvement Capacity Mitigation Disaster Floods in the Village Tambakrejo Through Early Warning System

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Abstract
This community service activity aims to enhance community capacity for flood disaster mitigation in Tambakrejo Village, Semarang City, through strengthening the management of the Early Warning System (EWS). Tambakrejo is a coastal area vulnerable to floods and tidal inundation due to land subsidence and sea level rise. The main problems include low community preparedness and suboptimal management of the existing EWS. The implementation method involved training, mentoring, and the development of Standard Operating Procedures (SOP) for the local Disaster Preparedness Group (KSB) as the main partner, carried out through stages of socialization, capacity building, implementation, and evaluation. The results showed improved knowledge and skills of KSB members in operating and maintaining the EWS device, along with the creation of a management SOP serving as an operational guide at the community level. This activity demonstrates that community capacity building through participatory and technology-based approaches can strengthen disaster mitigation systems and enhance community preparedness against flood risks in coastal areas.

Keywords: disaster mitigation, early warning system, tambakrejo, community preparedness

INTRODUCTION

Natural disasters are a major challenge for coastal communities, including in Tambakrejo Village which is vulnerable to flooding and tidal flooding [1]. Geographically, Tambakrejo Village is located in a lowland with an elevation of 1.5-2.8 meters above sea level and close to the coast of Semarang City [2]. The location of Tambakrejo Village which is close to sea waters, makes it vulnerable to sea level rise caused by global warming [3]. There are similarities in the patterns that occur between climate change and sea level rise, which are marked by the same pattern of increasing trends in air temperature values each year by 0.003℃ with a trend value of sea level rise reaching 0.222 cm/year during the 2011-2019 period in Semarang Waters [4]. In addition, Tambakrejo Village is vulnerable to the impact of hydrometeorological disasters due to land subsidence that reached 8 cm in 2019 [5][6]. Tambakrejo Village, located in Gayamsari District, Semarang City, is vulnerable to hydrometeorological disasters due to high tides, rising sea levels due to global warming, poor drainage systems and residents who still do not protect the environment.[7]

One of the hydrometeorological disasters that are prone to occur is flooding and tidal flooding, which has a strong link to climate change and land subsidence [8]. It was recorded that flooding and tidal flooding occurred in Semarang City 18 times in 2023. [9]Meanwhile, in Tambakrejo Village, the last recorded flood disaster occurred in 2024, affecting 10,335 people with inundation levels reaching 30-150 cm. The economic impact of flooding is damage to homes and equipment, agricultural crops, and the loss of livestock [10]. Flooding also causes disruption to the population's economic activities due to the loss of access due to submerged roads [11].

Figure 1Flood Disaster Conditions in Tambakrejo Village

The main challenges in handling floods in Tambakrejo Village include low community awareness and preparedness due to the unavailability of early warning tools (Early Warning System) in flood-prone areas [12]. So that handling flood problems requires the creation of a flood forecasting and early warning system in the form of disaster mitigation activities carried out to reduce negative impacts, especially for the community [13]. As a disaster mitigation effort, an early warning system or Early Warning System (EWS) is a strategic solution to minimize the negative impacts of disasters that may occur [14]. Early Warning System (EWS) or Early Warning System is a system designed to monitor, detect, and provide early warnings of natural disasters [15]. Early Warning System (EWS) aims to provide early warnings to the community through threat detection, so that they can take anticipatory steps before a disaster occurs [10].

Figure 2Early Warning System (EWS) tool in the sub-district Tambakrejo

Tool location *early warning system* in the sub-district Tambakrejo located on the banks of the East Flood Canal River which provides risk disaster flood for residential areas in the sub-district Tambakrejo which is located lower compared to River . The EWS infrastructure installed in Tambakrejo Village consists of technology that detects river water coming from upstream, including sirens and lights. This technology can detect rising river levels during the rainy season, thus providing early warning to the public of potential flooding.

However, challenges in implementing EWS, such as management and operation, as well as damage to EWS systems, hinder their effectiveness and are a pressing concern for all stakeholders. These issues can erode public trust in the EWS system, potentially weakening their disaster preparedness. Optimizing the EWS is expected to increase capacity.

METHOD

Implementation method improvement capacity mitigation disaster flood for partners based on analysis description problem as well as plan activities . Based on the description of the problems that occurred with the partners, the program implementation method is as follows:

a. Group-based, all stages and types of activities will be carried out for all residents of Tambakrejo Village through the Disaster Preparedness Group (partners). This includes training and mentoring on group management, planning, implementation, and monitoring of activities.
b. Comprehensive, to improve the knowledge and skills of all partners in implementing flood disaster mitigation actions through *an early warning system* . This activity focuses on management and human resources aspects in increasing disaster mitigation capacity.

c. Based on Local Potential, increasing knowledge and skills in mitigation is supported by community knowledge regarding the potential for flooding, the number of recurring events, and actions taken in disaster management.

The existence of these three methods is expected to have an impact on the Tambakrejo Disaster Preparedness Group which is a fostered partner, both in terms of human resources and group management aspects. In accordance with the objectives of the activity, the methods that will be taken in this community service activity will be implemented in 4 (four) stages of activity, namely: (1) Socialization, (2) Competency Improvement, (3) Activity Implementation, and (4) Monitoring and Evaluation.

RESULTS AND DISCUSSION

Activity implementation of the Cultural Education Movement Environment in Schools (GPBLHS) which was implemented at Al-Fatah Middle School, Terboyo done through a number of activity among others:

Early Warning System Management

early warning system management was carried out by involving the Tambakrejo Disaster Preparedness Group (KSB) as the main partner. This improvement was carried out through training on *early warning system management* for flood disasters in Tambakrejo Village to increase community capacity in responding to flood disaster risks. Socialization activities for the use of early warning systems (EWS) and technical training on EWS management were carried out on August 6, 2025, involving the Village Head, Village Disaster Preparedness Group (KSB), LPMK, and RW representatives in Tambakrejo Village with a total of 25 participants. This series of activities was carried out to convey the role and function of the EWS located on the East Flood Canal Riverbank which is the result of a collaboration between Semarang State University and Saka Energi Muriah Limited in 2024.

Figure 3and EWS Management Capacity Building Activities

The socialization activity was delivered directly by the resource person and head of the community service team, M. Fikri Amrullah, S.Pd., M.Pd., in this session the resource person conveyed the function of the EWS owned by Tambakrejo Village which functions as an early detection tool for flood disasters by measuring the water level in the East Flood Canal. The system used by the EWS of Tambakrejo Village is sensor-based to measure the water level to a certain limit, then the sensor provides a signal to send information to the application while sounding a siren. This siren functions to provide notification to residents around the East Flood Canal River to prepare for flood disaster evacuation. The EWS application can be installed on the Android operating system owned by every community leader such as the Village Head, KSB Tambakrejo, and RW representatives, especially those on the banks of the East Flood Canal River.

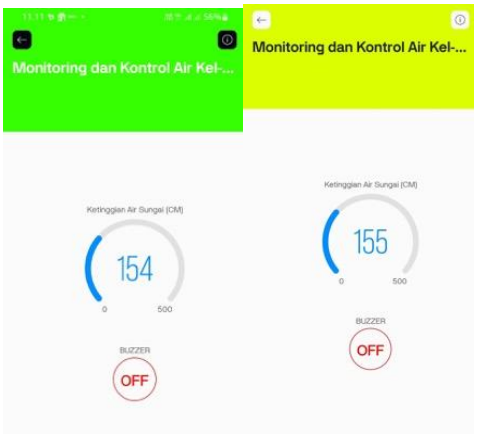

Figure 4Display Early Warning System Application

Preparation of EWS Management SOP

Based on discussions during the EWS management training, the main challenges in EWS management are equipment maintenance and calibration to ensure proper sensor operation. Furthermore, ongoing community outreach is needed to raise awareness, including information about the EWS's existence, siren sounds, application alerts, and the dissemination of information regarding the system.

flood disaster status. Furthermore, the management aspect involves the development of standard operating procedures (SOPs) for EWS management. These SOPs ensure that every stakeholder has a role in the EWS management phase, from information dissemination to equipment maintenance. The SOPs are presented in poster format to facilitate the management of each responsible party.

Figure 5EWS SOP Booklet

SOP then arranged in booklet format accompanied by animation form and method EWS work for make it easier understanding users in operate and perform EWS maintenance in the sub-district Tambakrejo .

CONCLUSION AND SUGGESTIONS

Community service activities in Tambakrejo Village have successfully increased the capacity of the community and the Disaster Preparedness Group (KSB) in managing the Early Warning System (EWS) as part of flood mitigation efforts. Through management training and technical outreach, residents have learned the function, mechanisms, and use of the EWS application to provide early warnings of potential flooding. The results of the activities indicate that the EWS is a crucial instrument in strengthening community preparedness. However, challenges remain in equipment maintenance, sensor calibration, and ongoing public outreach. Therefore, strengthening the KSB institutional

framework and developing Standard Operating Procedures (SOPs) for EWS management are strategic steps to ensure the sustainability of the early warning system at the local level. Local governments, together with university partners, need to provide ongoing support for the management and maintenance of EWS to ensure the equipment continues to function optimally and provides long-term benefits to the community. The Disaster Preparedness Group (KSB) is advised to strengthen internal coordination and increase outreach activities to communities around riverbanks so that understanding of the function and warning signs of the EWS becomes broader and more effective in supporting flood disaster mitigation in Tambakrejo Village.

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