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ANALYSIS OF ROB FLOOD MITIGATION IN BAGAN DELI VILLAGE, MEDAN BELAWAN DISTRICT, MEDAN CITY

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Abstract

Bagan Deli Village, located in Medan Belawan District, is a coastal area that is vulnerable to tidal flooding due to rising sea levels and land subsidence. The land subsidence and speed of land subsidence that occurred in Bagan Deli Village, Medan Belawan District, amounted to 6.50 cm. This problem has a significant impact on the social, economic, and environmental lives of the local community. This study aims to analyze tidal flood mitigation strategies that can be applied to reduce its impact. The method used is descriptive qualitative with a field study approach, interviews, and documentation. The results of the analysis show that the construction of drainage channels, river dredging, raising floors, infiltration wells, water gates, socialization and formation of working groups, planting mangroves, pump houses, and stilt houses are effective mitigations. This study provides strategic recommendations for local governments and related parties in formulating appropriate and sustainable tidal flood mitigation policies.

Keywords: ***tidal flood, mitigation, AHP, Bagan Deli, Medan Belawan.***

INTRODUCTION

The coastal area that is the ROB Flood area in Medan City is in Medan Belawan District. The sea level rise that occurs on the coast of Medan City, Medan Belawan District is ±1,042 cm/year (Nurzanah, 2021). Vulnerability factors for Rob flood disasters in Medan Belawan District are: High building density, Network conditions that are not flooded, Suboptimal drainage channel conditions, public facilities that are flooded, Quality of buildings that are flooded, decreasing community income in vulnerable sectors, Reduced water catchment areas, Reduced mangrove forest areas, Residential areas located near rivers, Residential areas located in lowlands, Built-up areas built on forests and swamps. (Zandiba et al., 2023). The subsidence and speed of land subsidence that occurred in Medan Belawan Regency, North Sumatra, showed a subsidence rate of 0.84 to 8.64 cm/year and the predicted land subsidence that occurred in 2050 reached 93.60 cm. with a total land area affected by tidal flooding reaching 1,064.83 Ha or around 42.98% of the total area of Medan Belawan District, and in Bagan Deli Village from field observations in the last 1 year there was the highest decline in BM 03 - Bagan Deli of 6.50 cm (Randani et al., 2024).With the threat of rob flood disasters, it is necessary to have public understanding regarding rob flood mitigation steps in their area (Karana & Suprihardjo, 2013). Mitigation is actions that reduce or minimize the impact of a disaster on the community. Mitigating tidal floods and prioritizing mitigation are important in the context of the development of this region. Previous in-depth scientific research on tidal flood vulnerability factors and tidal flood vulnerability zones in Medan Belawan District may have been done before, but no one has conducted research on tidal flood mitigation. Study of seawater flood areas (ROB) in the Northern Medan Region (Ahmad Bima Nusa., 2022). From the study, the location most affected by tidal flooding was Bagan Deli Village, Medan Belawan. This study aims to analyze what mitigation can prevent or reduce the impact of tidal flooding in Bagan Deli Village, Medan Belawan District and provide relevant policy recommendations. The results of this study can be used by the government and local communities to design more effective policies and actions in dealing with the threat of tidal flooding.

LITERATURE REVIEW

1. Mitigation

Hard mitigation is a strategy of building the environment to withstand natural hazards. This includes engineered modifications to watersheds such as flood control dams and levees, provisions for building structures that are resistant to wind and earthquake loads or to flammability, and permanent systems in place, such as fire suppression systems and standby generators. The goal of hard mitigation provisions is to "harden" a facility, making it resilient to disasters with minimal active human intervention. Soft mitigation, usually associated with emergency preparedness or emergency response. The most obvious examples of soft mitigation are firefighting and sandbagging against floods, followed by general disaster relief activities such as search and rescue, first aid, care and protection, emergency communications, and health disasters. Soft mitigation reduces the effects of natural disasters that cannot be adequately addressed by hard mitigation measures.

2. Steps taken in Flood Disaster Mitigation

a. Collecting data on rainfall, topography, land use, and flood history.
b. Mapping flood-prone areas (flood mapping).
c. Analyze flood frequency and impact to determine area priorities.
d. Construction of embankments: holding back river or sea water overflow.
e. Installation of water level monitoring equipment (early warning system).
f. Rehabilitation of forests and river basins (DAS) f. Rehabilitation of forests and river basins (DAS).
g. Planting of landslide-preventing vegetation on river slopes.
h. Taking into account the geographical characteristics of the coast and breakwater structures for the Bay Area.
i. Sediment cleaning.
j. Construction of drainage channels.
k. Increased vigilance in flood plain areas.
l. Flood-resistant house building design (waterproof materials, strong foundations).
m. Agricultural training that is appropriate to flood-affected areas.
n. Raising awareness of deforestation.
o. Flood awareness training such as flood disaster evacuation preparation such as boats and other rescue equipment.

Here are some principles for mitigating flood disasters:

1. Build a good drainage system and clean it regularly.
2. Rehabilitation of river basins (DAS) and reforestation to reduce surface flow.
3. Community education and training on what to do when a flood occurs.
4. An early warning system that can be accessed by the public.
5. Periodic evacuation simulation.
6. Involve communities in planning and implementing mitigation programs.
7. Form disaster preparedness groups at the local level (RT/RW, village).
8. Joint supervision of land and building use.
9. Taking into account sea level rise and extreme rainfall.

Coastal flood risk mitigation based on nature, an approach that utilizes natural processes and ecosystems to reduce the impact of flooding in coastal areas. This approach focuses not only on physical protection, but also on ecosystem restoration and sustainable community empowerment. Community action efforts to adapt and anticipate tidal flood waves. For people who have an emergency budget, build an additional floor for their house, while for people who do not have enough money, build embankments around it or fill the flood with sandbags. Stilt houses like traditional houses are also effective in overcoming flooding for people who can afford to change their houses. Creating a Community Empowerment program through the Disaster Resilient Village Program (DESTANA) as an effort to mitigate tidal flooding. The purpose of this program is to form a Working Group (POKJA), which is fully responsible for all activities before the disaster, during the disaster, and after the disaster. An effective adaptation strategy is needed based on the identified vulnerability factors, Common vulnerability factors in the context of tidal flooding include physical, sosial and economic.

The following are sustainable coastal mitigation approaches and strategies:

1. Dikes and Breakwaters
   Artificial structures for coastal protection by building embankments and breakwaters.

Figure 2.1 1of hard engineering of coastal barriers (seawalls)

2. Infrastructure Drainage System
   Green buffer zone and bioswales based drainage systems are part of the sustainable drainage systems (SuDS) approach that aims to manage stormwater runoff naturally, reduce flood risk, and improve environmental quality and aesthetics: (i) Green Buffer Zone This zone is an area of natural or artificial vegetation that functions as a protector and regulator of rainwater flow. (ii) Bioswales are vegetative channels designed to drain, filter, and absorb rainwater gradually.

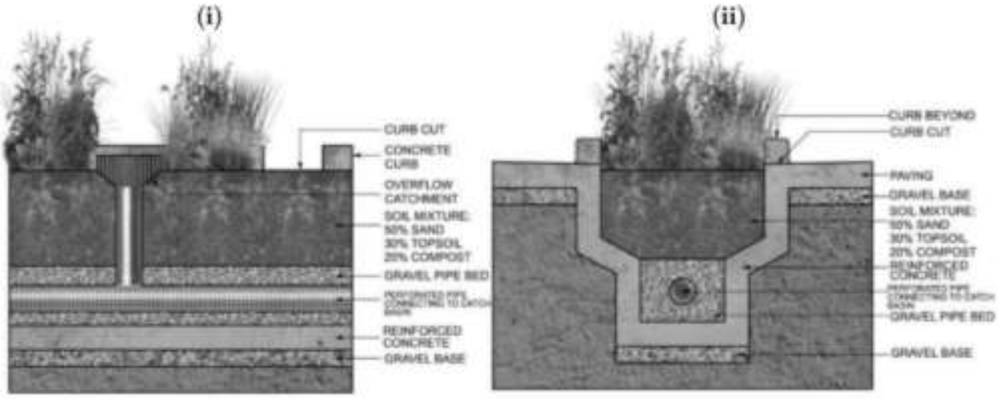

Figure 2.2 [i] green buffer zones and [ii] Bioswales

3. Wetlands
   Mechanical wetland mitigation strategies aim to reduce the risk of disasters such as flooding, erosion, or ecosystem damage by using technology or man-made physical structures. Wetlands are very important because they function as water storage, natural filters, and biodiversity habitats.

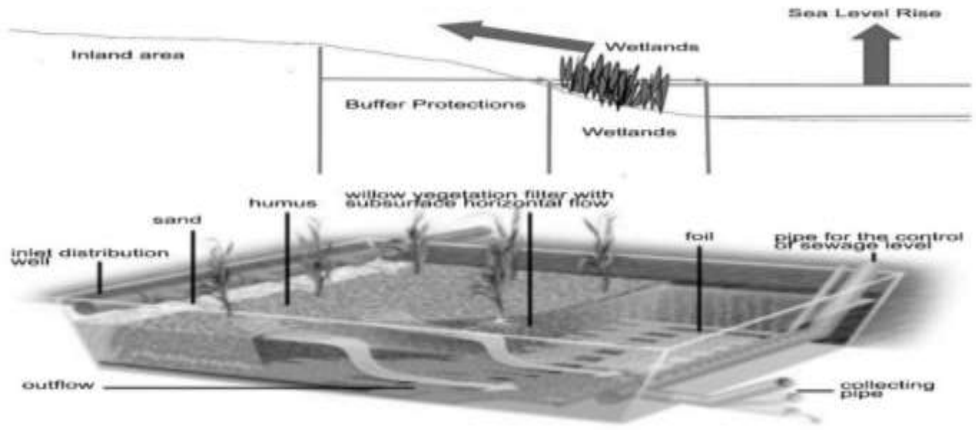

Figure 2.3 Illustration of Wetlands

4. Moving Dam
   Movable dams are water barrier structures that can be raised or lowered, opened or closed as needed. They are usually used to control tidal flooding (rob floods), manage river flows during the rainy and dry seasons, protect coastal areas and delta cities.

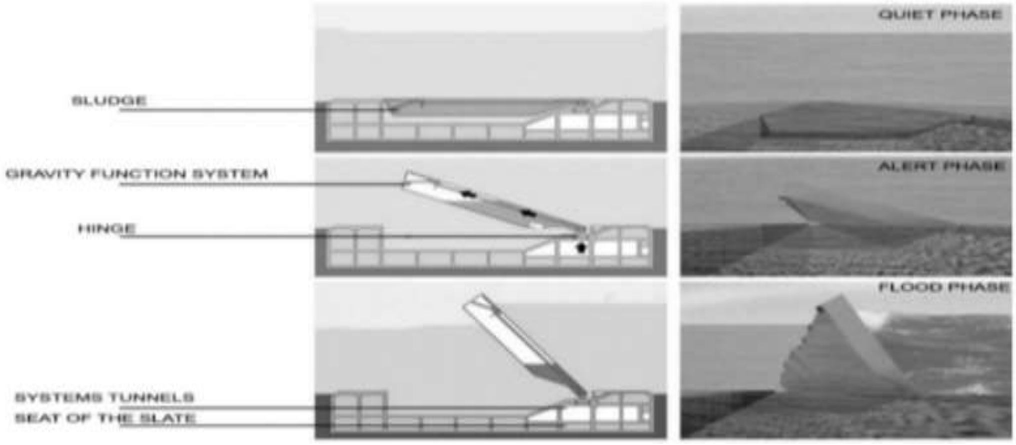

Figure 2.4 Illustration of a moving dam scheme used for coastal flood mitigation.

3. Adaptation to floods

1. Adaptation to the place of residence by making embankments, raising the house and its roof, raising the floor of the house by filling in the ground, making water channels around the house.

Figure 2.5 Floor elevation activities

2. Adaptation to the availability of clean water is carried out because tidal flooding has an impact on water quality.

Figure 2.6 Clean water storage tank

3. Adaptation to pond land is carried out to reduce the impact and losses due to tidal flooding, which is done by building embankments, installing nets or netting around the ponds, raising the embankments, creating connecting water channels between ponds, and planting and maintaining mangrove plants around the coast and ponds.

Figure 2.7 Concrete embankment and net in pond

METHOD

This study uses a quantitative and qualitative approach (mixed methods) to obtain a comprehensive picture of the causes, impacts, and mitigation efforts for tidal flooding in Belawan. Data collection using purposive sampling technique, which is one of the non-probability sampling techniques, where researchers deliberately select individuals or groups that are considered most relevant and have information that is in accordance with the research objectives. The data taken 150 respondents representing 10 most relevant respondents every 15 environments in Bagan Deli sub-district, Medan Belawan District. This research is included in the category of descriptive and explorative research. Descriptive: to describe the characteristics of tidal flooding and its impacts. Explorative: to identify possible solutions and community responses and local government policies.

Figure 3.1 Sampling point

RESULTS AND DISCUSSION

1. Identification of Mitigation Strategies to Overcome Potential Flood Risks

Bagan Deli Village has 15 neighborhoods, and each neighborhood was distributed 10 questionnaires with the aim of local community leaders as parties directly affected by the tidal flood. Figure 4.1 explains that of the 150 respondents who answered the identity of age 20 to 25 years as much as 19%, age 26 to 30 years as much as 17%, age 31 to 35 years as much as 15%, age 36 to 40 years as much as 12%, age 45 to 50 years as much as 21%, age >50 years as much as 16%.

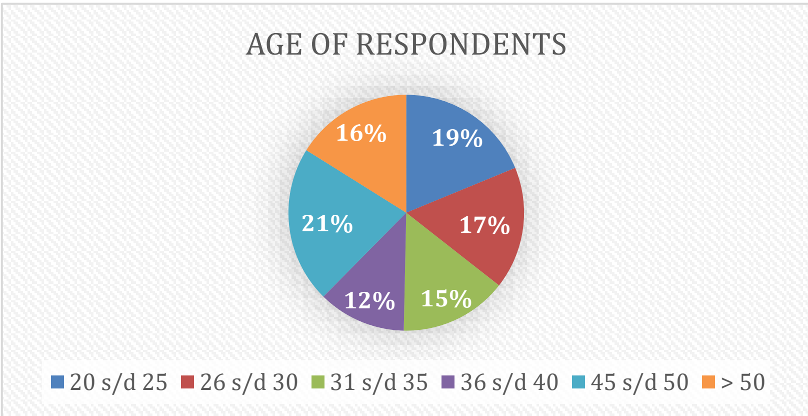

Figure 4.1 Respondents' Age

Figure 4.2 explains that of the 150 respondents who answered that their gender identity was male, 80% were female and 20% were female.

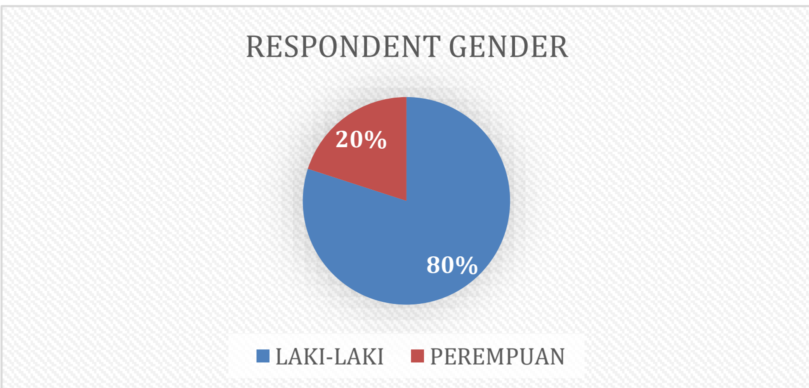

Figure 4.2 Respondent Gender

Figure 4.3 explains that of the 150 respondents who answered that their last education was junior high school, 29% were high school graduates, 68% were high school graduates, and 3% were undergraduates.

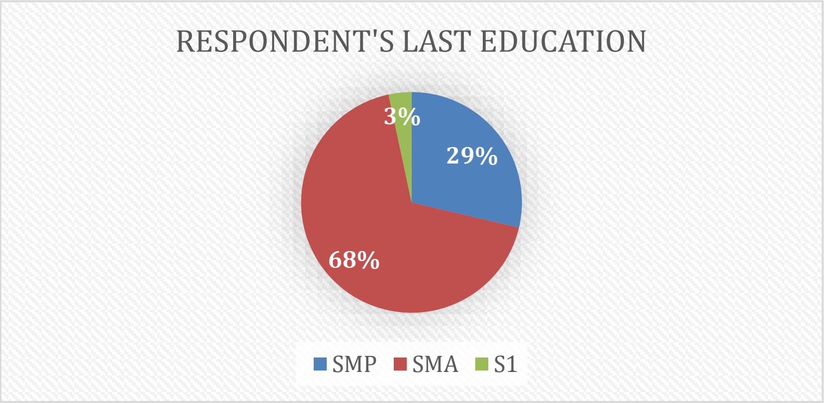

Figure 4.3 Respondents' Last Education

Figure 4.4 explains that of the 150 respondents who answered the identity Income ≤550,000 as many as 4%, ≤1,500,000 as many as 69%, ≤3,800,000 as many as 27% .

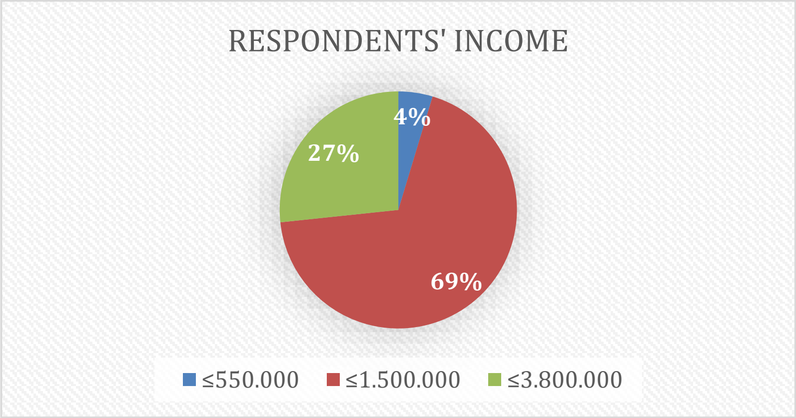

Figure 4.4 Respondents' Income

Figure 4.5 of the 150 respondents who answered 87% raised the floor as a citizen's action to prevent tidal flooding, 6% made a non-permanent embankment on the beach as a citizen's action to prevent tidal flooding, 2% raised the road as a citizen's action to prevent tidal flooding, 5% moved house as a citizen's action to prevent tidal flooding.

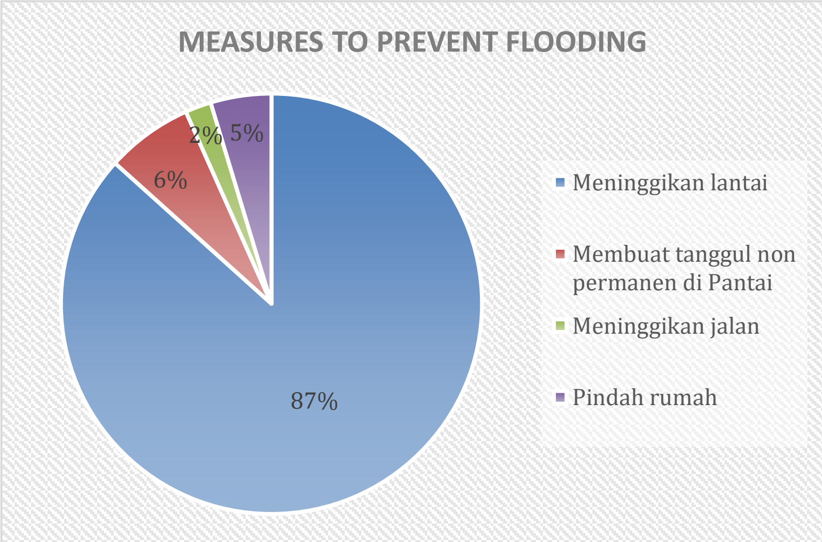

Figure 4. 1Actions of Residents to Prevent Tidal Floods

From the results of the analysis above, tabulation was carried out so that alternative mitigation strategy options could be obtained as shown in Table 4.1 and Table 4.2.

Table 1Stage of Identification of Alternative Mitigation Strategies

No	Description	Alternative Mitigation Strategies	%	Information
1	Citizens' Actions to Prevent Tidal Floods	Raise the floor of the house	87	Selected
		Creating a non-permanent sea wall on the coast	6	Not selected
		Raising the Road	2	Not selected
		Moving house	5	Not selected
2	Mitigation Strategy for Tidal Floods	Sea Wall	SS = 0 S = 21 TS = 79	Not selected
		Mangrove Planting	SS = 41 S = 59 TS = 0	Selected
		Pump House	SS = 39 S = 55 TS = 6	Selected
		Socialization and Formation of Working Groups	SS = 9 S = 78 TS = 13	Selected
		House on stilts	SS = 44 S = 55 TS = 1	Selected
		Sluice	SS = 15 S = 84 TS = 1	Selected
		River Dredging	SS = 10 S = 89 TS = 1	Selected
		Drainage Channel Construction	SS = 9 S = 91 TS = 0	Selected

		Wave Breaker (APO)	SS = 3 S = 48 TS = 49	Not Selected
		Infiltration wells	SS = 3 S = 87 TS = 10	Selected
		Relocation	SS = 0 S = 5 TS = 95	Not Selected

Table 4. 2Stages of Determining the Selected Mitigation Strategy

No	Description	Mitigation Strategy	%	Information
1	Citizens' Actions to Prevent Tidal Floods	Raising the Floor of the House	87	Selected
2	Mitigation Strategy for Tidal Floods	Mangrove Planting	59	Selected
		Pump House	55	Selected
		Socialization and Formation of Working Groups	78	Selected
		House on stilts	55	Selected
		Sluice	84	Selected
		River Dredging	89	Selected
		Drainage Channel Construction	91	Selected
		Infiltration wells	87	Selected

CONCLUSION

Mitigation of tidal flooding in Bagan Deli Village based on research results recommends the creation of drainage channels, river dredging, raising floors, infiltration wells, water gates, socialization and formation of working groups, planting mangroves, pump houses, and stilt houses as the most effective mitigation strategies. Community involvement and education are the main supporters of long-term mitigation success.

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