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Study of Flood Control in the Gang Mufakat of Balikpapan City (Qualitative Study)

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Abstract
Balikpapan City is a city that often experiences floods. One of the most frequently flooded locations is Gang Mufakat, which is located in Damai Village, South Balikpapan. This area is an area passed by the Ampal River Basin which is one of the causes of flooding besides the lack of vegetation as land cover in the settlement. This research aims to identify the management and control/control of floods in general. This is done to obtain information on several things that are considered important in management and to assess the understanding of the community and government regarding flood control/management. The research method used is a descriptive qualitative method. This research results from the community's understanding of floods and community actions in dealing with floods. Understanding of flooding in the form of causes of flooding, and the importance of the role of vegetation on land cover and the creation of infiltration wells. The recommendation for the government is to dredge sedimentation as well as deepen the Ampal River basin area and create a polder as a substitute for water catchment areas because many residential areas around the Ampal River basin area do not allow water to flow directly into the river basin area. The recommendation for the community is to build an infiltration well in the Gang Mufakat.

Keywords: Qualitative Study; Flood; Gang Mufakat.

1. Pendahuluan

Indonesia's geographical location has placed it as one area prone to natural hazards and natural disasters. Natural disasters are natural disasters caused by natural events, including earthquakes, tsunamis, volcanic eruptions, floods, droughts, hurricanes, and landslides. Indonesia is located in a tropical climate, so it has two seasons: dry and rainy. The impact of this location, Indonesia ranks third in the world as a country that is most prone to and frequently experiences floods, after India and China.

Balikpapan is a coastal city located in East Kalimantan, Indonesia. In one of the settlements in the city of Balikpapan, namely Gang Mufakat, there were cases of flash floods that occurred when there was heavy rainfall.

Figure 1. Flooding in the Gang Mufakat, Balikpapan (16 March 2022)

From Tuesday, March 15, 2022, to Wednesday, March 16, 2022, there was heavy rain which flushed the city of Balikpapan with high rainfall, causing inundation with an average height of 1.5 meters in the Gang Mufakat road area (Kurniawan, 2022).

Flooding is a natural phenomenon where there is excess water that is not accommodated by the drainage network in an area, causing inundation that is detrimental and inhibits the activities of the residents of the surrounding settlements. Losses caused by floods are often difficult to overcome, both by the community and related agencies. Floods are caused by several factors, namely the condition of the rain catchment area, the duration of topographical conditions, and the capacity of the drainage network.

The flooding that occurred in Gang Mufakat, Jalan MT Haryono was caused by high rain intensity, as can be seen in Table 1 below, which is the worst flood disaster data that occurred in Gang Mufakat in the last 10 years.

This research aims to identify the management and control/control of floods in general. This is done to obtain information on several things that are considered important in management and to assess the understanding of the community and government regarding flood control/management.

2. Metode

The research method used in this case study is qualitative research to examine the causes and solutions of the flood event in Gang Mufakat which is located along the Ampal River Basin, Balikpapan City, East Kalimantan Province, where the explanation can be as follows.

Identification of Land Resource Management Strategies

The purpose of this case study is to identify the management and control/control of floods in general. This is done to obtain information on several things that are considered important in management and to assess community understanding regarding flood control or mitigation.

Data Collection

The stages in data collection are as follows:

First, primary data which includes: Data from interviews with residents regarding flood vulnerability where residents have lived in the location for more than 10 years,

1. Gang Mufakat Topographic Map using ArcGIS Documentation in the form of photos and videos of the condition of the research location

2. Drawing of Gang Mufakat I Drainage using SketchUp
3. Draw the Ampal River basin area using SketchUp.

Second, secondary data which includes

1. Electronic media news regarding the flood that occurred on Jl. Gang Mufakat from the last 1 year to the present (2021-2022)
2. Rainfall Data for the City of Balikpapan for 2021 from the BMKG

Data Processing

The results of this case study are presented in a qualitative descriptive manner. A qualitative descriptive research approach describes a phenomenon that occurs in an area. The qualitative research method is descriptive in nature, describing the data in sentences and then separating them according to each category to obtain conclusions (Arikunto, 2010).

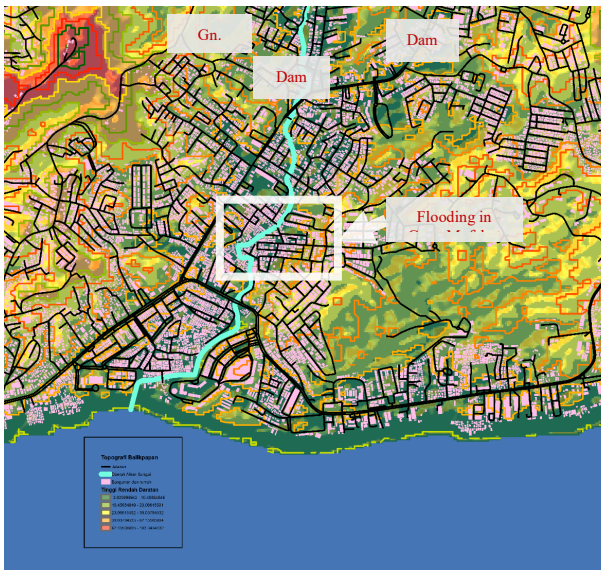

Figure 2. Slice of the Balikpapan Topographical Map Using ArcGIS

Table 1. Rainfall in Balikpapan in 2021

Month	Amount of Rainfall (mm)	Total Rainy Day (Hari)	Percentage Sun (%)
January	250.4	25	43.3
February	135.4	20	47.9
March	167.0	22	49.5
April	159.8	18	54.3
May	260.5	22	48.1
June	176.6	16	58.0
July	148.6	20	42.1
August	446.0	24	49.9
September	421.0	26	48.1
October	357.3	23	49.4
November	306.8	24	38.2
December	233.0	25	37.2

High Rainfall Intensity

Table 2. Results of Interviews with Gang Mufakat Residents

No	Question	Source					
		Mufakat I			Mufakat II		
1	Name	Saipul	Fenny	Matondang	Sidabutar	Yanti	Ros
2	Length of Stay in Flood Locations (years)	21	30	10	30	40	9
3	Flood Intensity	Often	Often	Often	Often	Often	Rarely
4	Flood Duration	Depends on the tides	Depends on the tides	Depends on rainfall	Depends on the tides	Depends on the tides	Depends on the tides
5	Flood Height	1.5	1.5	1.5	15cm – 1m	1.5m	2m
6	The Time of the Worst Flood in the Last Half a Year	2012	2012	2022	2022	2022	2022
7	Flood Time	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Night

3 Results and Discussions

The parameters used in this study are projected in the form of interview results (Table 2), topographic maps (Figure 2), and direct observations at the Mufakat Gang location along with the Ampal River basin area and case studies related to flood disasters that have occurred in the last 10 years through online media. Then an analysis was carried out based on the results of interviews, topographic maps, and observations at the Mufakat Gang location and the Ampal River basin area. The results of the analysis of data collection can be seen in the sub-chapters below.

A. Cause of Floods

Based on observations related to the flood disaster that occurred in Gang Mufakat, field observations, and interviews with residents, floods are caused by two categories, namely natural floods and floods caused by human activities. Floods caused by nature are influenced by rainfall, sedimentation, and the influence of tides. While flooding due to human activities is caused by human actions that cause environmental changes such as densely populated residential areas so that there is no vegetation in the location, drainage capacity, and drainage cleanliness will not be considered sedimentation.

Floods due to Nature

1) Rainfall Intensity

Indonesia is located in a tropical climate, so it has two seasons: dry and rainy. BMKG divides monthly rainfall into four categories namely; low (0-100 mm/month), moderate (100-300 mm/month), high (300-500 mm/month), and very high (> 500 mm/month-1) (Supriyati, 2018). Rainfall with high intensity can cause flooding. In Table 1 it can be seen that the highest rainfall occurs from August to October, where in that month there were quite large floods based on data from Electronic Media and the results of interviews show that in Gang Mufakat I and II with the lowest height, 15 cm and the highest, 2.5m.

2) Sedimentation

The amount of sedimentation will reduce the capacity of the river basin area causing inundation and flooding caused by overflow from the river basin area. At several points in the Ampal River basin area, a lot of accumulated sediment was found which could reduce the volume capacity of the Ampal River basin area.

3) Effect of Tide

Ocean tides slow down the flow of rivers into the sea. When floods coincide with high tides, the height of the inundation or flooding becomes large because backwater occurs.

4) Effect of Physiography of the Ampal River Basin area

Physiography or physical geography of rivers such as the shape of river basin areas are things that influence the occurrence of floods. The flow pattern of the Ampal River forms an angle close to 90o in the river channel behind the Zurich Hotel and even tends to reverse.

5) Topography of the Ampal

As can be seen in Figure 2, proves that the topography of the Ampal River basin area is very sloping so the river channel drainage system is greatly influenced by tidal conditions.

6) Topografi Gang Mufakat

Topography is the study of the shape of the earth's surface. Gang Mufakat is an area located close to the Ampal River basin area and the Balikpapan Super Block. It can be seen in Figure 2, where the location has the lowest topography symbolized in dark green the numbers - 3.833 – 10.456m so that residents experience flooding with a significant water level. This is evidenced at every entrance from Jl. MT Haryono to Gang Mufakat I and Mufakat II tended to decline.

Causes of Floods Due to Human Activities

1) Drainage Sedimentation

Sedimentation is a process of depositing material that is transported by the media of water, wind, ice, or glaciers in a basin (Marlina, 2018).

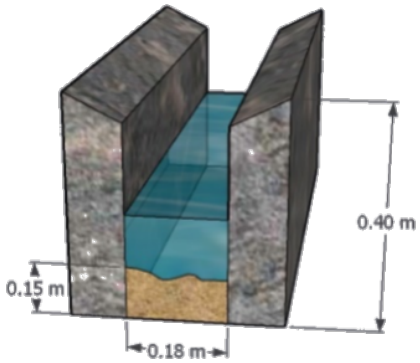

Figure 3. Dimensions of Gang Mufakat Drainage I

The amount of sedimentation found in the Gang Mufakat drainage is quite high, namely 15cm in Gang Mufakat I and 10cm in Gang Mufakat II. The sediment will also reduce the capacity of the drainage to function optimally in channeling water to the Ampal River basin area.

2) Inadequate Drainage Capacity

Most of the drainage dimensions in Gang Mufakat are small so the location is often flooded when it rains with high rainfall intensity.

3) Vegetation

Vegetation is a collection of several types of plants. Gang Mufakat is a densely populated residential area that has no water catchment and on Gang Mufakat I and II only found a total of 2 land covers in the form of empty land that is not large and all the terraces of the houses in the settlement have been cemented so that water is difficult to enter the ground and become runoff groundwater table (surface runoff).

B. Flood Control and Management

The solution to the problem in the flood case study in Gang Mufakat is as follows.

1) Infiltration Wells

Infiltration wells are wells or holes on the ground surface that are made to collect rainwater so it can seep into the ground (Iriani, 2013).

Figure 4. Infiltration wells

Infiltration wells are one of the strategies for controlling water that seeps into the ground, whether overcoming floods or droughts is through infiltration wells. This infiltration well is an effort to increase the infiltration of rainwater into the ground and reduce runoff as a cause of flooding.

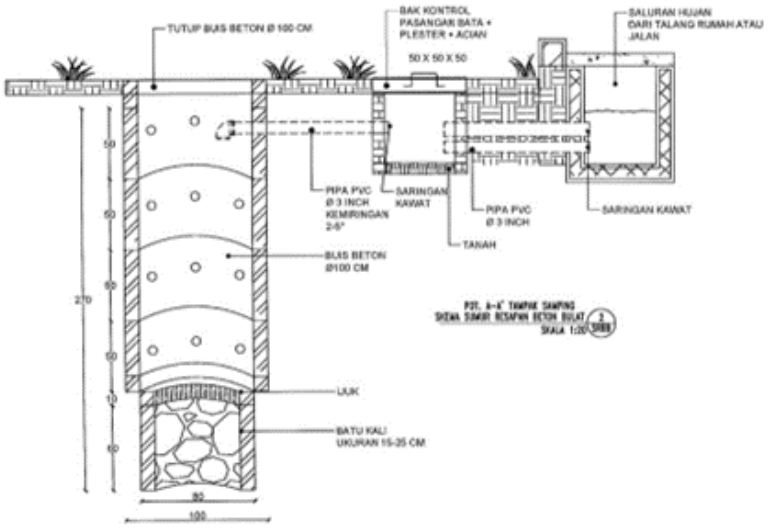

Figure 5. Infiltration Well Design in Jakarta
Source: Dinas SDA Jakarta

As can be seen in Figure 5, this is an example of an infiltration well in Jakarta to increase water absorption and hold the capacity to prevent flooding. During the observation, two vacant lands were found that could be built infiltration wells to tackle flooding.

2) Sediment Dredging

The following locations need to be considered for dredging sediment:

a. Sediment dredging in the Ampal river basin area

The local government must pay attention again to the condition of the Ampal river basin area because a lot of sediment has accumulated which has caused the area around the river basin area too.

b. Sediment Dredging in Gang Mufakat Drainage

Residents of the Mufakat Gang area should do mutual cooperation to dredge sediment in the Mufakat Gang drainage so that the drainage can function optimally.

3) Create a Water Polder

The polder system is a way of dealing with flooding with physical buildings, which include drainage systems, water retention ponds/reservoirs, and embankments surrounding the area, which have pumps and floodgates (Rahmawati, 2017). Polder development is useful in areas affected by flooding due to unbalanced development, where polders can control flooding and inundation due to upstream flow, local rainfall, and rising sea levels.

Figure 6. Example of a polder in Samarinda

In addition to Gang Mufakat, the Ampal is also a flood-prone area because the area around the Ampal has many settlements that reduce water absorption areas so that runoff water can flow smoothly into the. To replace the lost water catchment areas, a new recharge area is needed which is also by the previous water catchment area before the construction of settlements around the Ampal river basin area by building a Polder. In Figure 1 three vacant lands can be used for making polders, namely in the Damai Sub-District where two are located, and in the Gn. Sari Ulu one fruit. The polder can also become a temporary water reservoir during the summer to add to the water bank of Balikpapan City.

4 Conclusions and Suggestions

Conclusions

In one of the residential areas in the city of Balikpapan, located in Gang Mufakat, there was a case where when there was heavy rainfall the area would be flooded with a fairly high height. The flood disaster that occurred on March 16 2022 disrupted local community activities and caused significant property losses with the condition of the research location

being a densely populated settlement and the physiographic influence of the Ampal river channel which caused inundation along the banks of the Ampal river. This is caused by;

1. Causes of Flood due to Nature.

Rainfall with high intensity causes flooding with a minimum height of 15 cm and a maximum of 2.5m. Sedimentation in the Ampal area is also a cause of flooding due to reduced drainage capacity to accommodate rainwater that can be accommodated by the Ampal. Seawater tides can slow down the flow of river water into the sea with high tide conditions, so the flood height becomes large because of backflow. The physiographic influence of the Ampal River basin area is a factor that influences the occurrence of flooding because the Ampal River flow pattern forms an angle close to 90° in the Zurich Hotel river channel.

2. Human causes of flooding.

The amount of sedimentation found in the Gang Mufakat drainage is quite high, which is 10-15 cm thick based on direct observation in the field. These conditions lead to reduced capacity of the drainage to function optimally. Most of the size of the drainage in Alley Mufakat is small so that when it rains with high rainfall intensity it causes flooding and as for the conditions in the Gang Mufakat settlement which is a densely populated settlement, only two land covers are found in the form of vacant land and the settlement has been cemented so that water is difficult to seep into the ground so that it becomes surface runoff.

Suggestions

The construction of infiltration wells and dredging of sediments is an effort to help reduce the water level when a flood occurs but does not overcome flood disasters, especially when the intensity of rainfall is high. So a quantitative study is needed for the design and analysis of polder development which is considered quite important for the future.

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