FLOOD POTENTIAL IN THE DOWNSTREAM OF CITARUM RIVER, MUARA GEMBONG, BEKASI DISTRICT, WEST JAVA

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ABSTRACT

Flood can heavily affect one area. The area that is often hit by floods can suffer great loss. Muaragembong is one of the sub-districts in Bekasi District. This area is known to be a flooded regularly. The aim of this study is to analyze the changes of flooded areas in the study area, particularly with regard to residential areas. The results showed a significant change in flooded areas from 1993 to 2016. An increase in land use change from swamp area and mangrove forest to residential land is suspected as the cause of increased flooding each year. One way to reduce the impact of flooding in Muaragembong, is to restore the presence of mangrove forests along the Citarum River to the sea.

Keywords: Flood, Muara Gembong, Citarum River, Land Use

INTRODUCTION

Flooding is a natural event that can highly influence the society and environment. Flooding occurs as a result of too much water in a one place that tends to be closed so that the water is trapped and form a flood. The occurrence of inundation on land as a result of overflowing river water caused by flowrate that exceeds its capacity. In addition, due to overflowing river water that causes flooding can also occur as a result of more rainfall so that the river body is no longer able to accommodate and drain it (Rosyidie, 2013).

Flooding can be caused by a combination of heavy rainfall causing the river to overflow, and tides and storms that caused big waves in the coastal areas that made sea water pushed ashore.

Flooding can also be caused by long periods of low intensity rain for several days. If the storage capacity owned by each watershed is exceeded, then the rainwater will become runoff which will then flow quickly to the nearby rivers and overflow inundated low-lying areas on either side of the river. This kind of flood often occurs in Indonesia.

Muaragembong sub-district, Bekasi District is located at the Northeast of Jakarta. Physiographically, this area included in the Jakarta Zone. According to van Bemmelen (1970), it dominated by the morphology of the plain (Figure 1). This area was chosen as study area because it has the flood potential. Moreover, high rainfall and its position in the mouth of the Citarum River made this area more risked for flooding area.

Most of the soil conditions are fertile alluvial soils that used for agricultural areas and dominated by floodplain deposits in the south and swamp deposits in the north (Figure 2). Geologically, this area consists of three rock formations, namely the Cihoe Formation, Subang Formation, and the Parigi Formation which developed in the southeast area of the study area.

The aim of this study is to analyze the changes on flooding area since it can give the impacts to the land use in the study area, particularly with regard to residential areas. Furthermore, the cause of the flooding area changes will also be determined.

METHODOLOGY

This research was conducted by comparing and analyzing delineation of flooded areas that occurred from 1993 to 2016. The analysis uses satellite images with remote sensing and GIS approaches. In addition, direct field observations were carried out to map several areas that were also affected by flooding.

The results from GIS and field works then analyzed to find out the changes of flooded areas and the cause of the floods

RESULT

The results of the image analysis and field observations conducted in August 2017 shows the following data:

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1. Development of settlements in the river terrace area is growing

The results of image analysis show that 40% of the north of the Muaragembong sub-district has elevation below sea level with a morphology in the basin shape, especially near Citarum River (Figure 3). This condition made water accumulated in the basin shape area if the rain has high intensity.

Ironically, the development of settlements is increased along the banks of the Citarum River. As a result, when the Citarum River overflows, water pooled in the area. This condition made the residential areas change into flooded areas.

2. The embankment bursts in downstream of the Citarum River

Muaragembong Government Official has tried to anticipate flooding caused by the overflow of the Citarum River. The Government made embankments around the Citarum Riverbanks (Figure 4). However, many embankment in the area are no longer able to function due to a breakdown. The collapse of the embankment was influenced by a large volume of water due to rainfall.

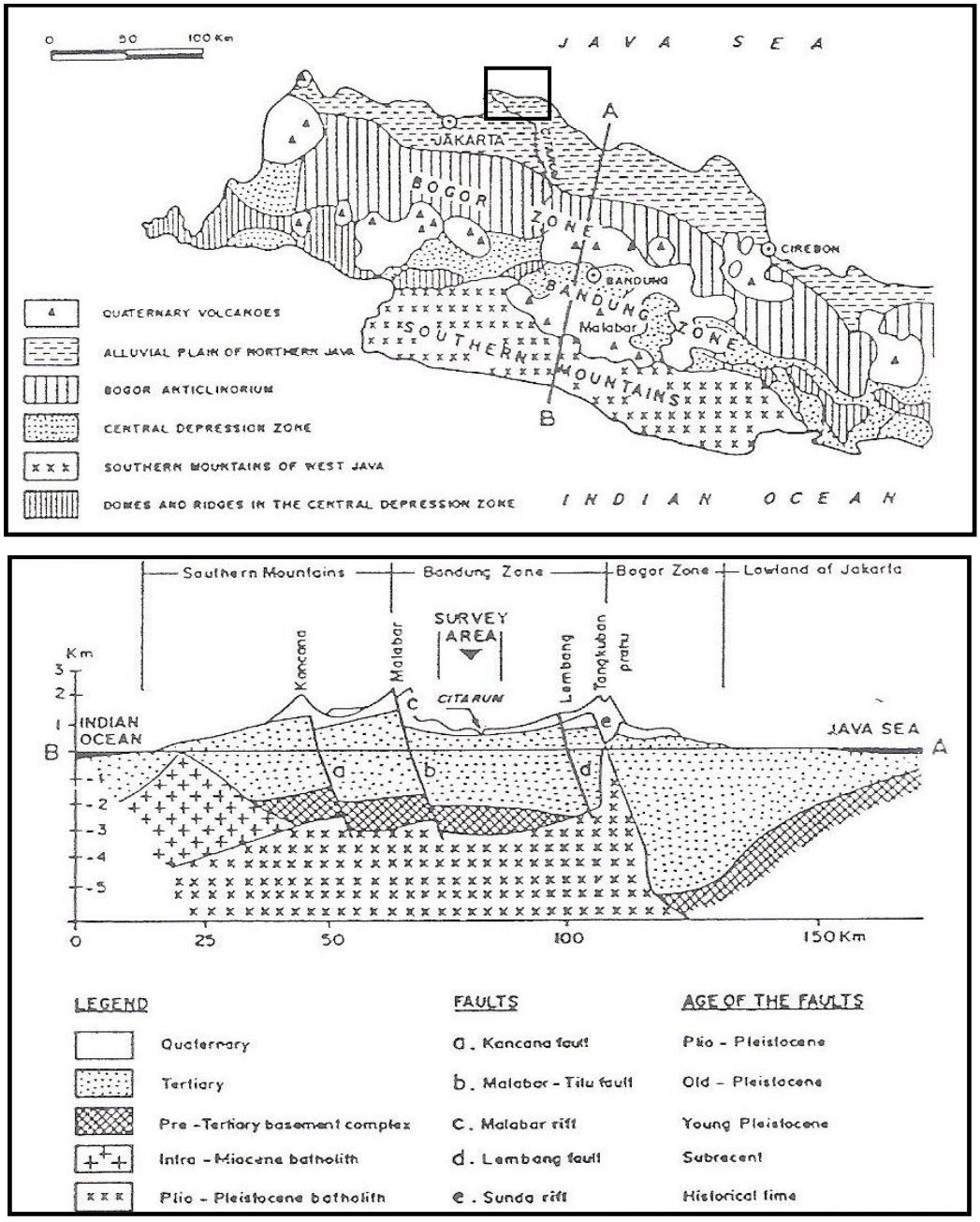

Figure 1. Physiographic of Bekasi District (Van Bemmelen, 1970)

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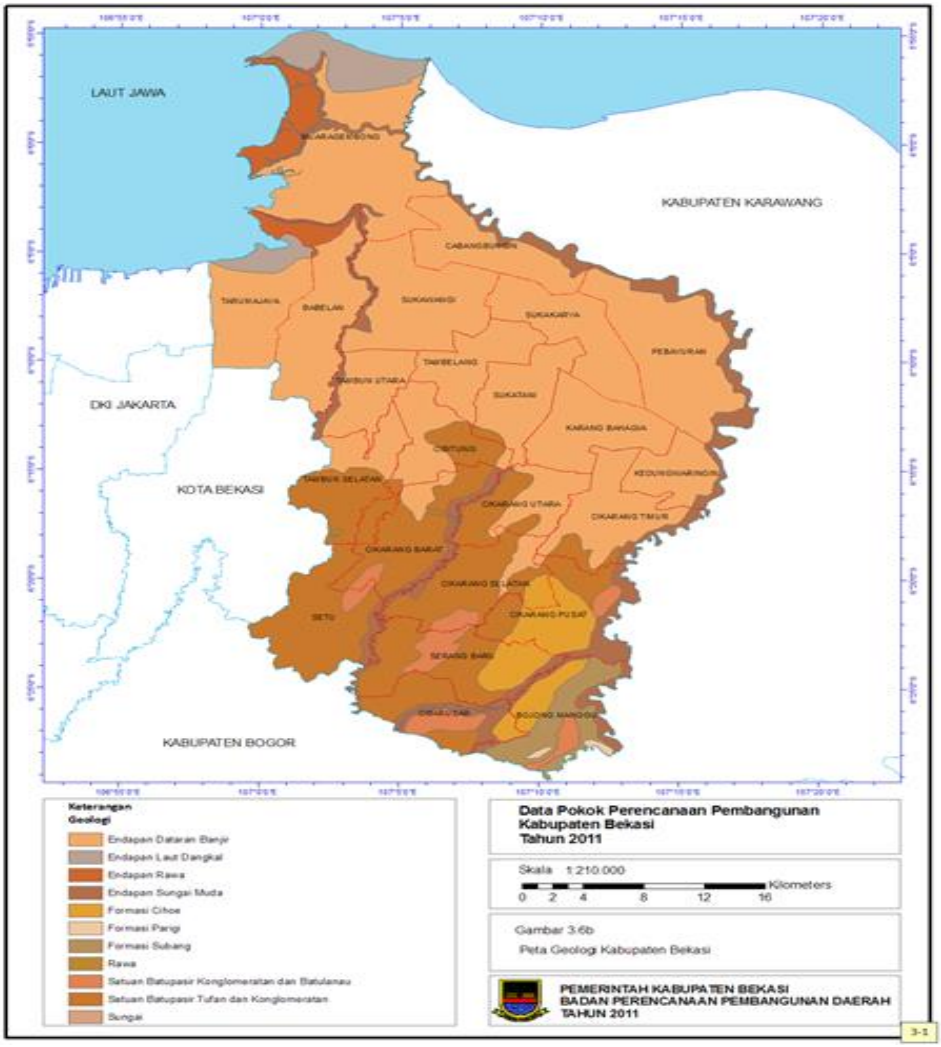

Figure 2. Geological map of Bekasi District (Source: BPBD Pemkab Bekasi 2011)

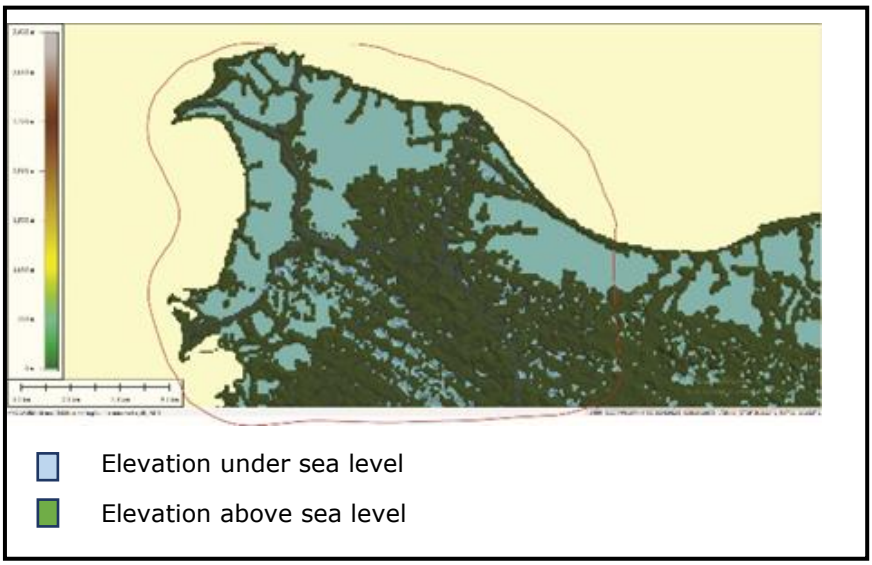

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Figure 3. Landsat imagery shows different elevation in Muara Gembong and surrounding area

Figure 4. One of embankment burst point due to heavy rain fall in 2017

There are 7 embankments burst points in the Muara Gembong area, and most of the points are found around the Citarum River meander. In this section, the river flow crashes into the river's edge with embankment before veering in the direction of the river's flow. This make the embankment experienced the greatest pressure. As a result, when the Citarum River overflows, the pressure becomes greater and the embankment cannot hold. This condition made the embankment breaks and causes flooding behind the damaged embankment area. Several broken points are shown in Figure 5.

Figure 5. Embankment burst locations in Muaragembong, Bekasi Regency

3. Sea level increase in the northern area of Muara Gembong sub-district

The northern part of Muara Gembong, is directly bordered by the Java Sea. This condition suspected reinforces the reason for flooding in Muara Gembong. Tidal wave of sea water can cause the flow of the Citarum River retained so that the water flow became slower and made the volume of water along the Citarum River downstream get higher and higher. This made the area along the river flow got flooded.

4. Increased rainfall, made the volume of water in the watershed is increased

According to BMKG, rainfall in Muara Gembong, Bekasi District tended to increase from 2011 to 2014 (Figure 7).

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The data on figure 7 shows the intensity of rainfall in Muaragembong experienced an increase from 2011 to 2014 with an average increase of 23.15% or 277.66 mm, except in 2015 relatively decreased by around 31.3%. But overall the pattern shows an increase in rainfall intensity of 9.5% or by 66.5 mm per year. This can cause the amount of water in this region to increase every year.

In addition, the basin shape of the Muaragembong area causes a lot of inundation during rain. This is supported by inundation data obtained from BMKG in 1993-2016 (Figure 8).

Figure 6. The border of Muaragembong with the Java Sea waters

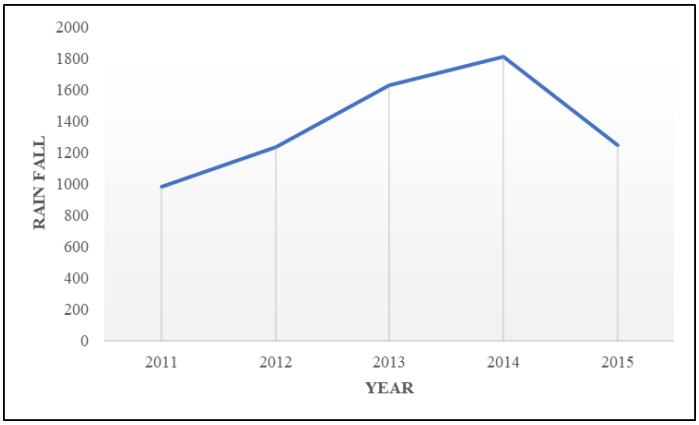

Figure 7. Graphic the intensity of rainfall in Muaragembong sub-district

Year	Inundantion area (Ha)
1993	0
2000	146
2005	326
2010	720
2016	2000

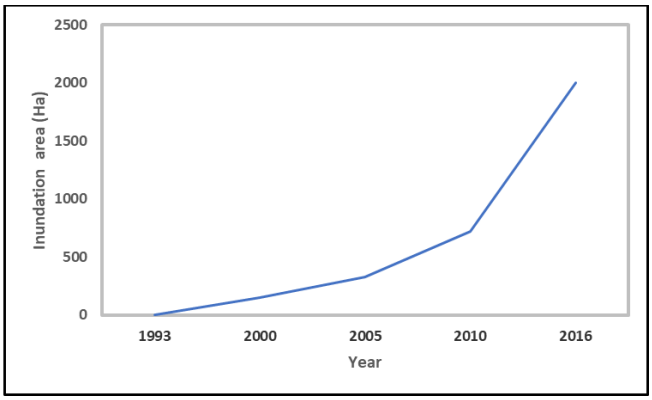

Figure 8. Inundation area in Muaragembong, Bekasi District Based on the BMKG data, the area of inundation has increased every year, with a peak in 2016.

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5. The increase of flood areas delineation.

Comparison of satellite images from 1993 to 2015 shows that the flooded areas is continues to increase (Figure 9). This is also exacerbated by the large number of settlements on the banks of the Citarum River. The relatively flat condition of the Muara Gembong sub-district in the downstream of the Citarum River also contributed to the spread of the flood. According to local residents, one of the major flood events that happened, occurred in 2015 which is marked by a broken embankment along the side of the Citarum River. The ambankment broke along 150 meters in the East and 50 meters in the southwest part of Pantai Bakti Village. Floods that occurred inundated almost all places in Harapan Jaya Village with an average height of 60-100 cm. The residents of the area generally took refuge in the village head's office. The local government has tried to regulate the flow of the water that enters the river by building water gates in the Ciherang River Basin. However, these efforts have not been able to prevent the flooding that occurred because the river in Muaragembong is getting narrower due to residential areas.

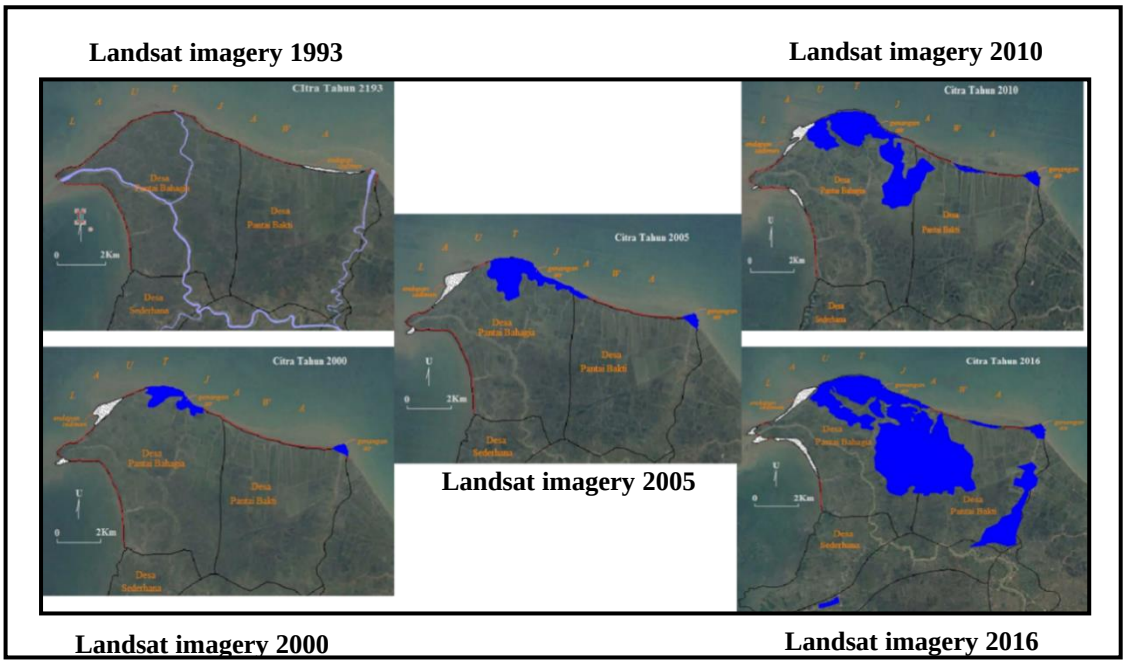

Figure 9. Delineation of flooded areas in Muaragembong from 2000 to 2016

DISCUSSION

Studio analysis and field observations show that Muaragembong and surrounding areas showed very significant changes from 1993 to 2017. Some of the changes that could be noted include:

1. Changes in land use.

Muaragembong area which has a morphological plain and immediately borders with the sea requires the presence of abrasion-retaining plants to retain water flow when sea is in high tide. Current condition shows that along with the development of the region, many abrasion-retaining trees (mangrove trees) are cut down to satisfy residential and fish or shrimp ponds need. This causes an increase in coastal abrasion which results in high tides, sea water enters and inundates on some of the Gembong Estuary.

2. Increasing number of residential areas around the Citarum Riverbanks.

The increasing number of settlements in Citarum Riverbank made the area of the river shrink significantly. When rains come with high intensity, the river cannot hold the volume of the water. This conditioan made the flood is inevitable. Since the residential area is near the river, the flood will inundate the residential area easily. Many buildings are affected by floods that cause material and non-material losses.

3. Citarum River silting up due to high levels of sedimentation.

High rainfall intensity causes a fairly high erosion level in the upstream of the Citarum river. This condition is worsened with increased deforestation and garbage disposal in the Citarum river.

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CONCLUSION

The area of flooding in Muara Gembong area is increased over the years. This condition is suspected by the change of land use at the upstream and downstream of Citarum River. Furthermore, the high intensity of rainfall and the tide effect from Java Sea also give a significant impact.

Local government has trying to prevent the flood by making an embankment along the Citarum Riverbanks. However, due to the high volume of the water, this method is not effective. Further handling needs to be done to prevent flood in the year to come. Couple things that can be done are replanting mangroves as a barrier to abrasion during high tides, reassessing land use around the banks of the Citarum River for settlement, rehabilitation of upstream Citarum river by replanting trees as water absorbers during rain, providing education to the community will be important to protect the environment by not littering and conducting training on recycling of waste to be economic.

Surely this can be done successfully if the government and the community work together to do this so that the impact of the flood can be reduced.

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