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THE DISTRIBUTION OF BUILDINGS AT VARIOUS FLOOD HAZARD LEVELS IN KEBON BARU VILLAGE, TEBET SUB-DISTRICT, SOUTH JAKARTA

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Abstrak: Banjir memiliki potensi yang dapat mengancam kehidupan manusia serta menghancurkan harta benda termasuk bangunan. Kelurahan Kebon Baru termasuk kelurahan yang seringkali mengalami banjir. Penelitian ini berfokus pada Tingkat Kerawanan Banjir di Kelurahan Kebon Baru. Metode yang digunakan adaah kuantitatif deskriptif dengan teknik analisis overlay. Parameter yang digunakan adalah ketinggian, jarak dari sungai, penggunaan lahan, dan Bangunan. Berdasarkan hasil pengolahan data Kelurahan Kebon Baru memiliki tiga tingkat kerawanan yaitu kerawanan rendah, sedang dan tinggi. Tingkat Kerawanan rendah jumlah bangunan sebanyak 4564 unit, kerawanan sedang memiliki 1060 unit bangunan dan kerawanan tinggi memiliki jumlah bangunan sebanyak 405 unit. Tingkat kerawanan banjir yang terdapat di Kelurahan Kebon Baru lebih banyak di pengaruhi oleh ketinggian dan jarak dari Ci Liwung. Semakin rendah ketinggian dan semakin dekat dengan Ci Liwung maka semakin tinggi tingkat kerawanan, sebaliknya semakin tinggi ketinggiannya dan semakin jauh jaraknya maka semakin rendah tingkat kerawanannya
Kata kunci: Persebaran Bangunan, Tingkat Kerawanan Banjir, Kelurahan Kebon Baru

Abstract : Floods have the potential to threaten human life and destroy property including buildings. Kebon Baru Village is one of the villages that often experiences floods. This research focuses on the Level of Flood Hazard in Kebon Baru Village. The method used is descriptive quantitative with overlay analysis techniques. The parameters used are altitude, distance from the river, land use, and buildings. Based on the results, Kebon Baru Village has three levels of flood hazard, namely low, moderate and high. Low level has 4564 buildings, moderate level has 1060 building and high level has 405 buildings. The level of flood hazard found in Kebon Baru Village is more influenced by the height and distance from Ci Liwung. The lower altitude and the closer to Ci Liwung, the higher of flood hazard level, on the contrary, the higher altitude and the farther distance, the lower flood hazard level.
Keywords : Buildings Distribution, Flood Hazard Level, Kebon Baru Village

A. INTRODUCTION

The inundation of land that was initially dry as a result of an increase in the volume of water caused by heavy rains, bursting of dams, or rising sea levels is called a flood. (Humam et al., 2021). inundation found in areas with lowlands that are usually not inundated is also called flooding (Putro et al., 2020). According to Pratama et al., (2020) flooding is a natural phenomenon that occurs in areas where there is a river flow, then the water discharge exceeds the capacity of the river so that it overflows into the surrounding area which can be residential or city center. Floods are said to be disasters if they have the potential to damage and harm human life. Flooding is one of the unique

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natural disasters. This is because the intensity of flooding is greater than other disasters (Wisnawa et al., 2021). In addition to unique, floods are also included in dangerous natural disasters, because of their destructive nature. (Perdana et al, 2019).

Floods have contributing factors in the process of occurrence. Factors that contribute to the flood process are high rainfall, land degradation, and continuous development (Lassa et al., 2022). According to Berndttson et al,. (2019) in (Mobini et al., 2021) the high flow of urbanization and population growth participate in reducing the rate of infiltration resulting in flooding. In addition to land changes, urbanization flows and changes in land use, extreme weather conditions with frequent and heavy rain intensity also have the potential to cause floods (Shrestha et al., 2021)

Floods can occur almost all over the world, both developed and developing countries, urban and rural areas. Certain places even become locations for annual flood routines (Wisnawa et al., 2021). According to Mobini et al., (2021) floods that occur in urban areas are increasing so that they become the focus of studies because the damage caused is considered quite large. Over the past few decades, economic losses caused by floods have increased in various countries (Shrestha et al., 2021).

Floods rank first as the most frequent disasters in Indonesia. Based on BNPB data in 2022, there were 1,531 floods spread across several regions of Indonesia, one of which was DKI Jakarta. In recent decades, the intensity of flooding and the scale of adverse impacts caused by floods in Jakarta have increased.

Based on the results of the recapitulation of flood event data released by the DKI Jakarta Provincial Government for the last ten years, it was recorded that Jakarta experienced floods in 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021 and 2022. According to Lassa et al., (2022) floods that occurred in 2013, 2018, 2019 and 2020 were included in the major floods that hit DKI Jakarta.

DKI Jakarta is included in the area located in the lowlands (Yusya et al., 2020). As a result of its unique topography, the DKI Jakarta area is passed by 13 rivers, one of which is Ci Liwung (Koto et al., 2018). Ci Liwung is one of the barriers between two municipalities, namely, East Jakarta City and South Jakarta City. Ci Liwung is included in rivers that often overflow, causing floods (Billa et al., 2022). One of the areas hit by flooding as a result of the overflow of Ci Liwung is Kebon Baru Village. Kebon Baru Village often experiences floods originating from Bogor City shipments. Kebon Baru

Village began to experience floods in 1996, then Kebon Baru Village also experienced floods in 2002, 2007, 2012, 2013, 2014, 2019, 2020 and 2021. Based on data obtained from Kebon Baru Village from 14 RW, as many as 6 RW often experience floods caused by the overflow of Ci Liwung, they are RW 01, RW 02, RW 04, RW 08, RW 09, and RW 10 which are directly adjacent to Ci Liwung.

For social and economic life, floods have a very visible impact on humans, such as physical damage, shelter, and infrastructure (Kumar D et al.,2020). Knowledge of flood hazard has an important role to adjust strategies that can be used to minimize damage caused by floods and can reduce the loss of human life (Perdana et al, 2019).

Flood hazard maps is made through a multiparametric approach that has been analyzed so that it can be used to inform the classification of flood hazard levels. The results of this analysis are expected to be useful in planning and decision-making on flood problems both, now and in the future (Wisnawa et al., 2021)

B. METHOD

This research will focus on the distribution of buildings at various flood hazard levels, that found in Kebon Baru Village, Tebet District, South Jakarta. Kebon Baru is astronomically located at coordinates 6°14'20.63"S – 6°14'18.82"S and 106°51'30.46"E – 106°51'31.51"E. Kebon Baru Village has an area of 123.29 Ha, which is divided into 14 RW neighborhoods and 153 RT neighborhoods.

Kebon Baru Village was bordered by Bukit Duri Village in northern. In the South it is bordered by Cawang Cikoko Village, the West region is bordered by Tebet Timur Village and in the East Region it is bordered by Bidara Cina Village and Ci Liwung River.

The unit analysis in this research was the number of buildings at each Flood Hazard Levels. Determination of the level of flood hazard in this study using the parameters of Altitude, Distance from River, Land Use and Buildings. According to Kumar et al., (2020) the height of an area (altitude) and distance from rivers are some indicators that can be used as parameters to analyze flood disasters. The method in this study uses descriptive quantitative which is then analyzed by overlay scoring weighting techniques using Geographic Information System Applications. The geographic information system has ability to process and analyze data spatially.

The data collection process is carried out in two ways, namely through primary data derived from field observation activities or Ground Check, then secondary data derived from the websites of related data provider agencies, namely the Jakartasatu.go.id

website and also Lidar. The secondary data contains shapefiles of Village Administration, Rivers and Buildings. In this study, the population as well as the sample is the number of buildings in Kebon Baru Village, which is 6119 buildings.

The determination level of flood hazard was obtained through the results of a weighting scoring analysis using two parameters, namely the Regional Height with a weight of 0.70 and the Distance From the River with a weight of 0.30. The use of this parameter is the result of the modification of researchers adjusted to the results of field observations. The parameters are entered into a formula as follows:

FHL = (0.70 x AHS) + (0.30 x DFR)….(1)

Information :

FHL : Flood Hazard Level

AHS : Area Height Score

DR : Distance from River

The results of these calculations determine the level of flood hazard, namely low, moderate, and high levels. Then, after the flood hazard level data was generated, an intersect process will be carried out between the flood hazard level data and building data with the aim of obtaining the number of buildings at each hazard level.

C. RESULT AND DISCUSSION

C.1. RESULT

a. Height Area/Altitude

Altitude data is obtained from the results of processing Lidar data with a resolution of 2 meters. The results of the processing lidar data can be seen at Table 1 Altitude of Kebon Baru village. Based on the results of processing the lidar data contained in table 1, it was found that the Kebon Baru sub-district has an area with an altitude below 13 meters above sea level to a height above 21 meters above sea level.

Table 1. Altitude of Kebon Baru Village

Altitude (Meter Above Sea Level)	Wide	Score	Weight	Classification
< 13	8.4	30	0,7	High
13 – 14	16.62	20	0,7	Moderate
14 – 15	15.82	10	0,7	Low
15 – 16	22.07	10	0,7	Low
16 – 17	15.01	10	0,7	Low
17 – 19	13.54	10	0,7	Low
19 – 20	13.92	10	0,7	Low
20 – 21	12.38	10	0,7	Low
> 21	5.53	10	0,7	Low

Source: Data Processing

The area that has a height below 13 meters above sea level is the lowest area in the village, this area is located along the Ci Liwung River, namely in RW 01, RW 02, RW 04, RW 08, RW 09, and RW 10. with a height of below 13 meters above sea level, it has an area of 8.4 hectares, and is classified as an area that has a high hazard level to flooding.

Furthermore, areas with a height of 13-14 meters above sea level are included in the classification of moderate flood hazard level. This area is also located in 6 RWs on the edge of the Ci Liwung River, namely RW 01, RW 02, RW 04, RW 08, RW 09 and RW 10. The area of this area reaches 16.62 hectares. Then, areas with an altitude of 14 meters above sea level are included as areas with a low level of flood hazard. The altitude in this area includes 14 - 15 meters above sea level, 15 - 16 meters above sea level, 16 -17 meters above sea level, 17 - 19 meters above sea level, 19 -20 meters above sea level, 20 - 21 meters above sea level and above 21 meters above sea level. sea level, the total area of all these elevations is 98.27 hectares.

Altitude below 13 meters above sea level are given a score of 30. This happens because this altitude was the lowest altitude in Kebon Baru Village. Then, altitudes that are at 13-14 meters above sea level have a score of 20 and altitude above 14 meters above sea level have a score of 10.

b. Distance from the river

The next step is the processing of river data to get the results of the distance from the river. The technique used in this section is to use buffering. Buffering is one of the functions to produce data with a certain distance (Darfia, et al., 2019). According to Liu (2018) in (Ardiansyah et al, 2020) the use of this buffering technique can be used to analyze flood disasters that occur in urban areas.

Table 2. Interval Distance from River at Kebon Baru Village

Interval distance from river (Ci Liwung)	Number of RW	Score	Weight	Classification
0 – 25 meters	8 RW	30	0,3	High
25– 100 meters	8 RW	20	0,3	Moderate
> 100 meters	14 RW	10	0,3	Low

Source: Data Processing

The buffering used in this study was to use a distance range of 25 meters, 50 meters, 100 meters, and above 100 meters. Areas that have a distance from the river with an interval of 0 – 25 meters have a score of 30 or high classification. Then in the range of 25-100 meters has a moderate classification with a score of 20 and at distances above 100 meters has a low classification with a score of 10. The

result of processing buffering technique can be seen at Table 2. Interval distance from Ci Liwung Rivers at Kebon Baru Village.

Based on table 2, the distance interval from the river, there are 8 RW's which have a distance of 0-25 meters from the Ci Liwung River. The RW areas included in this distance had a high level of flood hazard. Then at a distance of 25-100 meters there are also 8 RW's, so it is included in the area of moderate flood hazard level. Furthermore, at a distance of 100-500 meters from the river it can be found in all RW areas they are, The areas located at this distance are included in a low level of flood hazard.

c. The Flood Hazard Level and Distribution of Buildings

The Flood Hazard Map is obtained through an overlay process between height data and distance from the river. Map of The Flood Hazard levels can be seen at figure 1, with the distribution of building ta various levels.

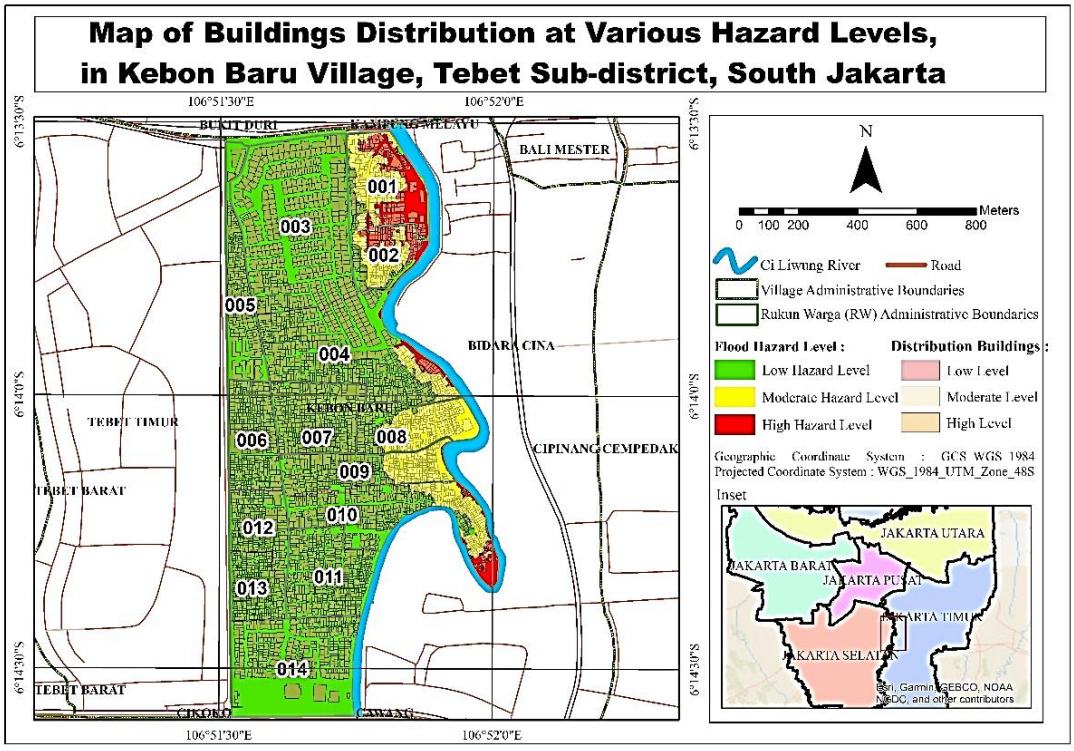

Figure 1. Map of Buildings Distribution at Various Hazard Level, in Kebon Baru Village

Based on the results of parameter processing, it was found that Kebon Baru Village has different levels of flood hazard. The flood hazard levels that can be found in Kebon Baru Village is divided into three levels, low, moderate, and high level. Based in Figure 1 the low level of flood hazard was marked with green colour. This level has an area of 102.74 hectares and can be found in all

RW areas at Kebon Baru Village, so this level has the widest area of all levels. The altitude of this level was in the range of 14-21 meters above sea level with 100 meters – 500 meters from Ci Liwung River. The low flood hazard level has a total of 4654 buildings.

The level of moderate flood hazard can be found in RW 01, RW 02, RW 04, RW 08, RW 09 and RW 10. The moderate level has an area of 14.92 hectares. This level has an area altitude in the range of 13-14 meters above sea level with 50-100 meters from Ci Liwung River. The moderate flood hazard level has 1060 buildings scattered in its area.

The high flood hazard levels can only be found in RW 01, RW 02, RW 04, and RW 10. The high level of hazard has an area of 5.63 hectares. This level has a lowest altitude, namely below 13 meters above sea level and can be found especially at the location adjacent to Ci Liwung Rivers. Then the distance of this level was 25-50 meters from Ci Liwung Rivers. The number of buildings at this level is 405 buildings.

C.2. DISCUSSION

Based on the results of the analysis, Kebon Baru Village have three hazard levels. The highest level can be found in areas with low altitudes directly adjacent to the Ci Liwung River.

Altitude is a parameter that has an influence on the flood hazard level (Kumar et al., 2020). Areas that have low altitudes will have higher flood heights and tend to experience frequent floods (Humam et al., 2021). Both statements are in accordance with the result found in this research.

RW 01, RW 02, RW 04, and RW 10 have the lowest altitudes, namely below 13 meters above sea level, when there is a large amount of water delivered from upstream areas (due to heavy rains) and when it starts to enter the rainy season, these areas can easily experience flooding. However, of the four RWs, RW 10 is the area that experiences flooding the most. Even when a major flood occurs, RW 10 is the area that has the highest flood point. This happens because apart from being in the lowlands and directly adjacent to the Ciliwung river, this area is one of the areas where river embankments have not yet been found.

Furthermore, besides based on the results of data processing, Ground Checking activities are also carried out as a step to validate the suitability between the processed data and the conditions in the field.

Based on the results of the Ground Check on each hazard level area, there is evidence of flood height at each level. Low levels were recorded to have flood heights in the range of 0-75 cm. Then the moderate level recorded to have a flood height between 75 – 150 cm and High level was recorded to have experienced

flood heights above 150 centimeters. The results of the ground checking activities are in line with the research conducted by Perdana et al., (2019), which in his research divided the classification of the level of flood hazard into three classes based on the height of the flood, they are low class with a flood height of below 75 cm, moderate class with a flood height of 75 - 150 cm, and high class with a flood height above 150 cm.

Figure 2. Results of Building Ground Check Activities at Various Levels of Flood Hazard

The flood height found at each level is obtained through former evidence of flood height marked with writing and lines of destruction found on buildings at each level. The evidence is then clarified again by providing a red line. The results of the Ground Check activity can be seen in Figure 2 Results of Building Ground Check Activities at Various Levels of Flood Hazard.

In Figure 2 the building on the left is a residential building that also functions as a grocery store were located in RW 01 Kebon Baru Village, and included in area with high level of flood hazard. Then the building in the middle (Figure 2) is residential house located in RW 04. The building is included in the level of moderate hazard. There is evidence of damage to houses that are straight broken due to damage caused by flooding. On the right of Figure 2 is a residential building located at a Low Hazard Level. The building was found in RW 04 where evidence of flood height is marked by straight damage to the bottom of the building.

The buildings in Kebon Baru Village are dominated by residential areas or buildings for residential houses. Based on land use data of Kebon Baru Village, the area allocated for residential areas is 98,597 hectares, the data is then carried out Ground Checking again and it is proven that the buildings that dominate at each level of hazard are more widely used for residential homes.

D. CONCLUSION

Kebon Baru Village has three levels of flood hazard, they are low level, moderate level, and high level. High and moderate flood levels can only be found

in RW 01, RW 02, RW 04, RW 08, RW 09, and RW 10 which are areas with low altitudes and are close to Ci Liwung.

The parameters of height and distance from the river have a role in determining the level of flood hazard. The closer the location and the lower the level of the area, the higher of flood hazard level. The lower the altitude and the distance close to Ci Liwung, the higher of flood hazard level.

Then the building that dominates at each level is a resident's house or residential house. This is reinforced by land use data found in Kebon Baru Village is a residential area. The land use of Kebon Baru Village used for housing is 98,597 hectares.

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