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Analysis of Flood Vulnerability Levels Using Overlay Method with System-Based Scoring Geographical Information (Case Study: District Tangerang)

Itah Safitri, Yayat Ruhiat, Asep Saefullah*
Universitas Sultan Ageng Tirtayasa

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Corresponding author:
asaefullah@untirta.ac.id

ABSTRACT

This research aims to determine the factors of flood disasters in Tangerang district, which consist of land height, slope, soil type, land use, river density, and rainfall, and to find out the results of flood mapping in Tangerang district. The research method used is the overlay method with scoring. This research uses secondary data consisting of rainfall data for the period 2022-2020, shp Admin data from Tangerang district, watershed data throughout Indonesia, OSM data throughout Indonesia, slope data throughout Indonesia, DEM data throughout Indonesia, DSMW data throughout Indonesia, 2017 landcover data. Data were processed using Microsoft Excel software, Arc GIS 10.8, and QGIS 3.26.0. Based on the results obtained, the flood disaster factors in Tangerang district that are very dominant in influencing the occurrence of floods in Tangerang district are soil type and slope. Meanwhile, the results of flood mapping in Tangerang district are categorized into three classes: not vulnerable, moderately vulnerable, and fragile. Four sub-districts in Tangerang Regency are not prone to flood disasters, including Panongan, Legok, Cisauk, and Pagedangan sub-districts. Meanwhile, the Tangerang district, which is categorized as quite vulnerable, consists of 9 sub-districts, namely the sub-districts of Kelapa Dua, Curug, Cikupa, Tigaraksa, Jambe, Solear, Jayanti, Cisoka, Balaraja. Meanwhile, there are 16 sub-districts in Tangerang Regency which are categorized as very vulnerable, namely Pasar Kemis, Sindang Jaya, Kresek, Gunung Kaler, Sukamulya, Sepatan, Sepatan Timur, Rajeg, Kemiri, Kronjo, Mekar Baru, Mauk, Sukadiri, Pakuhaji, Teluk Naga, Kosambi districts.

Keywords: Flood, overlay method, Scoring, Tangerang Regency.

1. INTRODUCTION

Indonesia is a country archipelago located between the continents of Asia and the Australian continent and the Indian Ocean and the Pacific Ocean [1]. Indonesia is located in a cross position, so it is related to climatic conditions. Indonesia is a country that has a tropical climate [2]. Tropical climates have two seasons, namely monsoons rainy and dry seasons, which occur in one year alternately [3]. Season Rain often occurs in Indonesia, resulting in several areas of opportunity affected by hydrometeorological disasters such as floods [4].

Flooding is a condition where an area of land is submerged by water because of increased water volume [5]. Based on data reported by National Board for Disaster Management (BNPB), Nature dominates one of them. Flood disasters were recorded 688 times throughout in 2022 [6]. A flood disaster is a natural event that is difficult to predict because it comes suddenly with periodicity (recurring periodically) erratic, except for areas that have already become regular occurrences of annual floods in the rainy season [4]. Several factors, including rainfall height, slope, land height, soil type, land use, and density of rivers, can cause flood disasters [7].

Banten province is one of 34 provinces in Indonesia recorded as frequently affected by flood disasters yearly [8]. Banten province has eight districts/cities consisting of Serang City and Tangerang City. Cilegon, Lebak Regency, Serang Regency, Tangerang Regency. One of the districts affected by flood disasters every year is Tangerang Regency [9].

Tangerang Regency is a district between 106° 20 – 106° 43 east longitude and 6° 00 – 6° 20 south latitude [10]. To the north, it borders the sea Java and the eastern border with DKI Jakarta province and Tangerang city. To the south, it connects the district Bogor and the city of South Tangerang, and next door, The west borders Serang Regency and Swamp [11]. The Tangerang district consists of 29 and 28 sub-districts and 246 villages. Tangerang Regency is a district affected almost every year by flood disasters. Tangerang Regency each has quite a high rainfall year with an average rainfall of 100 mm per year. Based on bulk secondary data, The average annual rainfall is 1996 mm, with the monthly maximum occurring in February 556 mm with a total of 23 rainy days [12]. Apart from the district rainfall factor, Tangerang is a district located in the lowlands, so the slope factor. The slope and height of the land also trigger flood disasters in the community of Tangerang [13].

One way that needs to be done to know areas prone to flooding is by doing some data processing to determine the level of vulnerability sites, especially the Tangerang district, using two applications, namely the Arc GIS application 10.8 and QGIS 3.26.0 applications for managing secondary data so that you can find out factors that influence flood disasters in Tangerang district and find out the results mapping areas prone to disasters flooding, especially in district areas Tangerang [14].

Arc GIS 10.8 is an application that can be used to process data for mapping vulnerable areas of flood disasters that the community can exploit as a means of related information on flood vulnerability in a room [15]. Based on the problems described above, the author will conduct research entitled "Analysis of flood vulnerability levels using the overlay method with scoring geographic information system-based (case study: Tangerang district)." This research aims to determine the factors of flood disasters in Tangerang district, which consist of land height, slope, soil type, land use, river density, and rainfall, and to find out the results of flood mapping in Tangerang district.

2. METHOD

This research was conducted in Tangerang district in November–June 2022. Rainfall data is collected at the station meteorology class III Budiarto waterfall and di Pondok Betung South Tangerang Climatology Station, Banten [16].

Data used in this research is secondary data obtained in the form of Rainfall data from the Curug area, region Balaraja and Cisoka regions, SHP boundaries district administration throughout Indonesia, Shapefile (shp) boundaries sub-district administration throughout Indonesia, shp DEM throughout Indonesia, shp slope throughout Indonesia, shp OSM throughout Indonesia, shp DAS throughout Indonesia, shapefile digital soil map of the world, shapefile land cover Indonesia 2017 [17].

Data processing uses Arc GIS 10.8, QGIS software 3.26.0, and Microsoft Excel. The data analysis process includes:

a. Attribute analysis the process is divided into two parts: scoring with weighting.
b. Flood vulnerability analysis the equation used is

$$K = \sum_{i=0}^{n} \left(W_i x X_i \right)$$

Information:

K = Vulnerability Value

W_i = weight of the ith parameter

X_i = Class Score for Parameters

n = Lots of Data

3. RESULT AND DISCUSSION

Flood Factors in Tangerang Regency

Land Height

Based on Figure 1 Classification results, the height of the land is divided into 3, including the classification of district areas Tangerang with a land height of fewer than 10 meters above the given sea level blue symbol, and district area Tangerang which has a height of between 10 – 50 meters above sea level is given a symbol yellow as well as the Tangerang district area which has a height of between 50-100 meters above sea level is assigned a color symbol red. Tangerang district area, having a height of less than 10 meters, is the area of Tangerang Regency, which is located in The northern part, consisting of 12 sub-districts.

The Tangerang district area, which has a height between 10 – 50 meters above sea level, consists of 14 sub-districts. Tangerang district area, having an altitude between 50 – 100 M, is the northern part of Tangerang Regency and consists of 3 sub-districts. Meanwhile, the district area

Tangerang, which consists of 12 sub-districts, has a height of less than 10 meters, the potential for flood disasters to occur due to the increasingly low elevation of land in an area increasingly vulnerable to flood disasters. The height of land influences the occurrence of flood disasters due to the nature of flowing water following the force of gravity, that is, flowing from highlands to lowlands, so the higher the land in an area, lower, the more vulnerable the site will be flood disaster while the area is located at high land altitudes it will very safe against flood disasters [18].

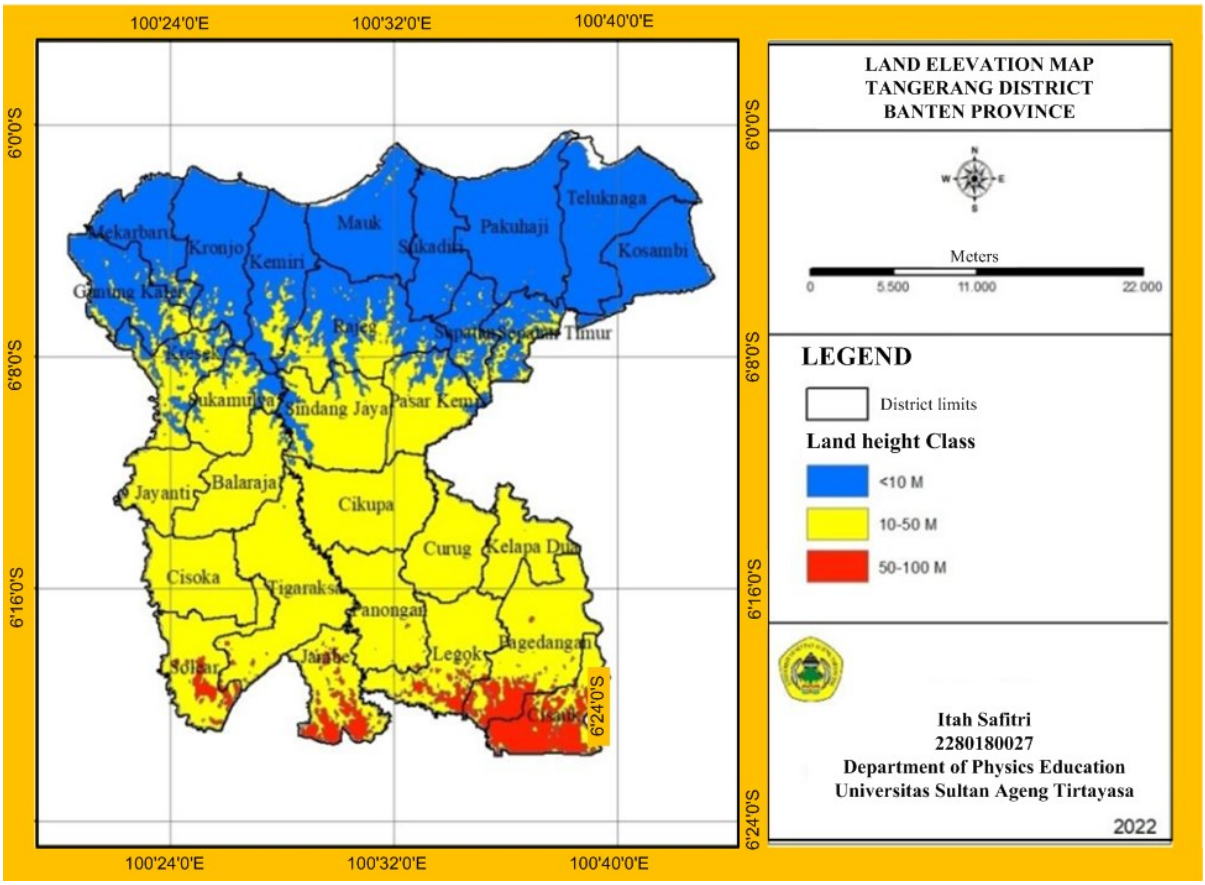

Figure 1. Land Height Classification Results Tangerang Regency

Slope

Based on Figure 2, classification results show the slope of the district area. Tangerang indicates that the district area of Tangerang is divided into five classifications. The classification consists of district areas Tangerang with a slope of 0% -8%, which is marked with red, and regional symbols Tangerang district with a hill of 8%-15%, which is symbolized in light green and Tangerang district with Slope slopes of 15% -25% are given a color symbol yellow, Tangerang district with pitch 25% - 45% is given a symbol orange, as the Tangerang district area with a gradient of more than 45% is given a dark green symbol.

Tangerang district area, with Slope slope of 0% -8%, is located to the north, consisting of 9 subdistricts. Meanwhile, the district area Tangerang, with a gradient of 15% -25%, consists of 3 sub-districts. Regency area Tangerang, with a slope of 25% -45%, consists of 7 sub-districts. Regency area Tangerang, with a more than 45% gradient, consists of 6 sub-districts.

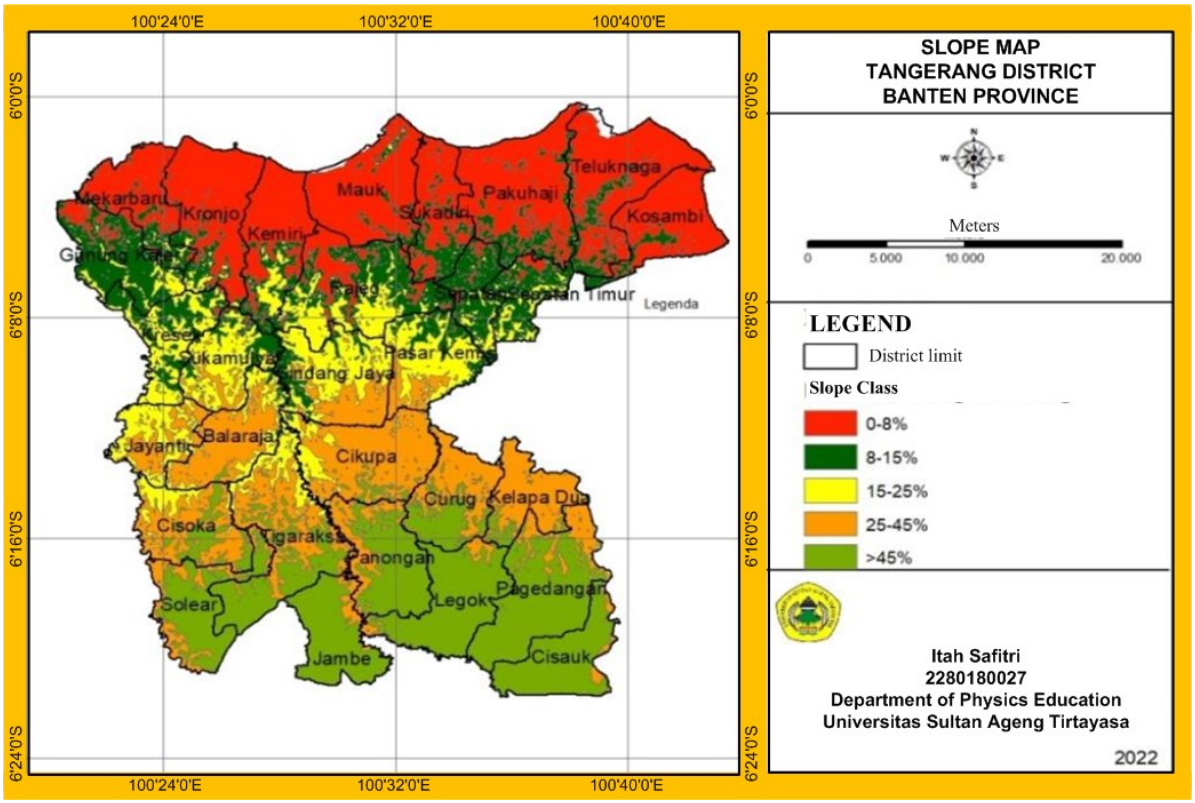

Figure 2. Slope Classification Results Tangerang Regency

Type of soil

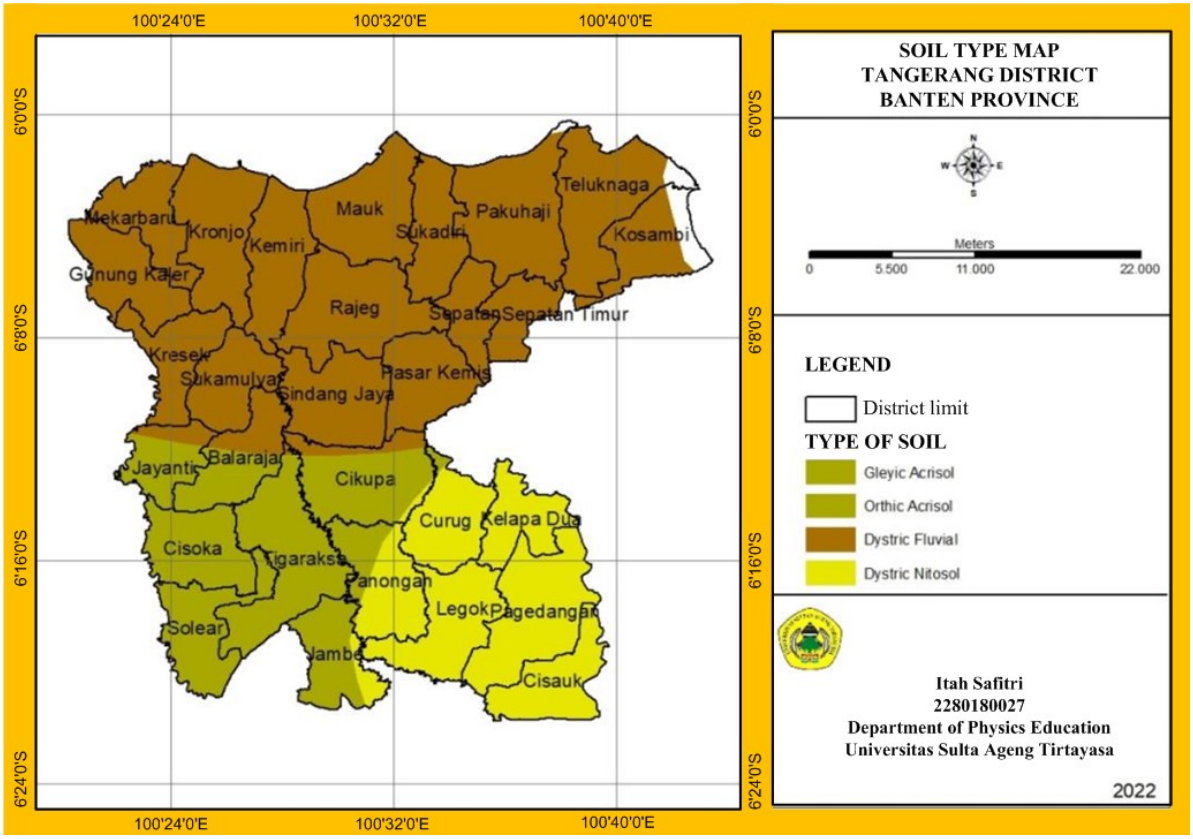

Figure 3. Soil Type Classification Results Tangerang Regency

Based on Figure 3 Classification results, Soil types in Tangerang Regency are divided into three types: 1. Jd land (fluvial district) or land commonly known as alluvial soil with the color symbol brown, 2. Ao soil (orthic acrisols), which is colored olive green, and soil Ag (gleyic acrisols), which is commonly known as acrisol soil, is given the symbol olive green, and Nd ground (dystric nitosol) is granted the color symbol citron yellow, widely known as soil nitosol [19].

Based on sensitivity level classification Types of soil in Tangerang Regency, Alluvial soil is included as a type of soil not sensitive or interpreted as very difficult to absorb water. Kind of soil This alluvial is spread across 16 sub-districts. Meanwhile, the Acrisol soil type is sensitive or quickly absorbs moisture. Acrisol land is spread across seven sub-districts.

The next type of soil is soil type nitosol. This type of soil is very sensitive or very quickly absorbs water. This type of nitosol soil is spread over six subdistricts. The soil type is a factor that can influence the surface, namely the soil's ability to absorb water quickly into the ground [20]. Suppose the land's level of sensitivity is low or not sensitive. In that case, This area is prone to flood disasters because if the soil is not liable to infiltration, then the site will be slow to absorb water and unable to reduce the amount of water discharge, thus causing an area to be vulnerable to flood disasters [21].

Land Use

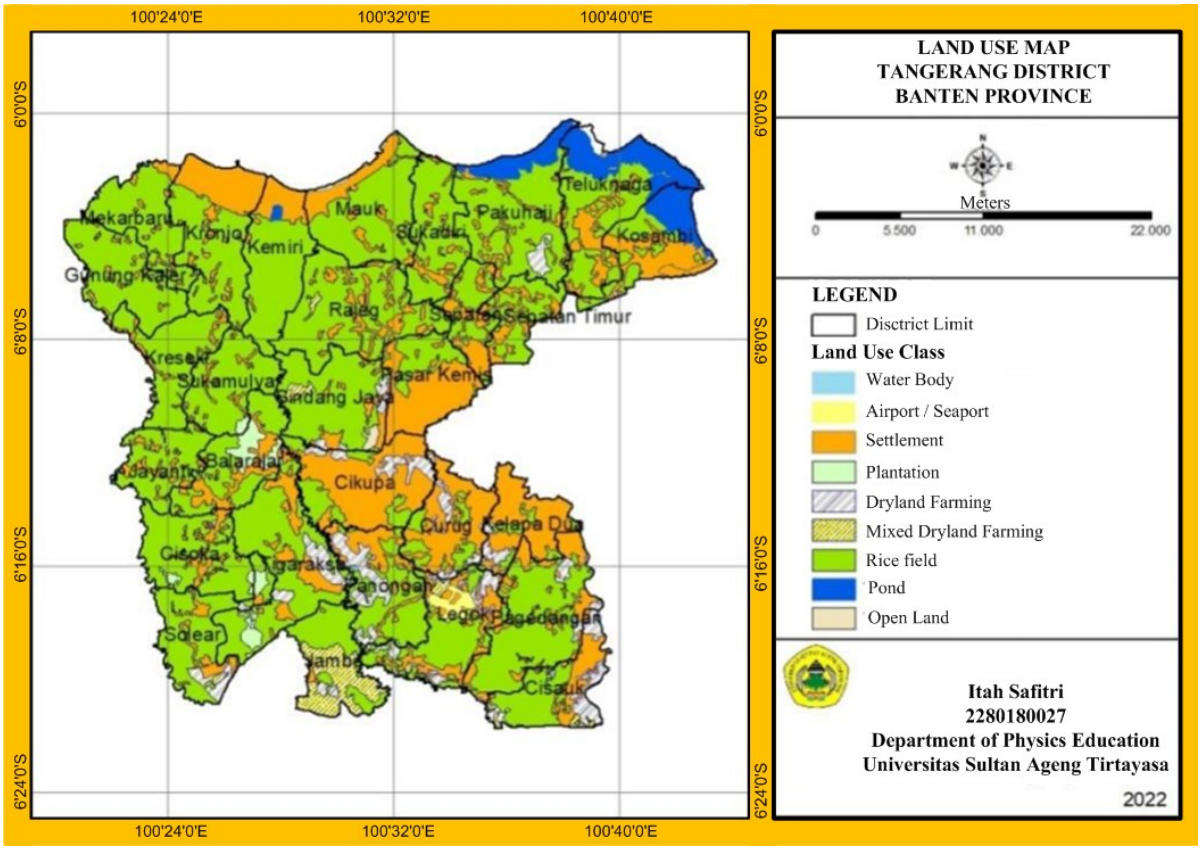

Figure 4. Land Use Classification Results Tangerang Regency

Based on Figure 4, Classification results Tangerang district land use dominated by rice fields. District area Tangerang is dominated by rice fields with few settlements are sub-districts Bloombaru, kronjo, kemiri, mauk, sukadiri, pakuhaji, kresek, sukamulya, sindangjaya, jayanti, cisoka, solear, tigaraksa, pagedangan, cisauk, legok, sepatan East, Sepatan. Tangerang district area dominated by residential areas Kosambi sub-district, Kemis market, sub-district Cikupa, Curug, Kelapa Dua. District area Tangerang, which has a pond, is Paki hajj, naga bay, kosambi and kemiri.

There is also the Tangerang district area. The airport is in the Legok district. Tangerang district, which has the plantation, is in Balaraja District, Tigaraksa, and Cisoka. Agricultural land area dry spread in Cisauk sub-district, sub-district pagedangan, Kelapa dua subdistrict, subdistrict Legok, Curug sub-district, Jambe sub-district, Panongan subdistrict, Cikupa subdistrict Sindang Jaya sub-district, Tigaraksa sub-district, solear subdistrict.

Tangerang district area has a dry land agricultural area mixed with the Legok sub-district, sub-district, Jambe, Tigaraksa sub-district, Balaraja sub-district, Solear sub-district, and Cisoka sub-district. Land use can influence vulnerability to flood disasters in an area because it plays a role in the amount of runoff that results from rain that has exceeded the infiltration rate [22].

River Density

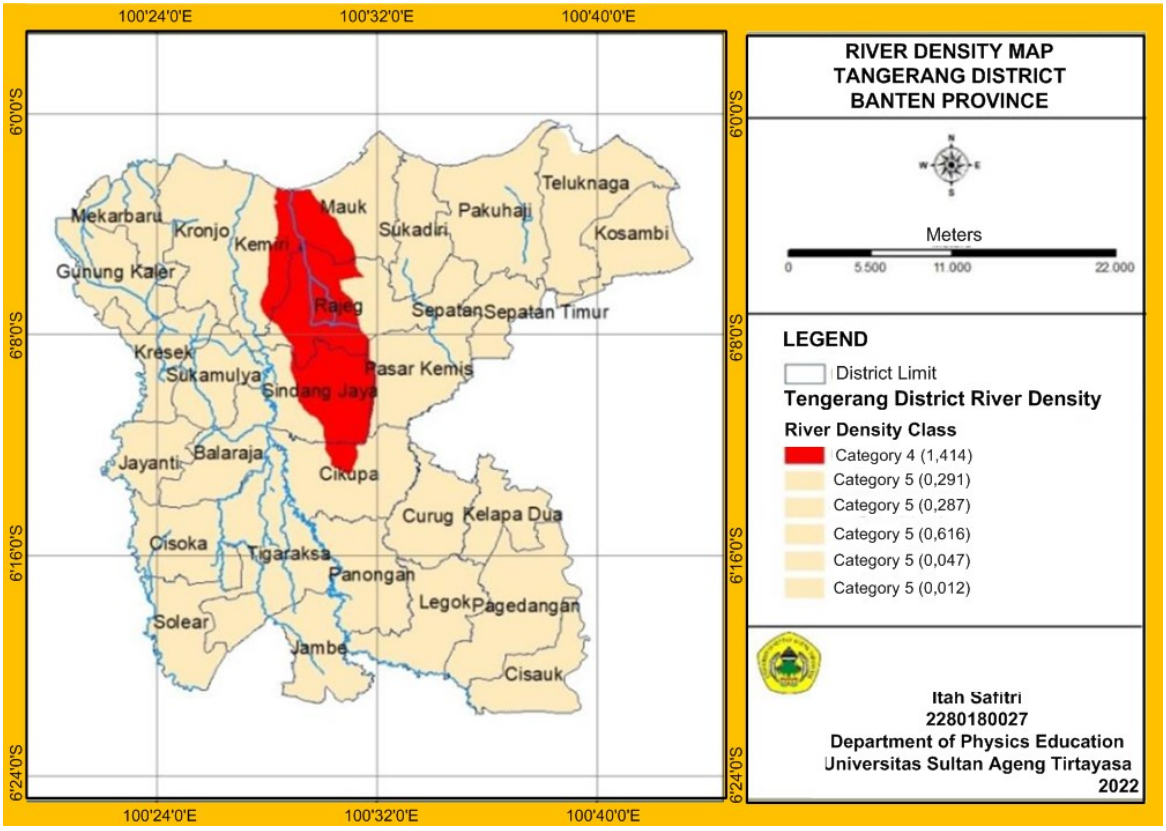

Figure 5. River Density Classification Results Tangerang Regency

Based on Figure 5. Classification results, river density in the Tangerang district shows that the thickness of regional rivers in the Tangerang district is divided into two classifications. Where is the classification for regions? Tangerang district is given two color symbols: red and beige. The red symbol is designated for river density in category 4. Meanwhile, the red sign is set for River density in Category 5.

River watersheds with category 5, with a density of less than 0.62, are areas not potentially affected by flood disasters due to dense areas. Rivers less than 1 mile are watershed areas. Rivers are always dry. Meanwhile, river basin areas are categorized as 4 with a density of (0.62-1.44) areas prone to disasters and floods [23].

Rainfall

Based on Figure 6 Classification results rainfall in the Tangerang district area, Tangerang district is an area with moderate rainfall of 2500 mm/ year. Using the IDW method and the reclassification process using data rainfall obtained from 2 rainfall stations, Rain is the Budiarto Curug meteorological station and Pondok Betung climatology station and one post rainfall with Cisoka coordinates. Based on rainfall Parameters, Tangerang district is one of the districts that is quite prone to flooding [24].

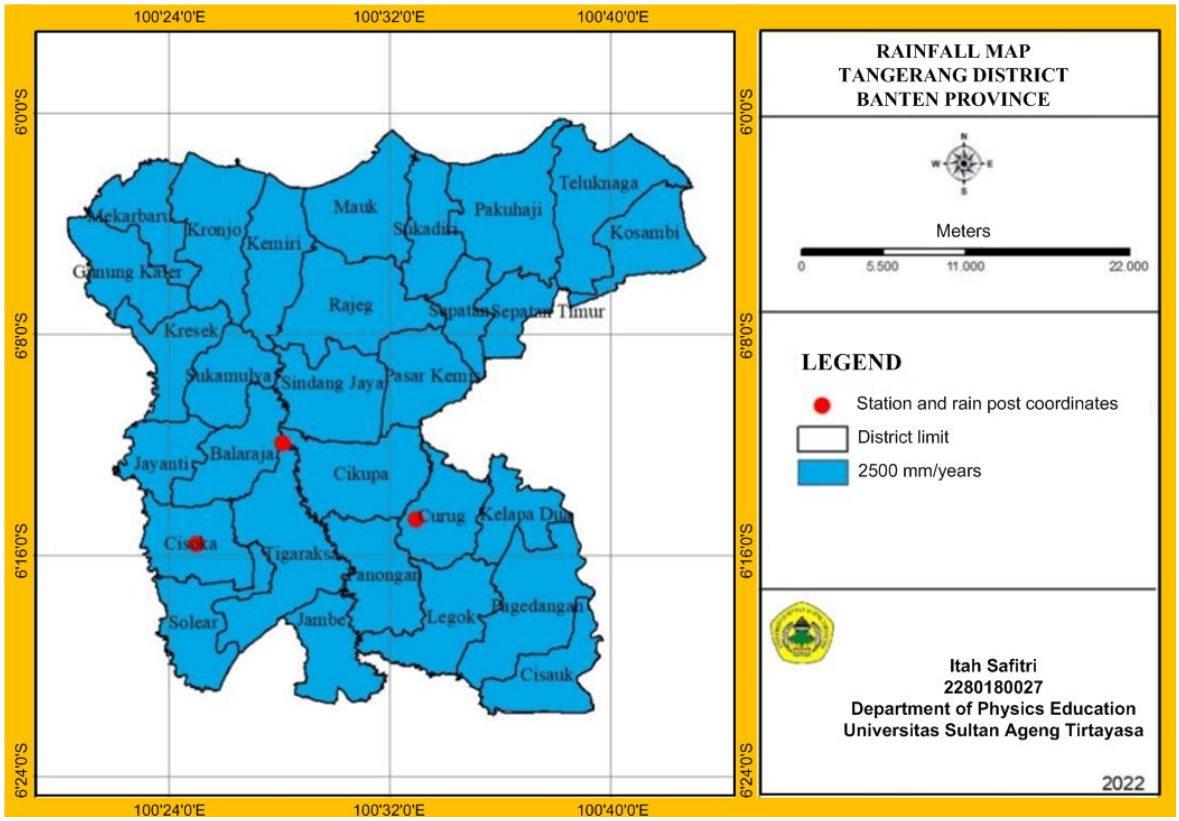

Figure 6. Results of rainfall classification Tangerang Regency

Flood Vulnerability

Flooding is a disaster that occurs yearly in each region, including the Tangerang district. Disaster This flood can be influenced by rainfall factors, high rainfall, the height of the land in an area, slope, soil type in the area, land use of a size and density of river. The flood vulnerability of a site can be known using six factors that influence the flood disaster classification based on experts utilizing the help of Arc GIS software as well QGIS software so that maps can be produced which can describe areas that are not vulnerable, moderately vulnerable and very vulnerable in the area such as in the Tangerang district.

Based on Figure 7, the classification results in the level of flood vulnerability in the district area is divided into three classifications: classification as not prone to flooding, which is given a color symbol green; classified as quite prone to flooding which is given a yellow symbol and type very vulnerable to flooding, which is given the symbol red.

The Tangerang district area includes four sub-districts that are not vulnerable, including the Panongan sub-district, the Pagedangan sub-district, and the Cisauk. Meanwhile, in Tangerang district, There are nine sub-districts included in the pretty vulnerable areas, including Kelapa Dua, waterfall, cikupa, balaraja, Jayanti, cisoka, solear, Tigaraksa, Jambe. Tangerang district's weak spots are included in the area. 16 sub-districts are very vulnerable Pasar Kemis sub-district, Sindang sub-district Jaya, Kresek sub-district, Gunung sub-district Kaler, Sukamulya sub-district, sub-district Sepatan, East Sepatan sub-district, sub-district rajeg, kemiri subdistrict, kronjo subdistrict, Mekar Baru sub-district, Mauk sub-district, Sukadiri sub-district, Pakuhaji sub-district, Teluk Naga sub-district, Kosambi sub-district.

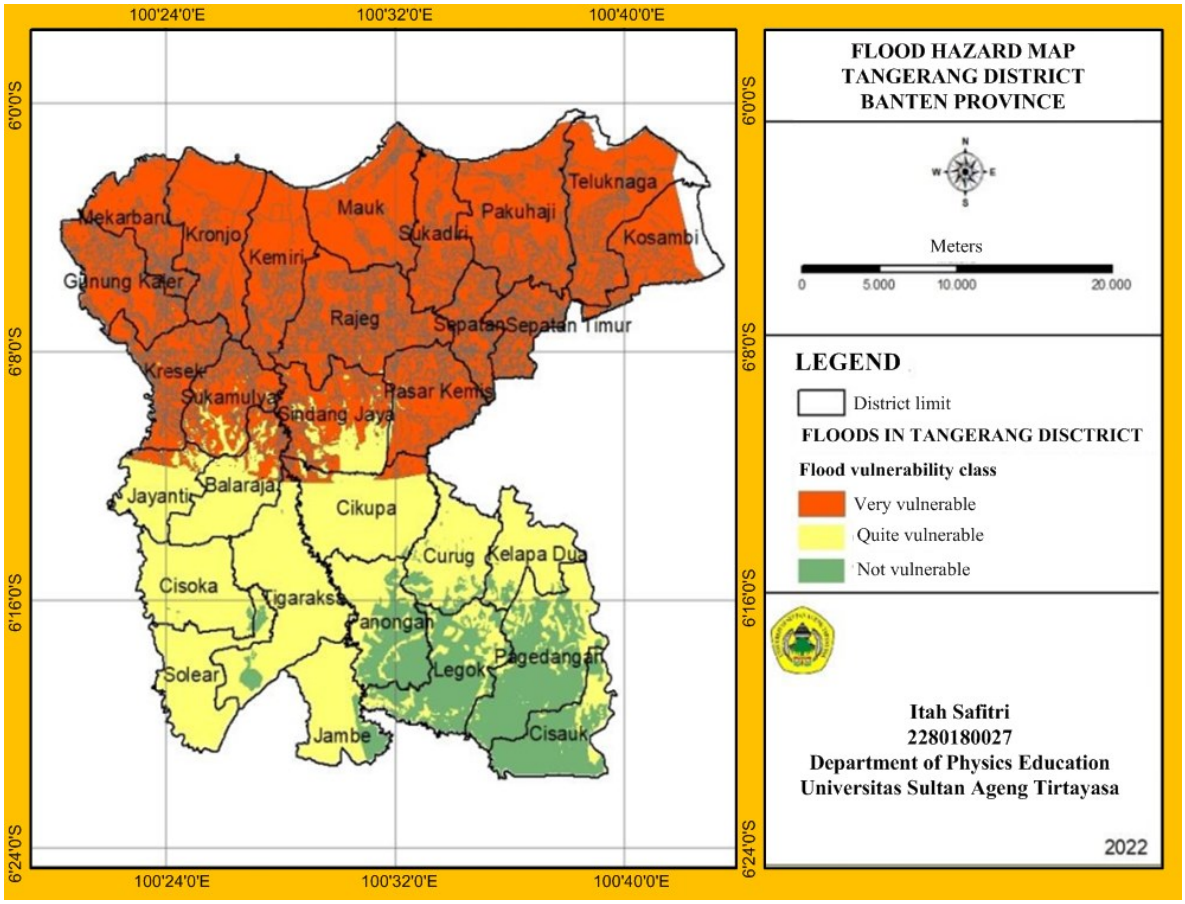

Figure 7. District Flood Vulnerability Map Tangerang

4. CONCLUSION

Influencing factors of flood disaster in Tangerang district There are six factors: land height, slope factor, soil type actor, land use, density factor rivers, and rainfall factors. Factors that significantly influence vulnerability to flood disasters in Tangerang district are the slope factor and soil type factor because most of the community of Tangerang has a slope of 0-8%, which can cause areas to be inundated by flood disasters. The type of soil in Tangerang district is alluvial soil, where alluvial soil is insensitive to infiltration or absorption.

Results of mapping disaster-prone areas floods in Tangerang district are divided into three classes: non-vulnerable, quite vulnerable, and very weak. The Tangerang district area is not prone to flooding by four subdistricts. Meanwhile, the site is classified as susceptible to flood disasters in as many as nine sub-districts in Tangerang district. Meanwhile, areas classified as very vulnerable to flood disasters in the community of Tangerang have 16 sub-districts.

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