ANALYSIS OF FLOOD DISASTER AREAS, JOMBANG REGENCY, EAST JAVA USING ARCGIS REMOTE SENSING

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ABSTRACT

Flood is one of the natural disasters that occur in Indonesia. Each region in Indonesia has a different flood hazard level. Therefore, a study was conducted to map the level of flood hazard in Jombang Regency, East Java. Remote sensing methods are used to map flood-prone areas, ArcMap software is used to map disaster-prone areas and mapping vegetation density. The data required is in the form of flood data index from Inarisk and Landsat 8 imagery data from USGS. From these data, four maps were generated, namely the vegetation density map and the flood hazard map in the Jombang area. From the vegetation density map, it can be seen from the value it determines the level of vegetation density in the area, while the flood hazard map is categorized into three hazard categories, namely low, medium and high. And it was found that the lower the level of vegetation density, the higher the level of flood hazard in the area, and vice versa and it is also known that the Brantas river affects flooding in Jombang. Then seen from the regional geology, the area of North Jombang absorbs air more quickly because it is composed of karst rocks. Judging from the area of the flood hazard level, the Jombang area is more dominant to the moderate hazard level.

Keyword: Floods, Disasters, Vegetation

Introduction

Flooding is a form of natural phenomenon that occurs due to high rainfall intensity where there is excess water that is not accommodated by a system (Suripin, 2014). Disaster is an event or series of events that threaten and disrupt human life caused by natural factors or human factors (Arandita, 2011). In Indonesia, flooding is a disaster that occurs every year, especially during the rainy season. Floods in Indonesia have different levels of danger depending on where they occur, the higher the level of danger, the greater the risk of loss to be received. Therefore, it is necessary to have a mapping of the level of flood hazard in an area so that prevention or mitigation can be carried out so that areas affected by floods can be reduced or at least can reduce the losses obtained. This study aims to map the flood hazard in the Jombang district, East Java.

Regional Geology

Jombang Regency has a variety of geological structures, each type of geological structure is divided into 7 (seven) types, namely volcanic facies plitocene, sedimentary plitocene facies, volcanic alluvium facies, sedimentary plitocene facies, old quarter volcanic products, volcanic products young quarter and alluvium. The geological structure with the largest area is alluvium with an area of 52,792.82 Ha.

Based on the physical characteristics of the soil in Jombang Regency, it can be divided into three parts, namely: The northern part of Jombang Regency is part of the limestone mountains which have relatively infertile soil, which is located north of the Brantas River. The central Jombang district in the southern part of the Brantas river is mostly agricultural land with scattered rivers and irrigation areas suitable for agriculture. The southern part of Jombang Regency is mountainous land that is used for plantation areas. (Jusfarida, 2017).

Inarisk

Inarisk is a risk assessment portal that uses the ArcGIS server as a data service that describes the scope of the disaster threat area, affected population, potential physical loss (Rp.), potential economic loss (Rp.) and potential environmental damage (ha) and is integrated with implementation realization. disaster risk reduction activities as a monitoring tool for disaster risk index reduction.

InaRISK has been officially launched by the Head of the National Disaster Management Agency (BNPB) on November 10, 2016 which was also attended by Ministries/Agencies, representatives from UN agencies, representatives of organizations from other donor countries (NGOs) and other relevant government institutions. It is hoped that InaRISK can be used by all parties, including the community in preparing disaster management plans (inarisk.bnpb.go.id).

NDVI

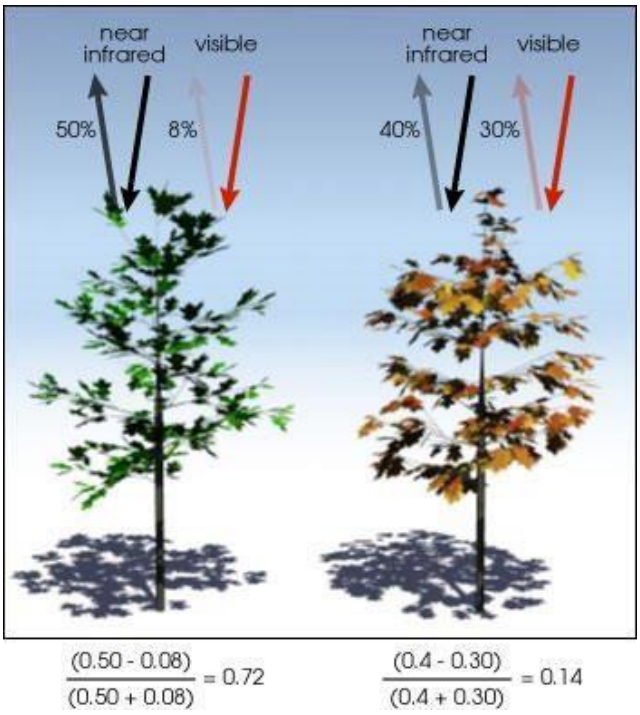

Figure 1. Example comparison and formula application

NDVI (Normalized Difference Vegetation Index) is a method used to determine the existing vegetation by observing the photosynthetic activity of the observed vegetation in the area (DeFries, 1994). Processing generally uses a formula which is a process between near-infrared and visible radiation. The formula is the Reflectance ratio (Jiang, 2006). The formula can be written as follows:

NDVI = [NIR – VIS] / [NIR + VIS]

Based on the figure 1, it can be seen that the NDVI value is only in the range of +1 and -1 (Pettorelli, 2005). Where when the value is close to +1 then the area is indicated to be dense with vegetation, whereas when the value is close to 0 or -1 then it can be said that the area is indicated to have no vegetation. This can be seen in the image above where the color of the vegetation corresponds to the existing NDVI value.

Methodology

In this study, remote sensing techniques are used to analyze flood-prone areas in Jombang district. To find out flood-prone areas, some data are needed, including the administrative map of Jombang district obtained from Ina-Geoportal, Landsat 8 image data (earthexplorer.usgs.gov) and the Flood Hazard Index map downloaded on the inarisk website (inarisk.bnpb.go) id) all of the data is then processed using ArcMap 10.5 and produces a flood-prone map and a map of the vegetation density of Jombang district.

The obtained Landsat 8 image data was processed into a Vegetation density map using the NDVI (Normalized Difference Vegetation Index) method. Landsat image data used are Band 5 and Band 4 which are calculated on ArcMap 10.5 so that a map of the vegetation density is obtained. The flood hazard index data obtained on the inarisk website is processed by correlating the administrative map of the Jombang area, so that a flood hazard map is obtained. From these two maps, an analysis of the joint relationship with the regional geology of Jombang district was carried out. So, it is known the spread of flood areas and the possible causes of the disaster in Jombang district. Then an area measurement is carried out by each region to determine Jombang Regency is included in the low, medium or high category in flood hazard.

Result and Discussion

Vegetation Development Map

After processing the Landsat image data using the NDVI method, the vegetation density map shown in Fig Picture. 2. From the map, it can be seen that the NDVI value is in the range of -0.294 to 0.309. As in the discussion of the NDVI problem, when the value is close to -1, the area shown does not have or has low

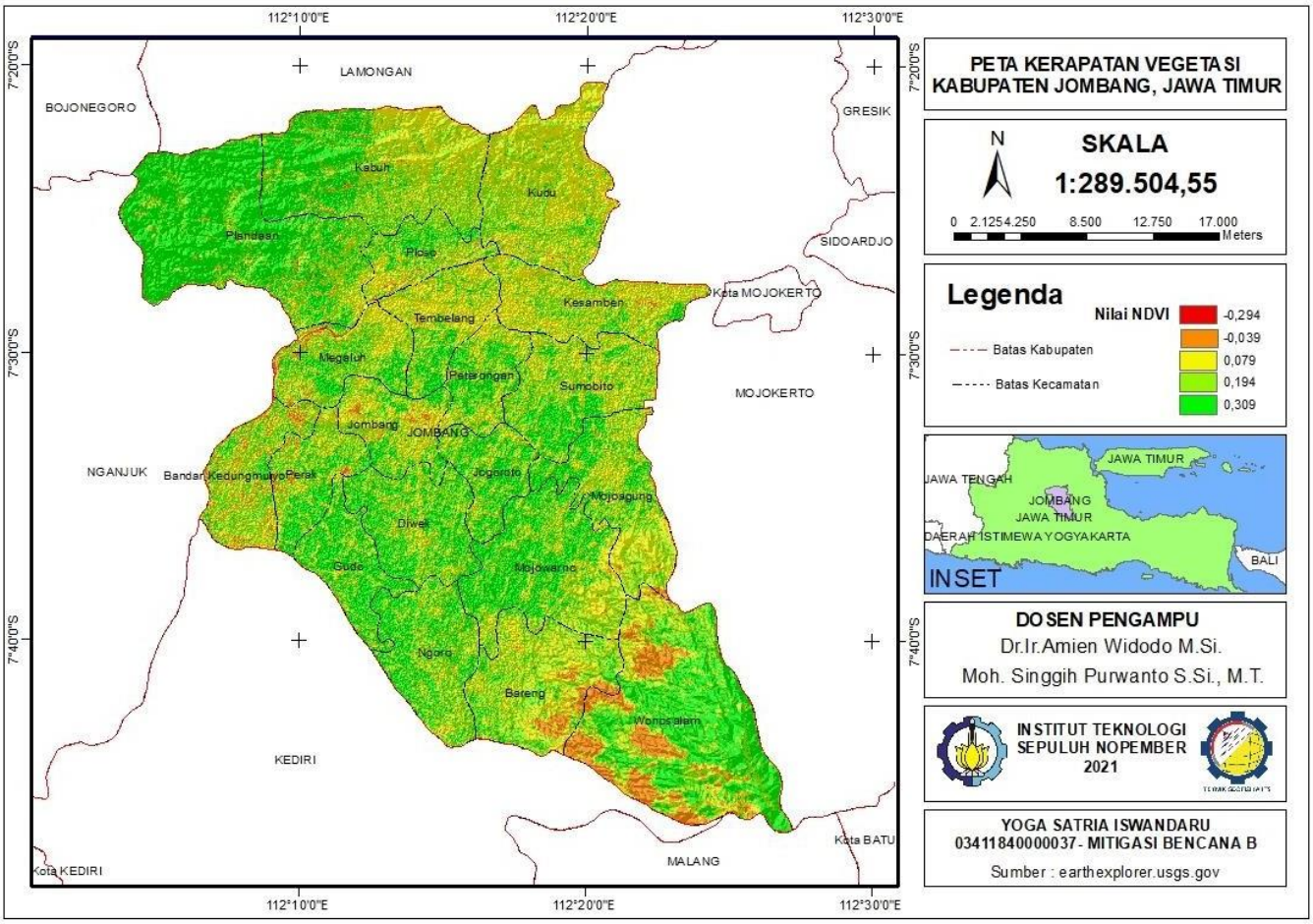

Figure 2. Vegetation density map from the NDVI method

vegetation, while when it approaches the value of +1, the area has a high vegetation density. In the map above, it is known that there are 5 color classifications where each color represents a different value. The values of -0.294 and -0.039 on the map shown in red and orange are indicated as areas with very low vegetation levels, possibly the area is a residential area or water area. While the NDVI value of 0.079 indicated by the yellow color is an area that is indicated to have a low vegetation density. It is possible that the area is a rice field area where Jombang district itself has rice fields that are spread almost throughout its territory. Then for the NDVI value of 0.194 – 0.309 which is indicated by the light green color, it is indicated as an area with high vegetation density because the range of values is closest to +1. To prove the possibility indicated by the NDVI value, a cross check was carried out using google earth.

Flood Vulnerability Map

After obtaining the vegetation density map of Jombang district, a flood-prone map was then made using flood index data from Inarisk. The flood hazard map is shown in Fig. 3 where on the map there are three levels of danger obtained from Inarisk data. The range 0 – 0.3 is categorized as an area that is low in flood hazard, a value of 0.3 – 0.6 is categorized as an area with a moderate level of flood hazard, while the value range of 0.6 – 1 is included in a high level of flood hazard. The three values are shown in 3 different colors as shown on the map. It can be seen from the results of the flood-prone map that Jombang district is mostly located in the central and northern Jombang areas which are low-lying areas, while the southern Jombang area which is a highland area does not appear to be affected at all by flooding. While in the northern part, there are several areas that are not affected by flooding, the area is a pucangan hill area.

If you look at the flood-prone map, most of the areas affected by floods with a high level of danger are near the artillery river, which in Jombang district is the Brantas river. This is very possible, to flooding if there is an overflow of rivers or rain with high rainfall. Meanwhile, areas with dense vegetation have a low level of flood hazard. So it can be said that rice fields that have low vegetation density are more difficult to absorb water and are vulnerable to flooding if there is an overflow of rivers or rain with high rainfall.

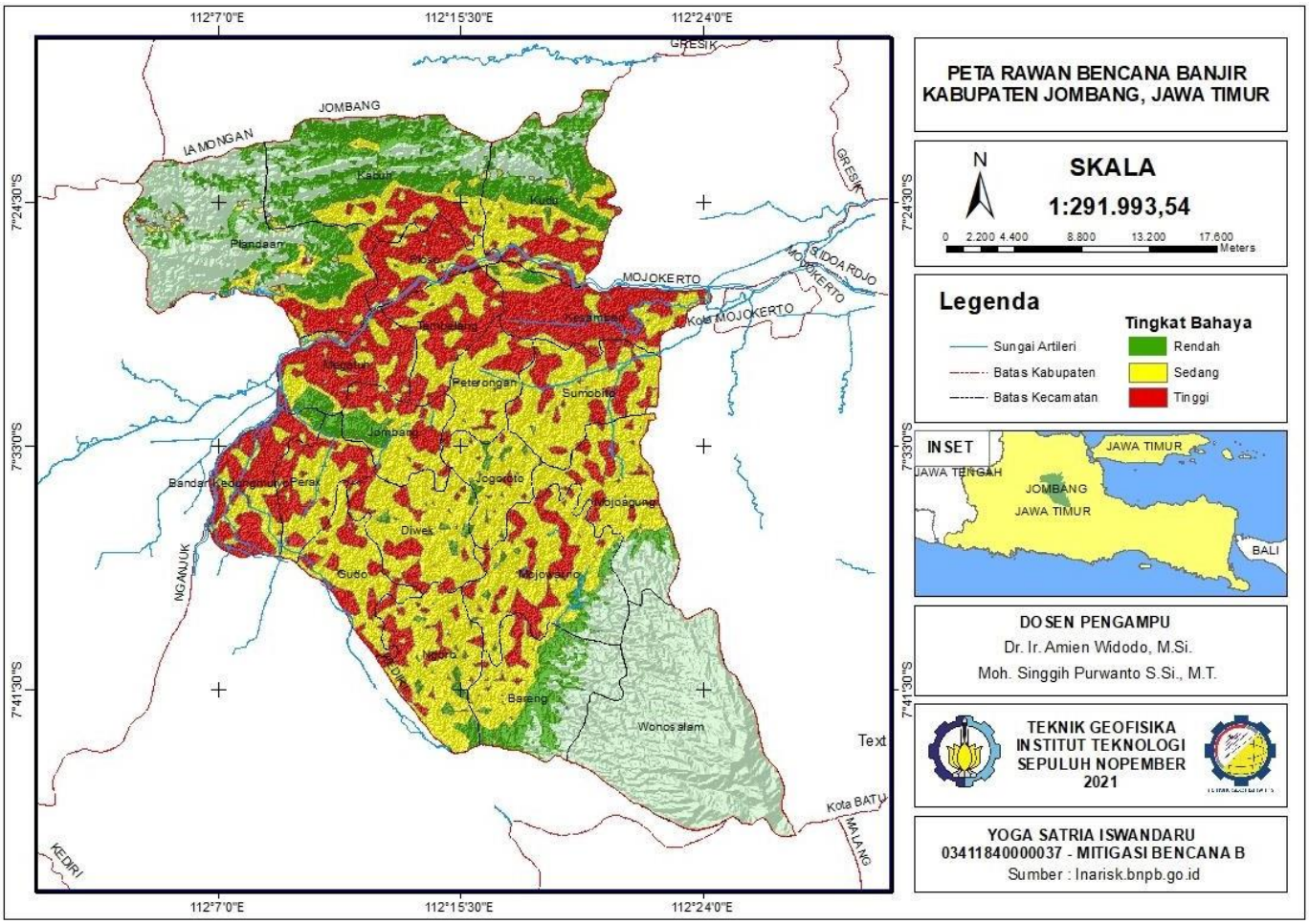

Figure 3. Map of flood-prone areas in Jombang district from Inarisk data

Meanwhile, areas because every rainy season the Brantas River will overflow so that it is possible to flood the surrounding area. In addition, when viewed from the vegetation density map, areas that have a high level of flood hazard have a fairly low vegetation value. Where indicated the area is a residential area and agriculture. This is quite reasonable because according to (Trudgil, 1985) dense vegetation areas will have abundant CO2 content in the soil as a result of the overhaul of organic residues by microorganisms where the greater the concentration of CO2 in the water, the higher the solubility of water in the soil. So, it can be said that rice fields that have low vegetation density are more difficult to absorb water and are vulnerable with dense vegetation have a low level of flood hazard. So, it can be said that rice fields that have low vegetation density are more difficult to absorb water and are vulnerable to flooding if there is an overflow of rivers or rain with high rainfall. Meanwhile, areas with dense vegetation have a low level of flood hazard.

When viewed from the regional geology, the Jombang area is divided into 2 main rock layers separated by the Brantas river which is dominated by karst rock layers in the north and volcanic rock layers in the south. So, if there is a flood, the northern Jombang area is likely to recede more quickly because the karst rock layer is easier to absorb water.

Dominate the level of flood hazard in Jombang

After knowing the relationship between vegetation density and flooding. Then the calculation of the area of each area the level of flood hazard is carried out. Calculations were performed using ArcMap and the results are shown in the following table.

Table 1. Dominate the level of flood hazard in Jombang

	Low	Currently	High
Area Km2	152,71	428,11	264,82

The area in the table above is the total area for each level of flood hazard. It can be seen that values above the moderate hazard level have a fairly large area, followed by a high hazard level. So, from these results it can be said that the Jombang area is included in the area with a moderate level of danger.

Conclusion

From the data processing carried out, it can be concluded that areas with a high level of flood hazard are in rice fields and residential areas close to the Artillery River. This is due to the lack of water absorption in areas with less vegetation density. In addition, it is also known that the northern Jombang area which is composed of karst layers has a higher water absorption capacity than the central and southern Jombang areas. From the calculation of the area of each flood hazard area, it is known that most of the Jombang area is affected by floods with a moderate level of danger. So that the Jombang area can be said to have a moderate level of flood hazard.

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