Analysis of Differences In Vegetation Development In 2009 and 2022 In Semboro Sub-District, Jember Regency

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Abstract. One type of spatial information that can be extracted based on remote sensing satellite data is land cover information. This information is created and used for various types of purposes, so that many different versions are found according to the intended use. This study aims to identify the vegetation density index in the Sukokulon rubber plantation area in 2009 and 2022. This research was conducted using a descriptive approach in which the researcher explained the results of field identification. Data analysis techniques were carried out by means of descriptive analysis by describing the situation based on observations made and secondary data on Landsat 7 and Landsat 9 images to determine differences in vegetation density, as well as by analysis through literature studies. Vegetation density in 2009–2022, shows an increase in the value of vegetation density in the Semboro District area, but in the northern region it is still with high vegetation density.

Keywords: Vegetation Density Index, Semboro District, Landsat 9, Landsat 7,

1. Introduction

One type of spatial information that can be extracted based on remote sensing satellite data is land cover information. This information is created and used for various purposes, so there are many different versions according to the intended use. The level of detail in land cover information is higher the larger the map scale, and vice versa. When land cover information is based on remote sensing data, the level of detail is influenced by the type of data used. More specifically, the level of detail is influenced by the spatial resolution of the remote sensing satellite data used. Object identification using remote sensing technology is carried out with several approaches including; image spectral characteristics, visualization, floristics, geography and phsygonomics (Faizal & Amran., 2005).

As the years go by there is more and more population growth and development that causes changes in land use (Aftriana et al., 2013). Changes in land use will affect the level of sustainability and affect the reduction of existing vegetation. Vegetation is a heterogeneous unit of plants that has a major role in the continuity of the ecosystem (Yanti et al., 2020). If the balance of vegetation is disturbed, it will also affect the sustainability of the surrounding ecosystem.

Information on vegetation density and its changes, land area, and field conditions can be detected using Landsat imagery (Purwanto, 2015). One method that can be used to review the state of vegetation using Landsat images in Semboro District is the NDVI method. The NDVI method or Normalized Difference Vegetation Index is one of the spectral (Putra, 2011). The NDVI method utilizes near infrared (NIR) and red waves to calculate vegetation density (Wahrudin et al., 2019).

Sukokulon Plantation is a state-owned rubber plantation with an area of approximately 30 hectares and is located between the two sub-districts of Semboro and Tanggul. Most of Sukokulon's plantation area is located in Semboro sub-district, which borders directly on the community and is where plantation activities take place. This, of course, has many impacts that are considered very dichotomous. There have been several frictions related to land disputes between the plantation and the community, leading to mass logging by the community, which is the end of a land dispute conflict. This incident occurred in 2011. And resulted in differential land cover in the rubber plantation area. Where there is a change in plant species due to previous mass logging. This change of plant species is an act of returning plantation plants, but with different types such as sugar cane, chocolate, and a small portion of papaya trees.

Based on the explanation above, the purpose of this study is to identify the vegetation density index in the Sukokulon rubber plantation area that has changed due to social conflict, with a visual remote sensing-based study system and in different time periods before the conflict in 2009 and after the conflict in 2022.

2. Methods

This research was conducted with a descriptive approach based on the results of processing Landsat 7 and Landsat 9 images. The bands used were the near infrared band and the red band (Silitonga et al., 2018). In addition to using a descriptive approach, of course, the researcher uses the observation method (Syamsudin., 2015). The research will be conducted at the Sukokulon Plantation, Semboro District and Tanggul District, Jember Regency by going directly or making direct observations to the Sukokulon Plantation and by utilizing secondary data in the form of Landsat 7 imagery recorded 27 September 2009 and Landsat 9 imagery recorded 23 March 2022 as material for analysis of the density of vegetation in Semboro District. In this study, researchers will use the sense of sight and the sense of touch to obtain data that can later be used as material for analysis. The research included identification of the comparison of vegetation density in Semboro District in 2009 and 2022.

2.1 Tools and Equipment

In conducting this research, there are tools used including cellphones, stationery, notebooks, laptops that have ENVI 5.3 and ArcGis 10.8 software installed which will be used in the research process so that it can help in identifying changes in land cover and land use that occur and are used for the documentation process and making proposals and reports. The materials used in this research are Landsat 7 image recorded on September 27, 2009 and Landsat 9 image recorded on March 23, 2022.

2.2 Data Analysis

Data analysis techniques are carried out when data has been obtained by a researcher in the form of direct observation and based on the help of secondary data in the form of Landsat 7 and Landsat 9 images. The data analysis technique is carried out by means of descriptive analysis by describing the situation based on the observations made and secondary data of Landsat 7 and Landsat 9 images to determine differences in vegetation density, as well as by analysis through literature studies. By using descriptive data analysis, researchers conduct data analysis by describing or describing the collected data without making generalizations of the research (Anggito & Setiawan, 2018).

The vegetation density class referred to is based on the Ministry of Forestry, (2003) in Yurike, (2018) which can be seen in Table 1. The resulting map output is the Semboro District Vegetation Density Map with a scale of 1:100,000.

Table 1. Vegetation Density Class

Vegetation Density Class	Value Range
Low Density Vegetation	0-0,32
Medium Density Vegetation	0,32-0,42
High Density Vegetation	>0,42-1

3. Results and Discussion

3.1 Sampel Point

Sampling here aims to determine the accuracy in determining the vegetation class on the vegetation density map of Semboro District. In determining the sample point, the researcher chose an area that had easy access. Considering that the accuracy test is carried out in the sub-district area, of course it takes time to make observations in the field directly. There are 30 sample points which are located in Semboro District to obtain sample diversity. Sample points are also placed in different vegetation classes so that all classes are represented. The reference map for the accuracy test uses a tentative map of vegetation density in 2022 based on processing from Landsat-9 imagery which can be seen in (Figure 1).
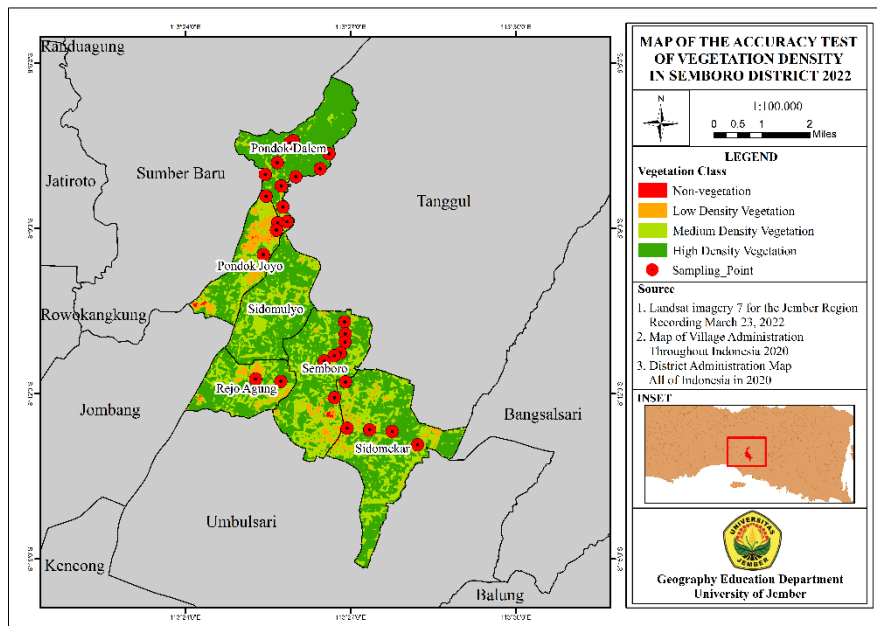

Figure 1. Map of Accuracy Test Sample Points

3.2 Result

The results of image processing for differences in vegetation density in Semboro District can be seen in (Figure 2) and (Figure 3).
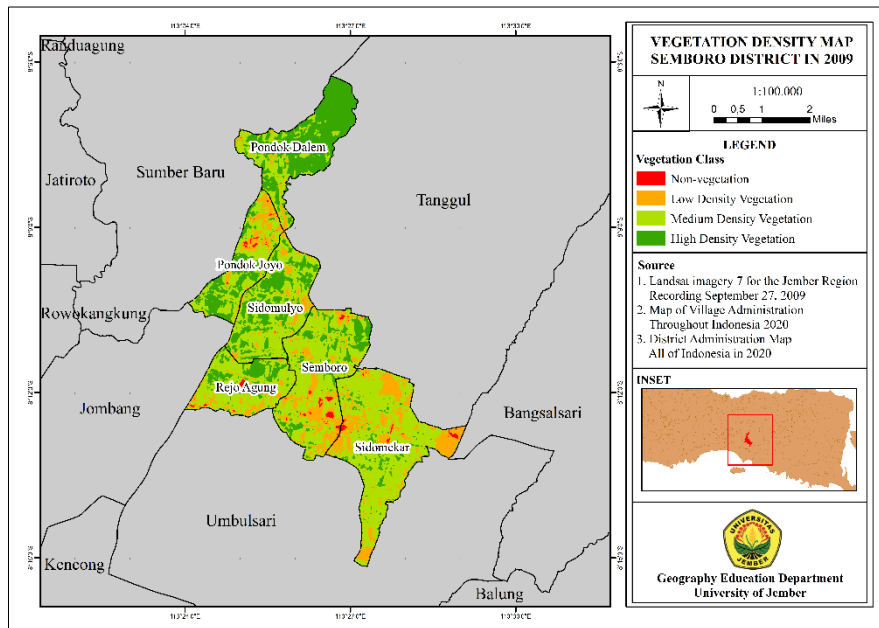

Figure 2. map of Vegetation Density of Semboro District in 2009
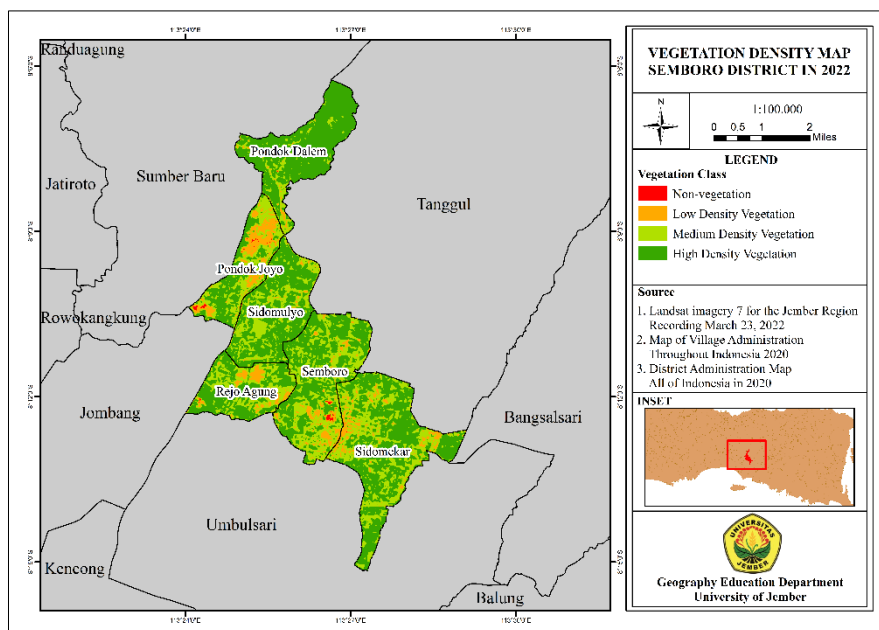

Figure 3. Map of Vegetation Density of Semboro District in 2022

3.3 Test Accuracy

After testing the accuracy in the field, the results of the vegetation density accuracy test in Semboro District can be seen in (Table 2) and (Table 3).

Table 2. Accuracy Test Result

Mapping Accuracy				Accuracy Result Accuracy
Produces's Accuracy	Error Omission	User's Accuracy	Error Omission	
8/12 = 67%	33%	8/9 = 89%	11%	(8+9+8)/30 = **83,33%**
9/9 = 100%	0%	9/10 = 90%	10%	
8/9 = 89%	11%	8/11 = 73%	27%	

Table 3. Error Matrix of Accuracy Test

Category Field	Interpretation Result Category			Totak Rows
	Low Vegetation Density	Medium Vegetation Density	High Vegetation Density	
Low Vegetation Density	8		1	9
Medium Vegetation Density	1	9		10
High Vegetation Density	3		8	11
Total Column	12	9	9	30

Based on the calculation of the data calculated from the accuracy test, the accuracy level produced by the three classes of vegetation density that is closest to the field conditions is medium density vegetation with a percentage of 90%. This condition is in line with the existence of a very large sugarcane plantation area so that it is easily interpreted. Meanwhile, high density vegetation has the lowest percentage of 73%. High density vegetation in Semboro District is mostly dominated in the northern region, one of which is a sukokulon rubber plantation which is included in high density vegetation. The test value for the accuracy of Low Density Vegetation, where in its class there is vacant land and built up land, actually changes slightly with a percentage of 89% accuracy test value. Overall the accuracy test value reaches 83% which can be said to be accurate and can be used as a reference for determining vegetation density.

3.4 Discussion

This research was conducted in Semboro Subdistrict and Sukokulon Plantation as an independent variable that affects changes in vegetation density, considering that Sukokulon rubber plantation is a rubber plantation with a very high area. Sukokulon rubber plantation is located in the north of Semboro sub-district and is included in two sub-districts, namely Semboro sub-district and Tanggul sub-district. The results of image processing that has been done obtained a map interpretation that shows the overall vegetation density class of Semboro Subdistrict in 2009 - 2022. The map interpretation shows an increase in the value of vegetation density in the Semboro sub-district area, but in the northern area there is still a high density of vegetation. This event is influenced by changes in vegetation types in that time span, Semboro plantation land is a wetland (Wes Land) which has a variety of potential values (Hiskiawan, 2016). Moderate vegetation density has experienced many changes in land area. The application of the NDVI method which has a value range of -0.1 to 1.0 by utilizing Red and Infrared. Red wave is a wave that distinguishes plant species, and Infrared distinguishes between land or soil and plant species. So that the value range of 0.32 to 0.42 includes medium density.

The results obtained through data processing shown in Table 2, state that the accuracy of the accuracy carried out reached 83.3% which can be said to be very good. This is supported by the opinion of Kusumowidagdo

et al. (2007) classification is said to be good if the accuracy value is ≥ 80% or error ≤ 20% when compared to the field situation. Based on the interpretation that can be seen in Figure 3 and Figure 4, there is a difference that moderate density vegetation decreases in the following year, Semboro Subdistrict whose people work in the agrarian sector and plus the presence of sugar factories that utilize sugar cane as a source of staple material, of course, will have a direct impact on land use. In line with research conducted by Ramadhan et al. (2022) which shows the influence of a population and industrial presence on vegetation density. Semboro sub-district has extensive sugarcane plantations, so that the results of the Landsat 7 interpretation where the recording was taken on September 27, which is the beginning of sugarcane plantation activities, where sugarcane plants are in their growth period before logging will be read as a medium density vegetation density. In the interpretation of the Landsat-9 image whose recording date was March 23, it was when the sugarcane plants were at an old age and produced high reflectance radiance, thus reading high density vegetation. According to research conducted by Arnanto (2013) vegetation density and vegetation age have a strong positive relationship or influence on the value of vegetation density (NDVI).

4. Conclusion

After analyzing the data related to the research findings, it can be concluded several things that the interpretation of the vegetation density class map for 2009 – 2022, shows an increase in the value of vegetation density in the Semboro District, but in the northern part it is still with high vegetation density. At medium vegetation density, the land area changes a lot. This change was caused by the difference in the time of taking the image where the Landsat 7 imagery coincided at the beginning of the planting season so that it reads medium density, while in the Landsat 9 image recording, the sugarcane plant is almost entering the harvest period so that it is indicated as high density vegetation.

Of the total 30 sample points used, the vegetation density that is closest to the field conditions is medium density vegetation with a percentage of 90%. Then the high density vegetation has the lowest percentage of 73%. Meanwhile, Low Density Vegetation, where in its class there are vacant land and built up land, actually changes slightly with a percentage of 89% accuracy test value. Overall the accuracy test value reaches 83% which can be said to be accurate and can be used as a reference for determining vegetation density.

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