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Changes In Greenness Level In PT Arumin Indonesia's RPT NPLCT Area with Normalized Difference Vegetation Index (NDVI)

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Greenness, NDVI, Sentinel-2A, Remote Sensing, Geospatial Information System, Kotabaru Regency, South Kalimantan

ABSTRACT
The observation focused on PT Arutmin Indonesia's NPLCT RPT area of 98 hectares. These observations are viewed with the help of remote sensing technology and geographic information systems (GIS). This observation aims to analyze changes in greenness levels that occur from 2019 to 2023 using the normalized difference vegetation index (NDVI) method and the materials used sentinel-2A imagery. The goal is to evaluate changes in greenness levels and their interpolation from 2019 to 2023. An area of 98 hectares was monitored using sentinel-2A satellite imagery with a pixel sharpness of 10 meters x 10 meters. The results show sentinel imagery from 2019 to 2020, 38.41 ha experienced reforestation, 1.65 ha experienced deforestation and 58.14 ha did not change. Sentinel-2A image from 2020 to 2021, 79.09 ha experienced reforestation, 1.35 ha experienced deforestation and 17.68 ha did not change. Sentinel-2A image from 2021 to 2022, 1.08 ha experienced reforestation, 79.48 ha experienced deforestation and 17.68 ha did not change. Sentinel-2A imagery from 2022 to 2023, 0.47 ha experienced reforestation, 40.65 ha experienced deforestation and 57.17 ha did not change. The sentinel-2A image changes from 2019 to 2023, 2.27 ha reforested, 20.35 ha deforested and 75.64. These observations highlight the importance of remote sensing technology and geographic information systems (GIS) in monitoring and analyzing land cover change to support conservation, rehabilitation and natural resource management policies in Kotabaru District, South Kalimantan.

INTRODUCTION

An ecosystem unit in the form of a stretch of land containing biological natural resources dominated by trees with an environment that cannot be separated from others is called a forest. Certain areas designated and designated by the government to maintain their existence as permanent forests are called forest areas. This is regulated in Law Number 41 of 1999. Forest areas are divided into 3 functions, namely, production forest (HP), protection forest (HL) and conservation forest (Adinda, Rusdi, & Sugianto, 2020).

Vegetation density has decreased due to changes in land use (landuse) which can affect

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changes in the average surface temperature of an area. This change in land use is caused by increasing a land use from one side of the use to another which is accompanied by a decrease in other types of land use over time or it can be said to change the function of a land resulting from human activities (Wahyunto & Heryanto, 2006). The use of remote sensing data can be used to determine and map the distribution of land surface temperature. One of the data that can be utilized is Landsat satellite data using thermal sensors carried by the vehicle. Landsat is a continuation of the Landsat mission which for the first time became an earth observation satellite since 1972 (Landsat 1).

The Normalized Difference Vegetation Index (NDVI) has good accuracy in forest greenness studies. The concept of using NDVI is fairly simple, namely by utilizing the best Near Infrared (NIR) light reflected by chlorophyll and red light radiation absorbed by green plants (Akbar et al., 2020). The method of measuring canopy density is basically utilizing canopy cover. Canopy cover is the area of land covered by vertical projections of vegetation canopy or tree canopy (Jennings, Brown, & Sheil, 1999) (Wachid & Tyas, 2022).

Remote Sensing has enormous benefits of terrestrial survey activities, this is because Remote Sensing can be known the characteristics of an area without going directly into the field. This is because Remote Sensing can describe objects on the surface of the earth in accordance with the shape and location of objects that are similar to the original (Nurmalasari & Santosa, 2018). Moreover, in hard-to-reach areas, remote sensing is very effective to use. Various sectors of use such as the meteorological and climatological sector, forestry, population sector, marine (oceanography), and so on.

Deforestation is the condition of forest area that has decreased due to land conventions for infrastructure, settlements, agriculture, mining, and plantations. Forest destruction in Indonesia continues to increase every year. Forest destruction can affect climate change, because reduced forest land is one of the causes of increasing greenhouse gases, especially carbon dioxide as a source of emissions. Around 80% of emission sources are caused by forest burning (Wahyuni & Suranto, 2021).

Reforestation is the process of replanting trees on land that has previously been deforested or degraded. Reforestation helps the environment by guaranteeing or accelerating the re-establishment of healthy forest structures by regrowing the forest canopy and preserving biodiversity in ecosystems. Reforestation also helps reduce carbon emissions because trees can absorb carbon dioxide from the atmosphere through the process of photosynthesis. Land undergoing conversion needs to be reduced in order to maintain land cover (Mustafa & Marsoyo, 2020). Forest areas must be maintained so that they do not continue to decrease and be damaged. Some solutions to overcome the root of the problem of deforestation and reduce its negative impacts require reforestation activities and human awareness not to cut trees in the forest continuously (Asrin, Putri, & Utami, 2022).

The purpose of this report analyzing the level of greenness that occurs in PT Arutmin Indonesia's RPT NPLT area from 2019 to 2023. Seeing changes in the area of greenness of land that occur in PT Arutmin Indonesia's RPT NPLT area from 2019 to 2023. The benefit of this report is that it can analyze changes in the greenness level of the area or land by utilizing remote sensing science with software and satellite imagery.

METHODS

This analysis was conducted at NPLCT PT Arutmin Indonesia, Pulau Laut Utara District, Kotabaru Regency, South Kalimantan. The analysis is carried out during 3 months from preparation, collection and processing.

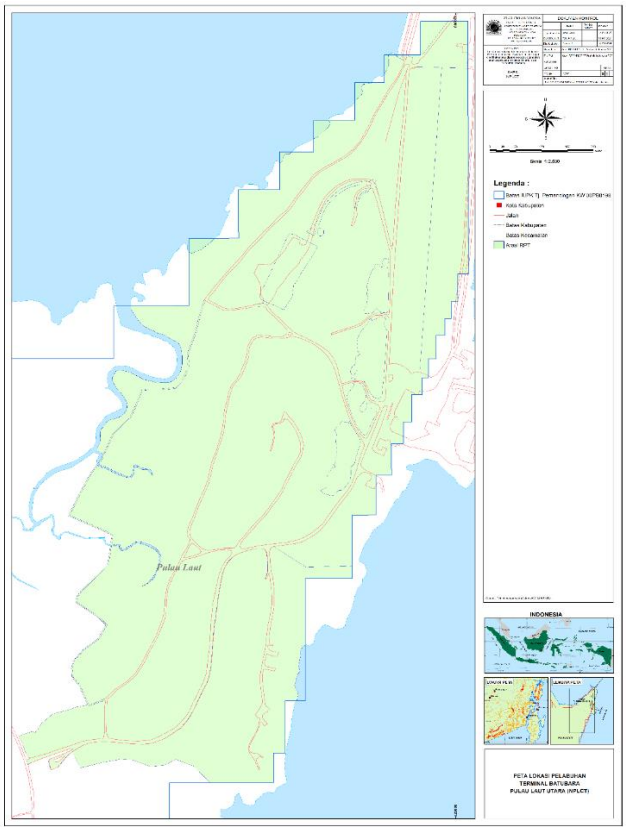

Figure 1. Location of *NDVI Analysis* at NPLCT PT Arutmin Indonesia

The object of this research is changes in the level of greenness with the *NDVI method* at NPLCT PT Arutmin Indonesia.

Tools used in the study.

1. *ArcMap Software 10.8*
2. Sentinel-2A imagery.
3. Map of Rupa Bumi Indonesia (RBI) administrative boundaries of PT Arutmin Indonesia's NPLCT working area.
4. Laptop for data processing and report writing.

Procedure

The procedure used includes the following stages:

1. Data Retrieval
   a. Download satellite imagery via *the* Copernican website. The downloaded image is Sentinel-2A from 2019 to 2023.
   b. NPLCT administration data of PT Arutmin Indonesia in the form of a shapefile (SHP).
2. Data Processing
   a. Cropping imagery to retrieve the area that the observation was conducted. Image cropping aims to simplify the analysis process.
   b. Radiometric correction is carried out to remove noise contained in the image as a result of distortion by the position of sunlight and clouds at the research site.
3. Data Analysis
   a. Changes in the greenish index in the observation area using the *Normalized Difference Vegetation Index* (NDVI) method which is based on a combination of pixel values of infrared band images or NIR and red bands. This method produces 7 classes of greenish

level changes, namely land is not vegetated, low vegetation, rather low vegetation, medium vegetation, high enough vegetation, high vegetation and very high vegetation. In these 7 classes of greenness level change, there will be areas that experience reforestation, deforestation and do not change (Bashit, 2019).

b. This greenness change refers to the Circular of the Chief Inspector of Mines (KAIT) No.9E/MB.07/DBT.PL/2023 concerning the spatial database of planning, implementation, and reporting of reclamation and post-mining in mineral and coal mining business activities.

Table 1. *NDVI value*

Class	Color	NDVI	Information
1	Blue	-1 to -0.1	Non-vegetated
2	Red	0.1 to 0.3	Low vegetation
3	Oren	0.3 to 0.5	Vegetation is rather low
4	Yellow	0.5 to 0.6	Medium vegetation
5	Light Green	0.6 to 0.7	Vegetation is quite high
6	Toska Green	0.7 to 0.9	High Vegetation
7	Dark Green	0.9 to 1	Very High Vegetation

This analysis is to take advantage of the combination of calculating the pixel value of infrared band or NIR and red band images from the visible header frequency. The scoring result or value is further divided into 3, namely reforestation, deforestation and no change (Cahyono, Nugroho, & Arifilla, 2019).

The division of these 3 scores is based on changes from 7 NDVI classes. Reforestation sees a change from unvegetated to very tall vegetation. The opposite of reforestation is deforestation which from very high vegetation levels to non-vegetated. If the rate of life does not change, it does not change. Results of NDVI interpolation from year i to year n to see what has not changed, deforestation and reforestation.

RESULTS

Changes in the Greenness of the Land

The results of changes in the greenness level in PT Arutmin Indonesia's NPLCT area are as follows:

1. Sentinel-2A Image Processing

Sentinel-2A image processing obtained through the Copernicus website with a recording date of December 19, 2019 for the first image. The second image is recorded September 24, 2020. The third image recording date is June 21, 2021. The fourth image of the recording date is August 15, 2022. The fifth image of the recording date occurs October 29, 2023. The five images were cut according to the administrative area or location of the study. This cut was made to focus more on the research site (Fahreza, Aulia, Fauzan, Somantri, & Ridwana, 2022).

Figure 2. Research Location Benchmarking

After cutting the image, radiometric correction is performed. This radiometric correction is

to reduce noise such as lighting, color and clouds contained in the location imagery. All five images are 100% cloud-clean, so no cloud radiometric correction is required on the imagery. Satellite resources are said to be good if the area of cloud coverage is less than 10% (Danoedoro et al., 2019).

Sentinel-2A Image Analysis

The *Normalized Difference Value Index* (NDVI) analysis method calculates the pixel value by combining the infrared band or NIR and the red band. The band combination continued to divide the greenish level into 7 classes, namely unvegetated land, very low vegetation, low vegetation, medium vegetation and high vegetation (Faizal et al., 2023). After the division of 7 classes of greenish level, the results of greenness changes were obtained by interpolation from 2019 to 2023. The results of this interpolation get 3 changes, namely reforestation, deforestation and no change.

Table 2. Greenness Level 2019 to 2023

Information	2019	2020	2021	2022	2023
Non-vegetated	15,35	14,52	12,34	14,08	15,91
Low vegetation	12,81	7,17	4,27	8,00	27,29
Vegetation is rather low	67,30	43,64	7,20	55,19	55,28
Medium vegetation	2,95	31,31	6,07	20,99	0
Vegetation High enough	0	1,76	14,47	0,15	0
High Vegetation	0	0	54,09	0	0
Very High Vegetation	0	0	0	0	0
Total	98	98	98	98	98

Greenish level results for sentinel-2A imagery in PT Arutmin Indonesia's NPLCT RPT area with an area of 98 ha in 2019 in the non-vegetated class covering an area of 15.35 ha, low vegetation covering an area of 12.81 ha, rather low vegetation 67.30 ha, medium vegetation covering an area of 2.95 ha, high enough vegetation, high vegetation and very high vegetation covering an area of 0 ha. Sentinel-2A image in 2020 for the unvegetated class covering an area of 14.52 ha, low vegetation covering an area of 7.17 ha, rather low vegetation covering an area of 43.64 ha, medium vegetation covering an area of 31.31 ha, moderately high vegetation of 1.76 ha, high vegetation and very high vegetation covering an area of 0 ha. The 2021 sentinel-2A image for the non-vegetated class covers an area of 12.34 ha, low vegetation covers an area of 4.27 ha, rather low vegetation covers an area of 7.20 ha, medium vegetation covers an area of 6.07 ha, moderately high vegetation covers an area of 14.47 ha, high vegetation is 54.09 ha and very high vegetation is 0 ha. The 2022 sentinel-2A image for the unvegetated class is 14.08 ha, low vegetation covering an area of 8.00 ha, rather low vegetation covering an area of 55.19 ha, medium vegetation covering an area of 20.99 ha, moderately high vegetation 0.15 ha, high vegetation and very high vegetation covering an area of 0 ha. Sentinel-2A 2023 imagery for the non-vegetated class covering an area of 15.91 ha, low vegetation covering an area of 27.29, rather low vegetation covering an area of 55.28 ha, medium vegetation, moderately high vegetation, high vegetation and very high vegetation covering an area of 0 ha (Hasan, Widodo, Mutaqin, Taufik, & Hidayat, 2021).

Table 3. Greenish Rate Interpolation From 2019 to 2023

Information	Year				
	2019-2020	2020-2021	2021-2022	2022-2023	2019-2023
Reforestation	38,41	79,09	1,08	0,47	2,27
Deforestation	1,65	1,35	79,48	40,65	20,35
Remain	58,14	17,76	17,68	57,17	75,64
Total	98	98	98	98	98

The results of *the NDVI* image overlay from 2019 to 2020 obtained an area of land that experienced reforestation or an increase in greenness level of 38.41 ha. Deforestation or decrease in greenness levels that occurred covering an area of 1.65 ha. The area that has not changed is 58.14 ha. Seen in figure 3.

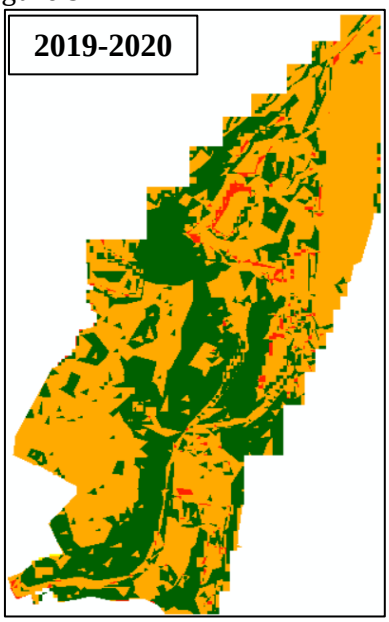

Figure 3. Greenish Level Interpolation from 2019 to 2020

The results of *the NDVI* image overlay from 2020 to 2021 obtained an area of land that experienced reforestation or an increase in greenness level of 79.09 ha. Deforestation or decrease in greenness levels that occurred covering an area of 1.35 ha. The area that has not changed is 17.76 ha. Seen in figure 4.

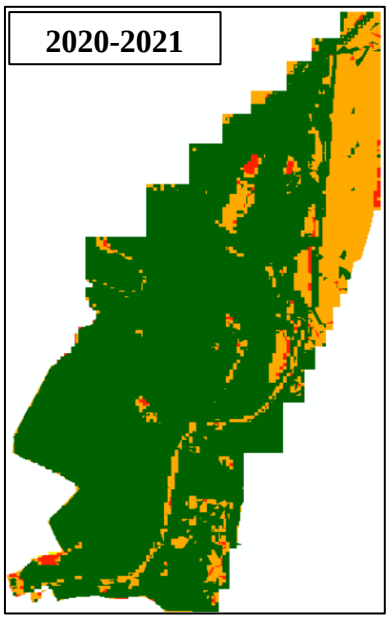

Figure 4. Greenish Rate Interpolation from 2020 to 2021

The results of *the NDVI* image overlay from 2021 to 2022 obtained an area of land that experienced reforestation or an increase in greenness level of 1.08 ha. Deforestation or decrease in greenness levels that occurred covering an area of 79.48 ha. The area that has not changed is 17.68 ha. Seen in figure 5.

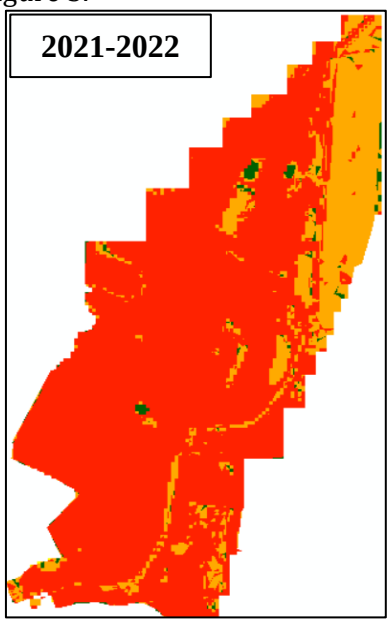

Figure 5. Greenish Rate Interpolation from 2021 to 2022

The results of the *NDVI* image overlay from 2022 to 2023 get an area of land that has undergone reforestation or an increase in greenness level of 0.47 ha. Deforestation or decrease in greenness levels that occurred covering an area of 40.65 ha. The area that has not changed is 57.17 ha. Seen in figure 6.

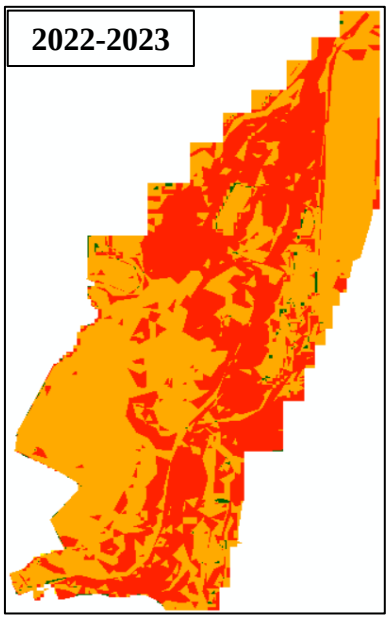

Figure 6. Greenish Rate Interpolation from 2022 to 2023

The results of *the NDVI* image overlay from 2019 to 2023 get an area of land that has undergone reforestation or an increase in greenness level of 2.27 ha. Deforestation or decrease in greenness levels that occurred covering an area of 20.35 ha. The area that has not changed is 75.64 ha. Seen in figure 7.

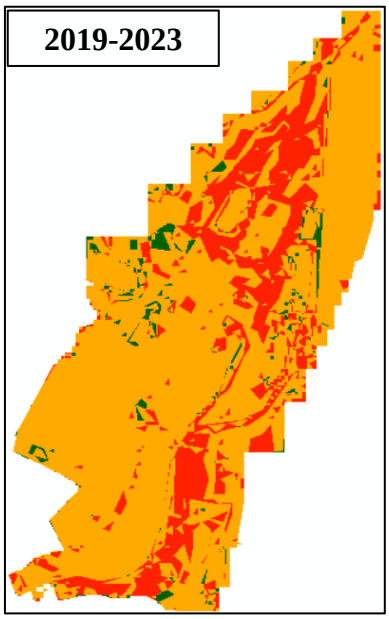

Figure 7. Greenish Rate Interpolation from 2019 to 2023

The graph of change shows that the largest area of 79.09 ha that experienced an increase in greenness occurred between 2020 and 2021. The rapid change in deforestation or decrease in greenness occurred between 2021 and 2022 with an area of 79.48 ha.

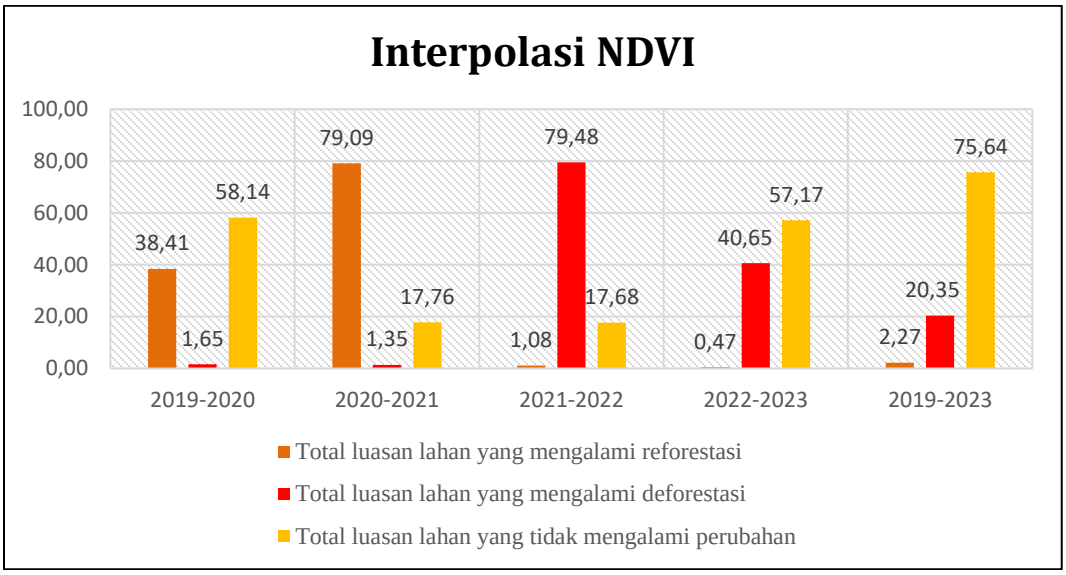

Figure 8. Interpolation graph of *NDVI changes* from 2019 to 2023

CONCLUSION

The greenness level in PT Arutmin Indonesia's NPLCT RPT area with sentinel-2A imagery in 2019 is the smallest area in the vegetation class is quite high, high vegetation and very high vegetation with an area of 0 ha, while the largest area in the vegetation class is rather low with an area of 67.30 ha. The sentinel-2A image in 2020 is the smallest area in the high vegetation class and very high vegetation with an area of 0 ha, while the largest area is in the rather low vegetation class with an area of 43.64. The sentinel-2A image in 2021 is the smallest in the very high vegetation class with an area of 0 ha, while the largest area is in the high vegetation class with an area of 54.09 ha. The 2022 sentinel-2A image is the smallest in the high vegetation class and very high vegetation with an area of 0 ha, while the largest area in the rather low vegetation class with an area of 55.19 ha. The 2023 sentinel-2A image is the smallest in the medium vegetation class, the vegetation is quite high, the vegetation is high and the vegetation is very high with an area of 0 ha, while the largest area is in the rather low vegetation class with an area of 55.28 ha.

Changes in land greenness in PT Arutmin Indonesia's RPT NPLCT area with sentinel-2A imagery from 2019 to 2020, 38.41 ha experienced reforestation, 1.65 ha experienced deforestation and 58.14 ha did not change. Sentinel-2A image from 2020 to 2021, 79.09 ha experienced reforestation, 1.35 ha experienced deforestation and 17.68 ha did not change. Sentinel-2A image from 2021 to 2022, 1.08 ha experienced reforestation, 79.48 ha experienced deforestation and 17.68 ha did not change. Sentinel-2A imagery from 2022 to 2023, 0.47 ha experienced reforestation, 40.65 ha experienced deforestation and 57.17 ha did not change. The sentinel-2A image changes from 2019 to 2023, 2.27 ha is reforested, 20.35 ha is deforested and 75.64 ha is unchanged.

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