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SPATIAL DISTRIBUTION ANALYSIS OF OXYGEN (O_2) BY USING *IN SITU* DATA AND LANDSAT 8 IMAGERY (STUDY CASE: GILI IYANG, SUMENEP)

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ABSTRACT

All living things need O_2 for breathing. O_2 was functioned to establish the metabolism process or the exchange of substances which were produced the energy for the growth and reproduction. The purpose of this study was to analyze the spatial distribution of O_2 content at the region of Gili Iyang by using chemical electro method. The content of O_2 analyzing was identified by vegetation index value using Enhanced Vegetation Index (EVI) algorithm through Landsat 8, and it relationship with Digital Elevation Model (DEM) data. The result of the study was obtained the average of oxygen content at Gili Iyang of 20.9 %. The relationship between EVI and O_2 showed the low correlation with R^2 = 0.2236. The low correlation was also shown in relation between DEM and O_2 content (R^2 = 0.1962). It means there was not relationship between EVI, DEM and O_2 content in the Gili Iyang.

Keywords: Oxygen, Digital Elevation Model (DEM), Enhanced Vegetation Index (EVI), Landsat 8.

INTRODUCTION

Indonesia is an archipelagoes country with a sea area was larger than the land (Nontji, 2005 *in* Zulkarnain et al, 2013). Gili Iyang is a small island located between the clusters of islands in the eastern of Madura Island. The concentration of O_2 in this island is very high with average of 21.4% (Jaelani et al, 2016).

O_2 was needed by all living things for the process of respiration. Humans being could live in the air that only contains 17 percent O_2 per volume, and yet when the concentration was less than this, the breathing became difficult and the symptom of anoxia (lack of O_2) appears. Victims became drowsy, unable to think clearly, and finally got into the unconsciousness (Scarlett, 1958).

This study was aimed to analyze the distribution of O_2 levels by performing direct measurements in the field (*in situ*) using an electrochemical method. The parameters for analyzing oxygen levels was obtained by using remote sensing technology to identify the value of vegetation index that used an algorithm of Enhanced Vegetation Index (EVI) through Landsat 8 imagery.

Another parameter that was used to analyze the distribution of O_2 levels was by seeing the topography condition in the region of Gili Iyang to investigate the influence of elevation on the O_2 levels by used data from the Digital Elevation Model (DEM). DEM was a continuously

digital picture according to the space of the state of the earth's surface relief. Attributes form regions / slope that could be derived from the DEM, as follows: the slope, slope shape, slope aspect, slope length, slope shape, and the difference in altitude (Buyung & Salwati, 2008).

According to Tempfli (1991), DEM is the digital data that describes the geometry of the shape of the earth's surface or its part which consists of a set of coordinate points sampling results from the surface with an algorithm that defined the surface using a set of coordinates.

MATERIALS AND METHODS

Study Area and Data Collection

This research was conducted in the area of Gili Iyang, Sub District of Dungkek, Sumenep Madura Island, East Java Province. Geographically Gili Iyang is located between 6.96^0 - 7.01^0 S and 114.15^0 - 114.19^0 E.

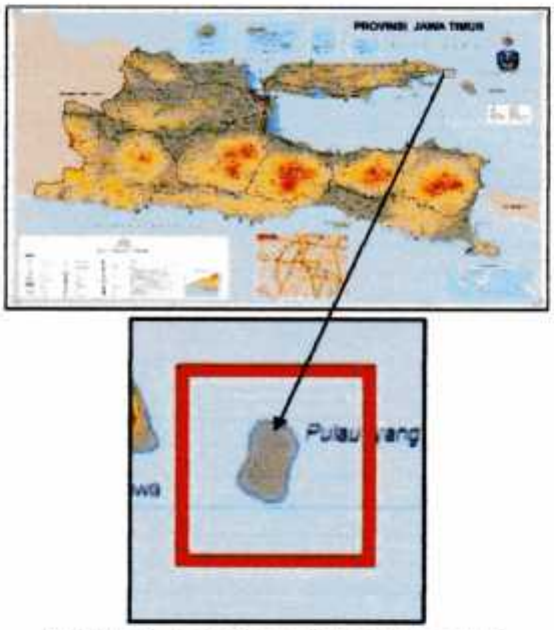

Figure 1. Location of the Research

Data Acquisition

a. *In situ* data
In situ data was collected by measuring collection the levels of O_2 and temperature using the DO Meter Lutron 5510, while the field coordinates was measured using HandHeld GPS. The distribution of sample points was done randomly at 16 stations with different elevation above the sea level. The distribution of the stations and coordinates observation were presented in the following table:

Table 1. Field Measurement Coordinates

Station	Longitude (°)	Latitude (°)
ST 1	114.17349	-6.96955
ST 2	114.16871	-6.97123
ST 3	114.17826	-6.97446
ST 4	114.18559	-6.97716
ST 5	114.16759	-6.98051
ST 6	114.16939	-6.98142
ST 7	114.17246	-6.98361
ST 8	114.17731	-6.9838
ST 9	114.17926	-6.98918
ST 10	114.18027	-6.98941
ST 11	114.18418	-6.98873
ST 12	114.17893	-7.00082
ST 13	114.17499	-7.00201
ST 14	114.16341	-7.00014
ST 15	114.16193	-6.99725
ST 16	114.16541	-6.98233

b. Landsat 8 Imagery
Imagery used in this study was the image of the Landsat 8 satellite recorded on October 15, 2015 in the area around Gili Iyang, Sumenep, Madura Island at a path/row = 117/065. The data was ordered and downloaded through http://espa.cr.usgs.gov/.

c. Digital Elevation Model (DEM)
DEM data used in this research was data downloaded through software of Global Mapper particularly the region of Gili Iyang.

Phase Data Processing

Landsat 8 used was the surface reflectance (SR) that has been atmospherically corrected. The vegetation index value was calculated from Landsat 8 – SR data. The algorithm used to analyze the vegetation index was the algorithm Enhanced Vegetation Index (EVI). Based on the research of Liu and Huete (1995), EVI algorithm could be written as follows:

$$EVI = G\ x\ \frac{NIR-RED}{NIR+(C1\ x\ RED-C2\ x\ BLUE)+L}$$

Where:

NIR = Value canal near infrared reflectance
RED = Reflectance value of the red channel

BLUE = Reflectance value of the blue channel
C1 = The effect of atmospheric correction coefficients in the red channel
C2 = Correction coefficients atmospheric influences on the blue channel
L = Background illumination correction ground
G = *gain factor*

The data from 16 stations were extracted following field coordinates. All of the data processing in this study was performed using software BEAM - VISAT 5.0. From the processed image, the coefficient of determination (R^2) between the field measurement data (content of O_2) and the value of vegetation index were calculated.

DEM data processing was more devoted to the altitude only. The results of the DEM processing were used to see the elevation difference at every point of the measurement of O_2.

RESULTS AND DISCUSSION

Analysis of Vegetation Index

Vegetation index is a indication of the optical level of greenness of vegetation canopy, the composite nature of the composite of leaves, leaf area, and a canopy covered by the vegetation (Huete, 2011). Enhanced Vegetation Index (EVI) is a vegetation index that was developed to minimize the effect of background canopy and atmospheric variations that better than NDVI.

EVI was calculated by using the reflectance of the blue band (0.45 – 0.51 µm), red band (0.64 – 0.67 µm), and near infrared (0.85 – 0.88 µm). Here is a table of field measurements of O_2 and EVI value from Landsat 8 data.

Table 2. Results of Measurement of O_2 Content and EVI

Stations	EVI	O_2 Content (%) (*in situ*)
St 1	0.21163863	20.9
St 2	0.2332807	20.8
St 3	0.1971175	20.4
St 4	0.24284512	20.7
St 5	0.20165534	21
St 6	0.1903107	20.8
St 7	0.18200293	21.3
St 8	0.20591395	20.6
St 9	0.19659388	20.8
St 10	0.20280726	20.3
St 11	0.16036086	21.5
St 12	0.1791406	21.1
St 13	0.19634955	21.2
St 14	0.22291346	21
St 15	0.23698081	20.8
St 16	0.20364502	20.7
Average	0.203972269	20.9

Table 2 shown that O_2 levels in Gili Iyang was very high with average of 20.9%. The average value of EVI obtained from Landsat 8 data was very low of 0.203972269. The low value of index vegetation caused Gili Iyang was in dry conditions. Therefore it could be concluded that, the low value of the vegetation was not affected by the high level of O_2.

Regression Model

The O_2 content could not be processed by using satellite data. To determine the relationship between the data in this study, the regression model was used. The relation (R^2) between O_2 content and EVI was 0.2236. This result showed a low relationship between these data. The relation between oxygen content and EVI could be seen in the figure 2 below:

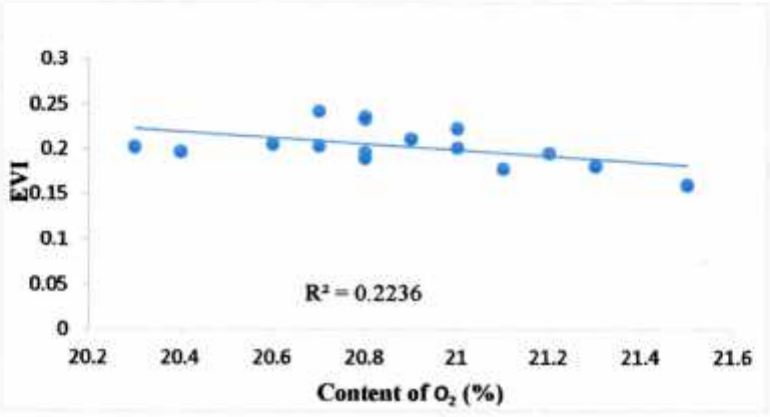

Figure 2. The relation between O_2 content and EVI

Thus the weakness of correlation between O_2 content and EVI was caused by field campaign was performed during a long dry season indicated by brown-leaves vegetation, condition within the area of Gili Iyang was suitable for vegetation analysis. The condition of Gili Iyang was shown in figure 3 below:

Figure 3. Landsat 8, recorded in 15th October 2015 (RGB 7;5;3)

DEM Analysis

In this study, DEM was used to see the topography condition of Gili Iyang area specifically for the elevation. The elevation result was 0 – 45 m. DEM was classified into 6 classes to analyze the effect of elevation. The relationship between elevation and content of O_2 was presented in the table 3 below:

Table 3. The relationship between elevation and content of O_2

Class	Elevation (m)	Stations	Average O_2 Levels (%)
1	0 - 5	11	21.5
2	5 _ 14	2	20.8
		14	
		15	
		16	
3	14 - 22	4	20.7
4	22 - 28	1	20.8
		5	
		8	
		9	
		10	
		13	
5	28 - 34	12	21.1
6	34 - 45	3	20.8
		6	
		7	

Based on Table 3, the highest of O_2 content was produced 21.5% at station 11 with the range of elevation 0 to 5 m. Meanwhile the lowest of O_2 content was obtained 20.7% at station 4 with the range of 14 to 22 m.

The correlation between O_2 content and elevation could be seen in the figure 4.

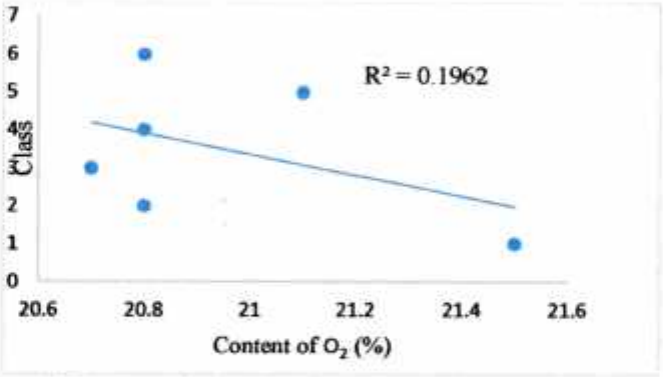

Figure. 4. The correlation between the elevation and O_2 levels

Figure 4 shown that the correlation between elevation and levels of O_2 had a low correlation. The elevation in figure 4 based on classification that made in previous stage. The low correlation produced of 0.1962. It means, there was not relationship between elevation and O_2 content in the Gili Iyang.

CONCLUSION

Study spatial distribution analysis of O_2 by using *in situ* data and Landsat 8 imagery in the Gili Iyang has been done. The levels of O_2 in this island is very high with average 20.9%. The relationship (R^2) between the O_2 content and EVI was 0.2236. These results indicated low correlation between them. The low correlation because the research conducted during dry season. Therefore, the vegetation in the area of Gili Iyang was in a poor condition. The low correlation was also shown in relation between DEM and Oxygen content (R^2 = 0.1962). It means the elevation level did not affect the O_2 content in Gili Iyang.

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