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The distribution of green open space in Jember City area based on image landsat 8 - OLI

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Abstract. Green open space has an important role in the ecological balance of urban areas with a minimum area that must be approved by 30%. Jember City Region consists of Sumbersari, Kaliwates, and Patrang Sub-Districts which are designated as Regional Activity Centers with four main functions. The distribution of green open space in Jember City can be known quickly and accurately by using remote sensing imagery. The purpose of this study is to study and analyze the distribution of green open space in the city of Jember specifically in the Sub-Districts of Kaliwates, Sumbersari, and Patrang whether it has met the minimum requirement of green open space construction of 30% of the total area. The analysis carried out with the help of Landsat 8-OLI imagery recording 10 June 2018. The method used is the NDVI classification. The results showed that classification of land use using vegetation index is good because it can minimize errors. The total area of determined vegetation green space based on NDVI classification is 23.70 km² or around 24.5% of the total area.

Keywords: green open space, jember, image Landsat 8 - OLI

1. Introduction

Jember Regency has a status as a regional activity center with four main functions, namely the center of government, the center of trade and services, the center of education, and the center of health [1]. Jember Regency has the 3rd largest population in East Java Province [2]. This makes the residents who live in Jember Regency have a dense activity, especially in the city of Jember. The Jember City area examined in this study included Kaliwates Sub-District, Sumbersari Sub-District, and Patrang Sub-District. These three sub-districts are designated as regional activity center in Jember Regency and are areas have higher activity and land use than other sub-districts in the Jember Regency.

Demand for land in the Jember city area continues to increase Besides being densely populated, it also requires an increase in the population who need land, and the construction of facilities to support accessibility such as roads. Increased construction of facilities in housing will reduce vegetation land or green space [3].

The existence of green open space has a role in the development of sustainable urban areas and the ecology of cities that are able to provide economic, social, and environmental benefits. The ecological benefits of green space include providing clean air, water and soil and maintaining the balance of the urban natural environment [4].

Landsat 8-OLI imagery is able to display green open space in Patrang, Kaliwates and Sumbersari Sub-Districts quickly and efficiently. The use of Landsat 8-OLI imagery in this study as



the main data source to determine the distribution of green space in the City of Jember which has the status as a Regional Activity Center. The distribution of green open space in the city area of Jember, especially in the Sub-Districts of Kaliwates, Summersari, and Patrang needs to be known to see whether the distribution meets the provisions in accordance with Law No. 26 of 2007 regarding the area of green space in the city area of 30% of the total area.

This study aims to determine and analyze the distribution of green open space in the city of Jember, especially in the Sub-Districts of Kaliwates, Summersari, and Patrang whether it has met the minimum requirement of green open space construction of 30% of the total area. The analysis carried out with the help of Landsat 8-OLI imagery which is integrated with geographic information systems.

2. Methods

This research was conducted based on the phenomenon of the conversion of green land (green open space) into developed land due to dense activity in the Sub-Districts of Kaliwates, Summersari, and Patrang which have status as the center of regional activities in Jember Regency. The distribution of green open space in three sub-districts was assessed through Landsat 8-OLI imagery, some related secondary data, and field surveys.

Broadly speaking the study includes 3 stages, namely the initial image processing, image processing, and analysis that is integrated with GIS. The distribution of green space in Kaliwates, Summersari, and Patrang Sub-districts is seen by its density through the NDVI vegetation index. Field surveys were conducted to test the accuracy of information obtained through Landsat 8-OLI imagery.

The research material used as primary data was Landsat 8-OLI image recording on June 10, 2018. Secondary data used was infrastructure data found in Kaliwates, Summersari, and Patrang sub-districts that support activities as regional centers of activity obtained from BPS.

2.1 Radiometric Correction

Radiometric correction on Landsat 8-OLI images was carried out to obtain the ToA (Top of Atmospheric) reflectance value and the correction of the sun's elevation angle. This is done so that the pixel value in the image represents the actual reflectance or spectral value of the object. Radiometric correction was used to minimize errors or disturbances during the recording process. The following stages of radiometric correction are performed [5]:

- a. Digital number (DN) conversion be the reflectant value ToA

$$\rho_{\lambda'} = M_{\rho} * Q_{cal} + A_{\rho}$$

Information:

$\rho_{\lambda'}$ = Reflectant value of ToA, without correction of the sun's elevation angle

M_{ρ} = Reflectant _MULT_BAND_x, x is a band number

Q_{cal} = DN Value

A_{ρ} = Reflectant _ADD_BAND_x, x is a band number

- b. Correction of the sun's elevation angle

$$\rho_{\lambda} = \frac{\rho_{\lambda'}}{\cos(\theta_{SZ})} = \frac{\rho_{\lambda'}}{\sin(\theta_{SE})}$$

Information:

ρ_{λ} = Reflectant value of ToA

θ_{SE} = solar elevation value

θ_{SZ} = zenith angle of the sun, $\theta_{SZ} = 90^{\circ} - \theta_{SE}$

2.2 NDVI ((*Normalized Difference Vegetation Index*))

NDVI is able to highlight aspects of vegetation density and is a combination of enhancement technique and image reduction technique. The channel used is the red channel and near infrared, both channels have different sensitivity to vegetation. The leaf cell structure (chlorophyll) reflect back the near infrared rays it receives, and will absorb light from the red channel [6].

NDVI vegetation index has been widely used in various green space studies. The transformation value of the NDVI vegetation index ranges from -1 to +1, the higher the NDVI value (close to +1), the higher the vegetation density [7]. According to Danoedoro [8], it this that Equation NDVI algorithm is:

$$NDVI = \frac{(\rho_{near\ infrared} - \rho_{red})}{(\rho_{near\ infrared} + \rho_{red})}$$

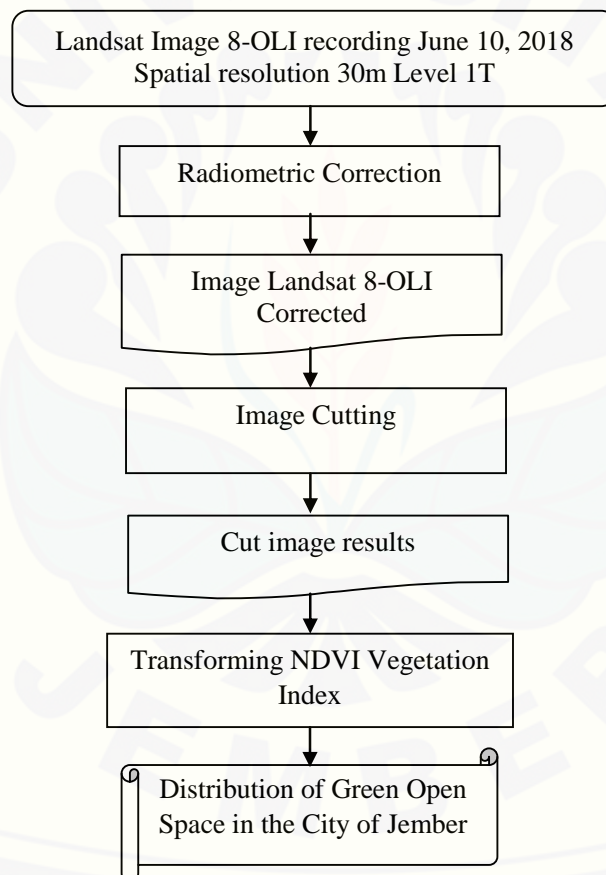


Figure 1. Processing Flowchart Image Landsat 8-OLI

3. Result and Discussion

Initial processing of Landsat 8 imagery was carried out in the Jember City area, namely Kaliwates, Summersari and Patrang Sub-Districts. The results of image pre-processing can be seen from the reflectant values displayed by Landsat 8 images before and after the correction of the ToA (Top of Atmosphere) and correction of the sun's elevation angle (Figure 2). The image display is shown by displaying a color composite band 5, 4, and 3.

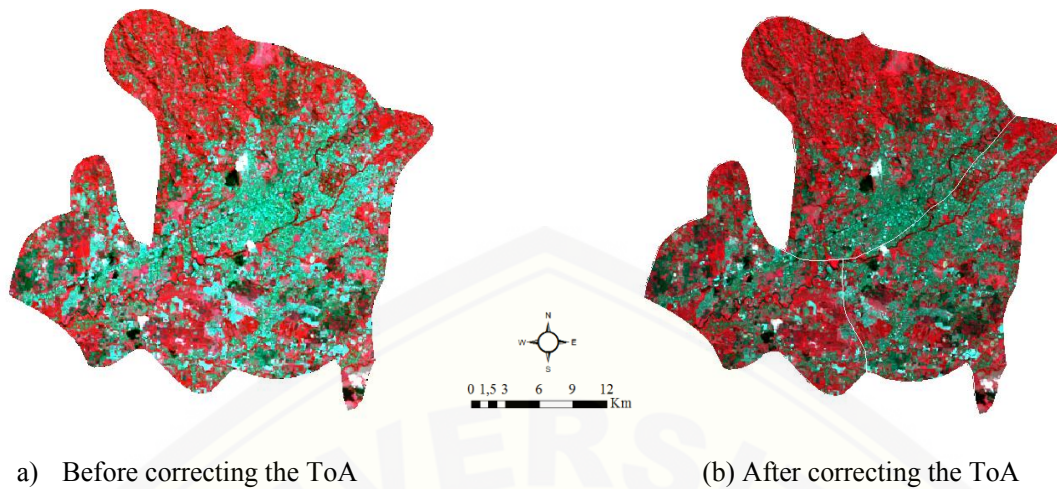


Figure 2. Image Landsat 8 - OLI composite Band 543

The Landsat 8 image that has been corrected to the ToA level (Figure 2.b) display the reflectance value of the object which can then be analyzed through the NDVI classification. The greenness index displayed by NDVI is obtained from calculations between the near infrared band (5) and the red band (4).

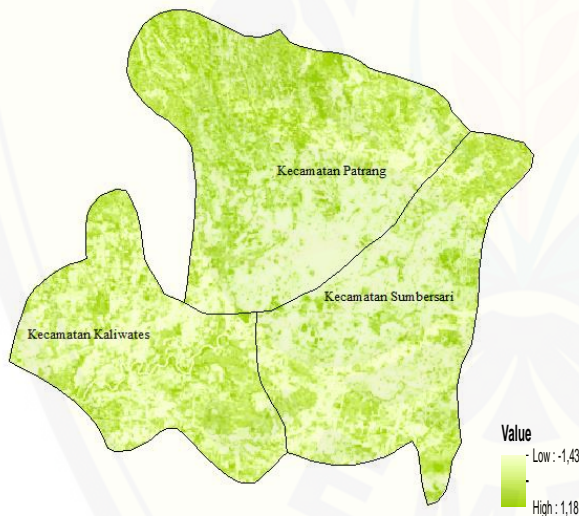


Figure 3. NDVI Vegetation Index

Table 1. Green Open Space Area

No	Land Class	Large (Km ²)
1	Vegetation Stand of Green Open Space	23,70
2	Vegetation non Stand of Green Open Space	32,75
3	Land Built Up	40,15
	Total	96,6

Jember City Region with the status of regional activity center consisting of Summersari, Kaliwates, and Patrang Sub-districts based on Table 1 has an area of standing vegetation green open space of 24.5%. Green open space of standing vegetation is dominated in plantation areas with cambium vegetation. Non-standing vegetation green space is dominated by rice fields and fields with a percentage of 33.9%, and the percentage of land developed at 41.5%. Constructed land is generally intended for settlements, commercial areas, government areas, trade and service areas, and education areas.

The central area of Jember City based on NDVI values has few green areas, because it is dominated by developed land. Vegetation land shown in green (Figure 3) has an NDVI value between 0.5 - 1.18. The highest NDVI value is found in the green open space of

standing vegetation area dominated by cambium plants. Non-standing vegetation green space consisting of rice fields, fields, fields and shrubs have NDVI values <0.5 .

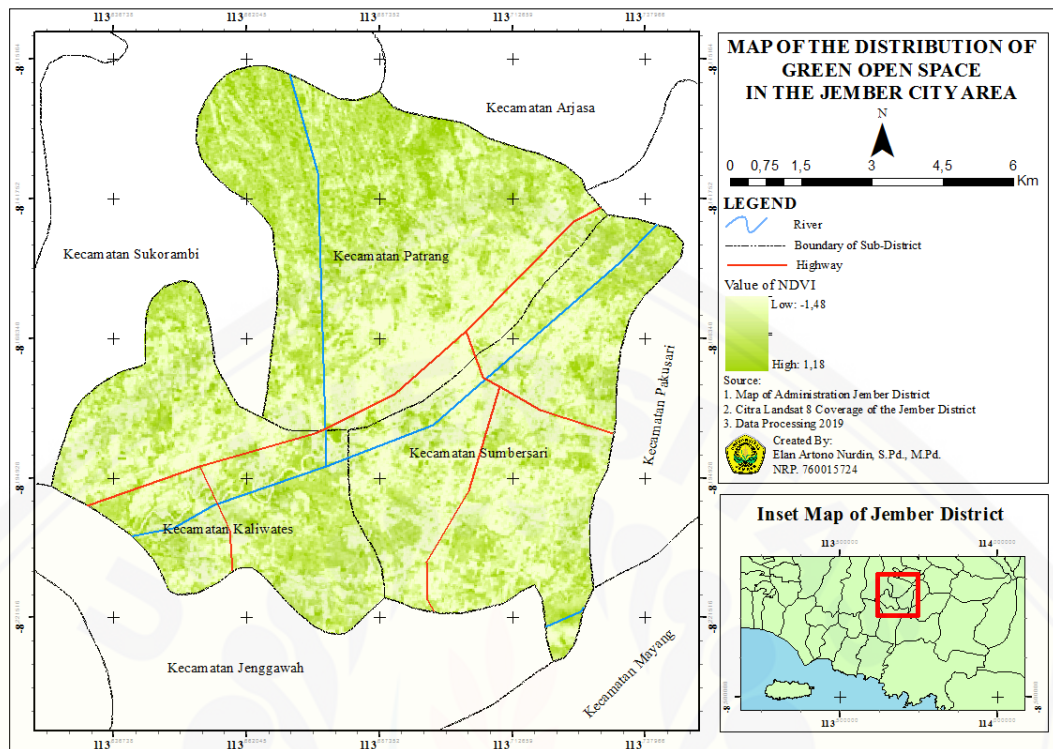


Figure 4. Map of The Distribution of Green Open Space In The Jember City Area

Based on the map above, the central area of Jember City based on NDVI values has few green areas, because it is dominated by developed land. Vegetation land shown in green areas (Figure 4) has an NDVI value between 0,5 - 1,18. The highest NDVI value is found in the green open space of standing vegetation area dominated by cambium plants. Non-standing vegetation green open space consisting of rice fields, fields, fields and shrubs have NDVI values <0.5 .

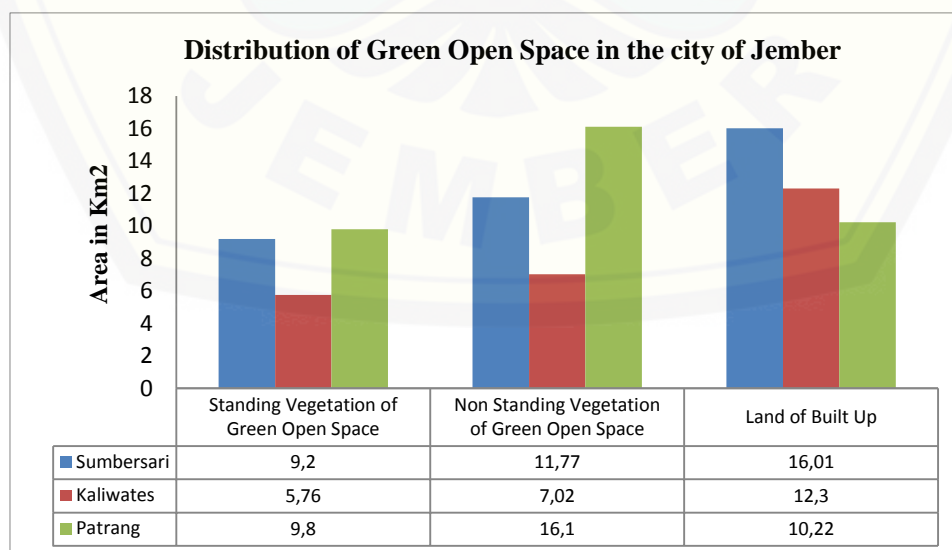


Figure 5. Diagram Distribution of Green Open Space in the City of Jember

Based on the green open space distribution diagram in the city of Jember above, it shows that Patrang Sub-District has the most extensive standing vegetation of green open space and green open space non-standing vegetation compared to the other two sub-districts. Other land cover classes, such as built land, are most extensive in Summersari Sub-District.

Jember City Region with the status of Regional Activity Centers consisting of Summersari, Kaliwates, and Patrang Sub-Districts based on Table 1 has an area of standing vegetation green space of 24.5%. Green Open Space of standing vegetation is dominated in plantation areas with cambium vegetation. Non-standing vegetation green open space is dominated by rice fields and fields with a percentage of 33.9%, and the percentage of land developed at 41.5%. Constructed land is generally intended for settlements, commercial areas, government areas, trade and service areas, and education areas.

4. Conclusion

The accuracy of Landsat 8-OLI's image recording on 10 June, 2018 coverage of the City of Jember covering the Sub-Districts of Kaliwates, Patrang, and Summersari has an accuracy rate of 89%. Based on the interpretation of land cover, it is known that Patrang Sub-District has the highest standing green space area of 9.8 Km². The highest non-standing vegetation cover for green open space is in Patrang Sub-District, covering an area of 16.1 Km². While the land cover class for the largest developed land is owned by Summersari Sub-District with a total area of 16.01 Km². Based on the research that has been done by analyzing the leaf greenness index with NDVI vegetation index and field checks, it is known that the distribution of green space in the City of Jember is quite evenly distributed. The proportion of green open space vegetation in each sub-district is quite high both for standing green space vegetation and non-standing vegetation green space.

Acknowledgment

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