

# Urban and Green Volume Estimation Using Remote Sensing-GIS Techniques: A Case Study of Surabaya, Indonesia

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Surabaya is the second largest city of Indonesia, a center of business, commerce, and industry. Thus, this city continues growing. Geographically, Surabaya is located in the east-northern part of Java island. Therefore, Surabaya becomes a center of trade traffic between islands in eastern Indonesia, due to an average economic growth of 7% per year (Surabaya Government, 2015). However, the growth of building is not equivalent to the growth of green spaces. The city government has developed a garden in several parts but it seems that it does not meet the ideal condition. Thus, the study on green volume and the proportion are becoming important. The study area is the Core Unit Development in Surabaya, including the CBD area. Remote sensing and Geographic Information System (GIS) method are applied in this study. This study uses ALOS AVNIR-2 and WorldView-2 as remote sensing data for determining land use/cover (LU/LC). The maximum likelihood classification technique is applied for the first satellite image, then object based classification is applied for the second one. DSM from ALOS-PRISM is employed to calculate the surface feature height. While for filtering the green area, I perform in two different methods, based on NDVI and LU/LC.

The results show that the total urban (built-up) volume of the study area is  $395.670.112 \text{ m}^3$ . The total green volume based on NDVI filtering is  $37.083.997 \text{ m}^3$ . It yields the green ratio around 9.37%. While the total green volume based on LULC filtering is  $35,589,309 \text{ m}^3$  then it yields the green ratio about 9%. The difference of the green volume from the two methods is about 4.03%, not significant in comparing with the urban volume. However, for the both green ratio, it indicates that the green portion still does not meet the ideal condition.

Keywords: Urban Volume, Green Ratio, Remote Sensing, Geographic Information Systems