Applications of Satellite-borne Remote Sensing for Monitoring Plantation Forests in Tropical Region: A Study of Southern Part of KPH Perhutani Jember, Java, Indonesia

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Jember is situated in the eastern part of Java, Indonesia. Land utilization in this regency is dominated by forests about 121,039.61 ha or 36.75% of the total area. Almost 9% of forested areas of East Java lie in Jember widely. Consequently, Jember is a regency as forest buffer region in the Eastern part of Java. Majority of forest in Jember consists of natural forest and plantation forest which managed by KPH Perhutani Jember. Tree species in the plantation forest managed by KPH Perhutani is dominated by teak, which becomes one of the most valuable woods in Indonesia. Teak plantation forest in Jember regency comprises approximately 28.494,30 ha. The appropriate forest monitoring over KPH Perhutani Jember based on remote sensing data needs to be considered to obtain better planning and management in the plantation forest of Perhutani.

This research aims to identify the land surface types throughout the KPH Perhutani Jember based on the land surface emissivity of Landsat 8 OLI/TIRS. The distribution of land surface types can be used as the base information to create the land cover type distribution over the KPH Perhutani Jember. Therefore, this research also aims to generate land cover types mapping in detail by using the data combinations of SAR (Synthetic Aperture Radar) and optical images from the Sentinel platform, i.e., Sentinel-1 and Sentinel-2. Several data combinations of Sentinel images through Random Forest classifier have examined to understand the appropriate method of Sentinel data combination in delineating the plantation forest distribution and other land cover types in the southern part of KPH Perhutani Jember. In addition, this research aims to examine the vegetation indices (NDVI, SAVI, NDVI_a, and SAVI_a) of Sentinel-2 that reliable to understand and assess standing tree volume over teak plantation forest for maintaining the production of teak in plantation forest of KPH Perhutani Jember.

The result showed that the utilization of remote sensing data could perform appropriate performance in monitoring plantation forest which managed by KPH Perhutani Jember. It is advantageous to understand the land surface types over the study area through land surface emissivity distribution of Landsat-8 OLI/TIRS over the vast area of KPH Perhutani Jember. It showed that the study area is dominated by a fully vegetated area in about 58.32% of the total area. The base information of land surface type from Landsat-8 can be utilized to improve the land cover monitoring over the KPH Perhutani Jember by using several data combinations of Sentinel platforms in classification. The result showed that land cover monitoring over KPH Perhutani Jember by using the integration of Sentinel-1 and Sentinel-2 through Random Forest algorithm performed outstanding results of overall accuracy about 85.0% and 0.814 of Kappa coefficient. This technique can be utilized as an effective method to monitor plantation forest in the tropical region. In the production sector, we also need a reliable technique to maintain teak production in plantation forest of KPH Perhutani Jember. The correlation between NDVI_a and standing tree volume of teak in the plantation forest showed excellent performance than other vegetation indices. The result revealed that the correlation between NDVI_a and standing tree volume of teak plantation forest had the highest correlation with an R^2 value of 0.893. The performance of NDVI_a from Sentinel-2 can be utilized to predict the standing tree volume over Teak stands in the plantation forest managed by KPH Perhutani Jember. All of the results showed that monitoring plantation forest in the tropical region by using remote sensing technology could be utilized as an appropriate and effective method to develop better forest management later on.