

# Multitemporal and Spectral Indices Analysis for Detecting Forest Degradation in West Kalimantan Using Spot-4 Data

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**Abstract:** Logging activity and forest fire are the most critical phenomena that cause forest degradation in Indonesia. These phenomena will cause a reduction in forest crown cover as well as loss of biodiversity which reduces the carbon stock and forest productivity for a long term. Many researches have explored remote sensing technology to detect the logging activity and forest fire in order to overcome difficulties in the conventional field monitoring. In this study, we did a comparison of various remote sensing indices to find the most suitable index for detecting forest degradation in Indonesia. We have analyzed the multitemporal and spectral of SPOT-4 data at least for 7 years since 2006 to 2012 for detecting the changes from undisturbed forest to degraded forest in Sintang Regency, West Kalimantan Province. The spectral indices for forest degradation identification were based on two approach i.e., the Spectral Mixture Analysis (SMA) model using endmember spectral, and spectral reflectance value. The Normalized Difference Fraction Index (NDFI) is generated using SMA model from 4 image fractions i.e., Green Vegetation (GV), shade of vegetation canopy (Shade), Soil, and Nonphotosynthetic Vegetation (NPV). Meanwhile, the Normalized Burned Ratio (NBR) and Normalized Difference Vegetation Index (NDVI) are generated from ratio of reflectances. Based on the multitemporal analysis of those indices, it shows that the forest degradation was detected initially in 2008 up to 2012 in the study area. In 2012, the increasing degree of degraded forest was shown by the widespread of GV fraction which had low value, and also the increasing of the NPV and Soil fractions in the region. All of the indices (NDFI, NBR, NDVI) showed lower value in degraded forest rather than in the intact forest. The Tukey's test has signified that all of the fraction images and all of the indices have significant difference for intact forest and degraded forest. The ground survey was done to verify the degraded forest classification from all of the indices. Through the ground survey data, then the degraded forest was classified into 2 class i.e. Logged and Burned (LB) area and Managed Logging (ML) area. We found that NDFI has higher accuracy to classify the LB area (95 %), ML area (70 %), and intact forest (80 %) rather than NBR or NDVI. The value of NDFI in intact forest is  $0.71 \pm 0.25$ , LB area is  $-0.96 \pm 0.14$ , while in ML is  $0.31 \pm 0.28$ . Thus, it shows that the NDFI is significantly capable to detect the forest degradation in the tropical rain forest of West Kalimantan.

**Key Words:** Forest degradation, Spectral Mixture Analysis (SMA), NDFI, NBR, NDVI.