

Assessing Borneo's tropical forests and plantations: a multi-sensor remote sensing and geospatial MCDA approach to environmental sustainability

ABSTRACT

The assessment of environmental sustainability is of utmost importance for the forests and plantations in Borneo, given the critical need for environmental protection through the identification and mitigation of potential risks. This study was conducted to assess the environmental sustainability of tropical forest and plantations landscape, a case study in northern Sabah, Malaysian Borneo. Applications of the latest high-resolution multi-sensor remote sensing and geospatial MCDA are cost-effective and useful for large-scale environmental sustainability assessment. The land use land cover (LULC) of the study area was mapped with synergistic use of Sentinel-1 Synthetic Aperture Radar (SAR) and Sentinel-2 optical and high-resolution PlanetScope satellite imageries, resulting in overall accuracy of 87.24%. Five sustainability indicator layers: slope erosion protection, river buffer, landscape connectivity and quality, high conservation value (HCV), and water turbidity were developed from the LULC map, ancillary datasets of SRTM, and forest operation basemap with reference to standards from the Environment Protection Department (EPD), Roundtable on Sustainable Palm Oil (RSPO), and Forest Management Plan (FMP) for the analysis using multi-criteria decision analysis (MCDA) model. The results revealed that overall, the study areas are in the high sustainability category at 61%, medium at 31%, and low at only 8%. We analyzed the environmental sustainability of five land use boundaries, and the results showed that Industrial Tree Plantations (ITP) and Village Reserve are mostly in the high category. Meanwhile, oil palm plantations, rubber plantations, and forest reserve (FR) are the majority in the medium category. Both oil palm and rubber plantations are a majority in the medium class due to monocropping land use type having low landscape connectivity and quality individual sustainability indicator layer. The study presented the concept of use of multi-sensor remote sensing for LULC mapping with geospatial MCDA for environmental sustainability assessment useful to stakeholders for improving the management plan also contributing toward the progress of achieving UNSDGs and addressing REDD+.