

# Evaluating Land Use and Above Ground Biomass Dynamics in a Tropical Forest-Oil Palm Landscape in Borneo Using Optical Remote Sensing

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**Abstract:** Over the past several decades, a significant proportion of Malaysian Borneo's rainforests have undergone several rounds of deforestation and conversion to oil palm plantations. Management of human dominated ecosystems such as these requires a detailed evaluation of AGB and forest structure across the landscape and how these are affected by varying levels of disturbance. Combination of field studies and remote sensing data has been extensively used for evaluating the variation of AGB and forest structure at a landscape level. This study explores the utility of optical remote sensing (RS) and field data in estimating variations in forest structure and above ground biomass (AGB) in East Sabah, Malaysia. The study area is a mixed landscape comprising of pristine old growth forests, forests that have undergone varying logging rotations (ranging from slight logging to heavily logging) and oil palm plantations. The field data pertaining to forest stand parameters and AGB were collected from 90 riparian and 60 non-riparian plots in the study region. Main objectives are: (a) To examine whether it is possible to distinguish between old growth primary forests, riparian forests, forest that had undergone different logging intensities and oil palm from the spectral characteristics of Landsat TM and SPOT 5 data (b) To examine if texture based measures can provide insights into the spatial variation of forest structure and biomass dynamics across the different forest types (c) To generate biomass estimation models of the study area using remote sensing data.

Multiple regression techniques were applied using band reflectance, vegetation indices and Grey Level Co-Occurrence Matrix (GLCM) texture features as predictor variables to identify the variation in AGB and forest structure across the different land use types. The ability of these variables derived from the aforementioned methods to distinguish between different land use types was examined. The research established that vegetation indices derived from Landsat TM and SPOT 5 data have only a limited potential to distinguish the different land use types present in the study area. Vegetation indices derived from Landsat and SPOT data (such as NDVI) can distinguish between major land use types such as old growth pristine

forests and oil palm but not between forests having different logging intensities. On the other hand, GLCM texture derived variables could distinguish between forests that had undergone different logging intensities and showed a strong correlation with forest stand parameters and biomass of the different land use types. Further, texture based variables could identify fragmented forests like the riparian forests. Hence it can be concluded that the use of texture analysis opens up the possibility of distinguishing between land use types that have undergone varying levels of disturbance, isolated forests and developing different biomass estimate models for different land use types.

*Key words:* Borneo, rainforests, Landsat, Grey Level Co-Occurrence Matrix, texture analysis