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RESEARCH PAPER

Temporal dynamics of above ground biomass of Kaimoor Wildlife Sanctuary, Uttar Pradesh, India: conjunctive use of field and Landsat data

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Abstract
The present study assesses the temporal dynamics of above ground biomass (AGB) in Kaimoor Wildlife Sanctuary (KWS), Uttar Pradesh, India using series of Landsat data for the years 1989, 2000, 2010 and 2018. The satellite images were pre-processed for surface reflectance, and subsequently we computed Normalized Difference Vegetation Index (NDVI), Soil Adjusted Vegetation Index (SAVI), and Enhanced Vegetation Index (EVI). A forest density map was generated by slicing the computed NDVI and this was used as a basis for sampling strategy. A total of 30 sampling locations were randomly identified. Plot size of 30 m × 30 m was established. Tree species were enumerated at each plot and the girth at breast height and tree height measurements were recorded for the year 2018. Tree and plot level AGB (i.e. AGB_F, t ha^{-1}) was computed by multiplying the tree volume and specific gravity of wood. AGB (i.e. AGB_P) prediction models were developed as linear regression equations for the year 2018 by assessing the vegetation indices and the AGB_F. The significant AGB_P models ($R^2 = 0.94$; $P = 0.0001$) were applied for all study years after the data correction among the Landsat sensor series. The AGB_P was over estimated (22.67 t ha^{-1}; 7.75%) compared to AGB_F (t ha^{-1}). Moreover, EVI ($R^2 = 0.90$) was found to be a better predictor for AGB compared to NDVI ($R^2 = 0.69$) or SAVI ($R^2 = 0.77$). The AGB_P of KWS ranged between 289 ± 36 (in 1989) and 292 ± 40 (in 2018) with an average decadal positive change of 1.06%.

Keywords Normalized Difference Vegetation Index (NDVI) · Enhanced Vegetation Index (EVI) · Soil Adjusted Vegetation Index (SAVI) · Biomass · Kaimoor · Tropical forests · Regression

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Introduction

The Intergovernmental Panel on Climate Change (IPCC) stressed the importance of terrestrial biomass for carbon sequestration, deforestation, global warming, and climate change modelling (IPCC 2007). Biomass mapping over a large area provides a specific view of carbon sequestration (Galidaki et al. 2017; Pan et al. 2011; Brown and Schroeder 1999). Due to continuous changes/accumulation in live biomass and losses due to fire, deforestation, and natural calamities, continuous monitoring and mapping of biomass are essential (Kumar and Mutanga 2017). Terrestrial biomass, in general, includes the aboveground biomass (AGB), belowground biomass (BGB), litter, woody debris, and soil organic matter (Egglestan et al. 2006; Meena et al. 2019). The AGB received considerable attention over the last few decades, as a 'live' biomass component for carbon stock and climate change studies (Rodger 1993; Gibbs et al. 2007). Due to the difficulty in collecting field data of belowground