Connecting Satellite Based Spectral Modelling Approach and Forest Inventory to Model Biomass and Carbon Stocks in Natural and Planted Forest over part of Semi-arid zone, India

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Forests have been recognized as having important mitigation potential because of their critical role in the global carbon cycle and significant potential to capture and hold carbon. Biomass is an important parameter to assess the atmospheric carbon that is harvested by trees.

This study describes an effort to estimate regional level Above Ground Biomass (AGB) and carbon from plot to point from multi-season MODIS data for a part of semi-arid zone i.e. Madhya Pradesh state by establishing a correlation with field observed data. Using clustered sampling approach a total number of 1200 plots were laid on ground for natural forests and planted forests/tress. Stand biomass for each plot was computed from ground inventory using diameter, height, generalized species and interspecies allometric equations.

Spectral modelling was done with red, infra-red and NDVI of different seasons with observed AGB using statistical functions like linear, logarithmic, power and exponential. Various linear and multiple regression models were tested among all seasons and bands, and the best fit model from those was used for predicting biomass and carbon at regional level.

Red band and NDVI spectral reflectance combined with logarithmic function in multiple regression was found to be the best model (r^2=0.5784) for model Y= a +b1* ln (NDVI) + b2 *1/x*(Red) +b3 *sqrt (NDVI) for predicting biomass and Carbon. Predicted biomass value is in the range of 0-134.836t/ha, while total biomass of the area is 5950Tg. Similarly Predicted Carbon content is in the range of 0-64.04tC/ha and total carbon content in the range of 2690TgC.

Results were validated using 50 random points. The observed ABG of these 50 points validated with predicted AGB, a correlation R^2= 0.6003 was obtained indicating biomass and carbon obtained through spectral modelling has given good estimation at regional level.

Comparing biomass and carbon value for natural forest and plantation study explicitly noted that planted forest/trees sequester more carbon because results from a combination of site factors and adaptation of good silvicultural practices, while for natural forest wide variation in stand structure, tree growth, different stages of forest growth cycle, and varying tree density resulted in lower carbon content.

Keywords: Biomass, Spectral Modelling, Carbon Cycle, MODIS