

Fixed Nonlinear Multiregression Based Spectral Modelling Approach for Predictive Quantification of Biomass and Carbon stocks of Tree Outside Forest areas (TOFs) over Arid zone of Jodhpur, Rajasthan, India

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Quantification of TOFs is very necessary to have a better understanding of their role in continuous purification of the atmosphere by mere absorption of CO₂ and the release of oxygen during photosynthesis, considering the large amounts of carbon accumulated per hectare in most TOFs. This work demonstrates a Multiregression based spectral modelling approach for assessment of carbon uptake by TOFs, first ever for Arid zone i.e. Jodhpur, Rajasthan using Landsat 8 data. Data from 46 plots including Leaf area Index (LAI) and Chlorophyll inventory were surveyed for three different TOFs type (Scattered, Linear, and Plantation) to calculate carbon stocks in their biomass. Stand biomass for each plot was computed from ground inventory using diameter, height, generalized species and interspecies allometric equations.

255 spectral models have been tested using 37 spectral vegetation indices and red, green, NIR, SWIR bands with observed biomass, LAI and Chlorophyll, using nonlinear transformation functions. The best fit models were used for prediction analysis.

For scattered areas Moisture Stress Index (MSI), Soil and Atmospherically Resistant Vegetation Index (SARVI) combined with SQRT and natural log function surprisingly found to be best model ($r^2=0.87, p<0.0002$) with predicted biomass in the range of 0.74-188.99t/ha and carbon 0.34-88tC, for linear areas NIR and SWIR combined with SQRT and natural log function found best model ($r^2=0.85, p<0.00004$) with predicted biomass 0.4-122.302t/ha and carbon 0.22-58.09tC, for plantation MSI and SWIR with natural log function found best model ($r^2=0.9, p<0.00015$) with predicted biomass 0.18-45.97t/ha and carbon 0.08-21.83tC. For LAI and chlorophyll Green NDVI and red band with logarithmic function found to be best model ($r^2=0.8, p<0$). Correlation between LAI and Scattered area found less significant ($r^2=0.46$) compared to linear and plantations ($r^2=0.8$). For the study area Predicted Co₂ sequestration noted in the range of 0.25-175.051tCo₂.

Observed and predicted values stated a correlation of ($r^2=0.8$) indicating this approach to be significant for ToFs carbon stocks estimation and their role for Carbon Sequestration over arid regions. Study indicates that for Arid areas trees can produce economical biomass yields under water stress conditions also.

Keywords: Multi regression, Spectral modelling, Biomass, Tree Outside Forest