Aboveground biomass models for trees and shrubs of exclosures in the drylands of Tigray, northern Ethiopia

MENGESTEAB HAILU UBUY[1], TRON EID[2], OLE MARTIN BOLLANDSAS[2], EMIRU BIRHANE[1]

[1] *Mekelle University, Land Resource Management and Environmental Protection, Ethiopia*

[2] *Norwegian University of Life Sciences (NMBU), Fac. of Environmental Sciences and Natural Resource Management, Norway*

Abstract

Globally, drylands cover large areas, but few models for estimation of biomass are developed for the relatively complicated tree and shrub structures found in this particular environment. The main objective was to develop aboveground biomass models generally applicable for all exclosures in the region. A first set of general aboveground biomass models for exclosures in the drylands of the Tigray region, northern Ethiopia were developed from a large dataset with 305 destructively sampled trees and shrubs covering 50 different species and distinct growing conditions. Since biomass revealed nonlinear relationships to the independent tree variables, we used a nonlinear least square modelling technique when fitting models. Selection of models was based on Pseudo- R^2, and root mean square errors and mean prediction errors (MPEs) from a leave-one-out-cross-validation procedure. Pseudo- R^2 and relative (MPEs) of the models varied from 0.76 to 0.84 and -3.7 % to -1.5 %, respectively. The large prediction errors observed when testing the "pan-tropical" models on our data, not only demonstrated the importance of developing the new models, but also indicated that careful considerations should done if the "pantropical" are planned for application in drylands elsewhere than Ethiopia. The new models may be applied generally for exclosures in Tigray region for decision-support in forest management and as basis for reporting changes in carbon stock as required in the Reducing Emissions from Deforestation and forest Degradation (REDD+) mechanism. Since no other appropriate model options exist, we recommend our set of general aboveground biomass models to be applied generally for large-area estimates of aboveground biomass of timber and fuelwood of exclosures in the region.

Keywords: Aboveground biomass, crown width, destructive sampling, exclosures, wood basic density

Contact Address: Mengesteab Hailu Ubuy, Mekelle University, Land Resource Management and Environmental Protection, P.O Box 231 Arid Campus, Mekelle, Ethiopia, e-mail: mengesteabh@gmail.com