Above-ground biomass and carbon stocks of different land cover types in Mt. Elgon, Eastern Uganda

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ABSTRACT

This research applied selected allometric models to estimate the Total Above Ground Biomass and Carbon stocks in three land cover types in Mt. Elgon National Park. The land cover types identified for the study included the Tropical High Forest (THF)-Normal and Degraded and Grassland fields. The vegetation in each land cover type was assessed at four category levels i.e. the mature trees (dbh >10cm), poles (5<10cm dbh), saplings (collar diameter less than 5cm) and undergrowth/ herbaceous layer (height<50cm). For tree density estimation, a 10 inch increment borer was used to extract a small cylindrical sample (4-5cm) at 140cm above the ground, from all the woody species (dbh>10cm) and poles and saplings (dbh 5-10cm) in the temporary plot. Following the extraction of wood core samples, diameter (dbh), height and crown width of each sampled tree were also measured as independent variables for calculating biomass. Tree biomass was derived using three allometric equations developed by Velle, (1997), Ketterings *et al.,* (2001) and Brown *et al.,* (1989). The equations were selected based on their independent variables and the land cover type where the equation was developed from. Calculation of the Mean Squared Error (MSE), the Prediction Sum of Squares (PRESS) statistic and the Predicted R^2 values of the three equations used was done, to establish the most appropriate equation for biomass and carbon estimation. For saplings of diameter less than 5cm, one sapling was uprooted and sub-samples of the foliage, bole and root components were collected and their fresh weight determined from the field. The sub-samples from the saplings and the undergrowths were oven dried to constant weight at 80°C to determine dry-to-wet matter ratios. These ratios were then used to convert the entire sample to oven-dry matter and for analysis of carbon. This study estimated the wood densities of 22 common tree species in Mt. Elgon in Kapchorwa district. The overall average wood density of 0.54 g cm^{-3} reported in this study is comparable to the reported values for trees in Africa which range between 0.58 and 0.67g cm^{-3}. A comparison between the wood densities obtained from the wood samples collected from Mt. Elgon National park in this study and the published wood densities indicated an insignificant difference between the two data sets (P>0.05). The Brown *et al.,* (1989) equation gave the least Mean Squared Error (MSE) and Prediction Sum of Squares (PRESS) and a high Predicted R^2. Therefore, the best model for estimating biomass and carbon in all the land cover types is $Y= \exp \{-2.4090 + 0.9522 \ln (D^2HS)\}$ developed by Brown *et al.,* (1989). The results indicate that the Total Above Ground Biomass (TAGB) was 652.15t/ha, 55.16t/ha and 41.7t/ha in the THF-Normal, THF-Degraded and Grasslands respectively. The TAGC in the THF-Normal was 293.65tCha^{-1}, 25 tCha^{-1} in the THF-Degraded and 18.76 tCha^{-1} in the grassland fields. The choice of an allometric equation in any particular biomass and carbon study is important, as different equations can give rise to very different estimates when applied to the same forest inventory data. This study also revealed that over 90% of sequestered Carbon is lost due to land cover change from THF-Normal to THF-Degraded. This calls for policy makers to come up with interventions to address forest degradation. There is need for local community sensitization on the likely negative impacts of biomass and carbon losses arising from deforestation.