Abstract

Background: Forests provide various ecosystem services. They are natural capitals that enhance nature to regulate itself via carbon sinks. However, anthropogenic and natural factors have altered their CO_2 sequestration and carbon storage potentials. This study is aimed for examining the effect of patch size and biomass extraction on carbon stocks in northern Ethiopia. A total of 61 sample plots measuring 20 m × 20 m size each (0.04 ha) had been systematically assigned on patches classified into three size categories. However, the numbers of plots taken per patch were different with their sizes. Moreover, stump density has been computed at each plot to estimate the difference in the level of disturbance among patches. Carbon stocks had been estimated via models previously developed. One-way ANOVA was used to examine a variation in carbon stocks and sequestration potentials. Besides, a linear regression analysis was discretely done to examine the relationship between patch sizes, disturbance level, and carbon stocks.

Results: The overall aboveground biomass (ton ha^{-1}) for the studied patches was 2059.13. There was a statistically significant variation in carbon stocks (ton ha^{-1}) among patch size categories. The mean levels of disturbance ranges from 10.83% ± 1.30 to 30.8% ± 4.04. However, statistically significant difference in the level of disturbance was observed between large and small patch size categories, respectively ($p < 0.05$). Besides, a regression analysis confirmed a significant and negative relationship between patch size and patch disturbances ($R^2 = 0.65$, $p < 0.05$). However, significant positive relation between carbon stocks (ton ha^{-1}) and patch size ($R^2 = 0.53$, $p < 0.05$) had observed.

Conclusions: In general, patch size and biomass extinction significantly influenced carbon stocks and CO_2 sequestration potentials of forests. Consequently, with the pressing need to mitigate the effects of rising atmospheric CO_2, maximizing carbon storage in the forest ecosystem is

increasingly considered a viable management strategy. Therefore, disturbed land restoration, increasing forest patch size, sustainable management, and conservation of the existing remnant forest patch is needed to enhance carbon stocks and CO_2 sequestration potentials.

Keywords: Aboveground biomass, Carbon stock, CO_2 emissions, forest disturbances, patch size categories, wood density