Carbon Sequestration Potential of Cashew Plantations under Varying Tree Densities in a Dry Zone Agroforestry System

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Cashew (*Anacardium occidentale* L.) is an important perennial crop with significant potential for carbon sequestration in tropical dry zone agroforestry systems. However, information on the influence of planting density on biomass carbon and soil organic carbon (SOC) accumulation under long-term plantation conditions remains limited. This study evaluated the effect of five planting densities on above-ground biomass carbon (AGB), below-ground biomass carbon (BGB), SOC, and total ecosystem carbon (TEC) in a field experiment established in 2012 at the Puttalam Plantation of the Sri Lanka Cashew Corporation. The experiment was arranged in a Randomized Complete Block Design (RCBD) with three replicates using cashew variety WUCC 19. Five spacings were evaluated: 7.62 m × 7.62 m, 7.0 m × 7.0 m, 6.0 m × 6.0 m, 5.4 m × 5.4 m, and 4.8 m × 3.9 m. AGB was estimated using a DBH-based allometric equation, while BGB was derived using the IPCC (2019) Tier 2 root-to-shoot ratio model. TEC was calculated as the sum of biomass carbon and SOC. Data were analyzed using ANOVA followed by Tukey's HSD test at $p < 0.05$. Results showed a significant effect of planting density on carbon sequestration. TEC increased progressively with higher planting density, from 51.0 Mg C ha^{-1} at 7.62 m × 7.62 m spacing to 67.0 Mg C ha^{-1} at 4.8 m × 3.9 m spacing, while intermediate spacings recorded 54.5, 58.5, and 62.5 Mg C ha^{-1}, respectively. Similar increasing trends were observed for AGB, BGB, and SOC. The findings demonstrate that closer planting densities significantly enhance carbon sequestration potential in dry zone cashew agroforestry systems and provide a scientific basis for climate-smart plantation management.

Keywords: Agroforestry, Carbon sequestration, Cashew, Planting density