Carbon Stock and Sequestration Potential of an Agroforestry System in Sabah, Malaysia

ABSTRACT

Total aboveground carbon (TAC) and total soil carbon stock in the agroforestry system at the Balung River Plantation, Sabah, Malaysia were investigated to scientifically support the sustaining of natural forest for mitigating global warming via reducing carbon in the atmosphere. Agroforestry, monoculture, and natural tropical forests were investigated to calculate the carbon stock and sequestration based on three different combinations of oil palm and agarwood in agroforestry systems from 2014 to 2018. These combinations were oil palm (27 years) and agarwood (seven years), oil palm (20 years) and agarwood (seven years), and oil palm (17 years) and agarwood (five years). Monoculture oil palm (16 years), oil palm (six years), and natural tropical forest were set as the control. Three randomly selected plots for agroforestry and monoculture plantation were 0.25 ha (50 × 50 m), respectively, whereas for the natural tropical forest it was 0.09 ha (30 × 30 m). A nondestructive sampling method followed by the allometric equation determined the standing biomass. Organic and shrub layers collected in a square frame (1 × 1 m) were analyzed using the CHN628 series (LECO Corp., MI, USA) for carbon content. Soil bulk density of randomly selected points within the three different layers, that is, 0 to 5, 5 to 10, and 10 to 30 cm were used to determine the total ecosystem carbon (TEC) stock in each agroforestry system which was 79.13, 85.40, and 78.28 Mg C ha−1 , respectively. The TEC in the monoculture oil palm was 76.44 and 60.30 Mg C ha−1 , whereas natural tropical forest had the highest TEC of 287.29 Mg C ha−1 . The forest stand had the highest TEC capacity as compared with the agroforestry and monoculture systems. The impact of planting systems on the TEC showed a statistically significant difference at a 95% confidence interval for the various carbon pools among the agroforestry, monoculture, and natural tropical forests. Therefore, the forest must be sustained because of its higher capacity to store carbon in mitigating global warming.