Estimating Carbon Sequestration by Sugi (*Cryptomeria japonica*) Plantations According to Site and Management Conditions

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Carbon sequestration by plantation forests depends on the site conditions and silvicultural system used. This study estimated the spatial distribution of carbon sequestration by sugi (*Cryptomeria japonica*) plantations in a study area according to site quality and thinning regime.

The study area was the University of Tokyo Forest in Chiba, which is located in the southern Boso Peninsula, Japan. Site index curves were created from height measurements in experimental plots in sugi plantations. Sixty-five sample points were located in sugi plantations, and the heights of three to five dominant trees around each sample point were measured. The site index was calculated for each sample point, estimating the average height at 40 years of age from the average height at each sample point using the site index curves. Site factors were calculated from a digital elevation model (DEM) on a geographic information system (GIS). Using discriminant analysis, a discriminant function with suitable site factors was developed to estimate site quality in the study area. In addition, stand growth was predicted for each site quality using LYCS ver. 2.32 under four thinning conditions: low thinning at thinning frequencies of 0, 1, 3, and 5 years. Carbon sequestration was estimated from the growth of stand volume multiplied by bulk density (0.314), biomass expansion factors (BEF; 1.57 at age ≤ 20 and 1.23 at age > 20), the ratio of total biomass to aboveground biomass (1.25), and carbon factor (0.5). The estimated carbon storage and sequestration for the study area were mapped using GIS according the estimated site quality and specified thinning regimes.

A discriminant function was developed from four site factors: shaded relief, the distance from a ridge, profile curvature, and wetness index. The correctness rate was 60%. For each cell, site quality was mapped using the discriminant function for the four factors on GIS. The average carbon storage per hectare peaked at a thinning frequency of one. Thinning during the young stage increases carbon storage, although frequent and strong thinning regimes decrease carbon storage. The average carbon sequestration per hectare increased with the thinning frequency because more frequent thinning leads to fast grow just after thinning in more stands. These maps enable us to know the change in carbon storage and sequestration over the study area according to the chosen silvicultural system.