

# **Tree Species–Soil Nutrients Association in Unlogged and Logged-over Tropical Forests, Sabah, Borneo**

## **ABSTRACT**

Natural forest cover in Sabah has been decreasing across all forest types for more than two decades since the 1990s, being replaced mostly by man-made forests. This contributes to the overall degradation of the forest ecosystem, which changes soil nutrient content and subsequently modifies forest species composition, as well as vegetation structure. This study investigated the association between soil nutrients and tree species in unlogged and logged tropical lowland forests in Sabah, Borneo, Malaysia. A total of eight and 27 sampling plots were established in randomly placed locations at the Danum Valley Conservation Area representing the unlogged site, as well as the Sapat Kalisun area of the Ulu Segama Forest Complex representing the logged site. Soil samples at two depths (0–5 cm; 5–10 cm) were collected from each plot and analyzed for soil nutrients: total N, available P, inorganic N ( $\text{NO}_3^-$  and  $\text{NH}_4^+$ ), exchangeable cations ( $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ , and  $\text{Na}^+$ ), exchangeable  $\text{Al}^{3+}$ , and exchangeable acidity. Results showed that certain exchangeable cations and soil nutrient concentrations were greater in the unlogged forest compared to the logged forest except for  $\text{K}^+$ ,  $\text{Na}^+$ , and inorganic N. Greater inorganic N concentrations were observed in the logged forest, hence suggesting a dominant shift toward inorganic N in the soil. PCA results indicated that exchangeable acidity and exchangeable  $\text{Al}^{3+}$  were correlated to logged forests, whereas  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  were associated with unlogged forests. CCA ordination showed the existence of association between specific tree species with  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ , and  $\text{Na}^+$  in the unlogged forest only. Logging, to some extent, influenced the status of certain soil nutrients but their association with tree species was complex. This could be attributed to the heterogeneous habitat resulting from past logging disturbances.