Effects of depth and land cover on soil properties as indicated by carbon and nitrogen-stable isotope analysis

ABSTRACT

The aim of this study was to evaluate the effect of soil depths (0-30, 30-60, and 60-90 cm) and landcover changes on selected physicochemical properties in soils transformed from a secondary forest status to plantation status for the cultivation of rubber and oil palm aged 5 and 15 years. Soil physicochemical properties; bulk density (Bd), pH, soil organic matter (SOM), total organic carbon (TOC), total organic nitrogen (TON), and their corresponding isotopes; and $\delta^{13}C$ and $\delta^{15}N$ were determined by conventional methods. The results showed that the content of SOM (3.39%) at 0-30 cm was signifi cantly greater than those of the 30-60 and 60-90 cm depths. The same pattern was demonstrated by the content of TOC and TON. With respect to land use, the secondary forest had signifi cantly greater SOM content than the rubber and oil palm plantations aged 5 years. The same pattern was also observed for the content of TOC and TON by land use. Similarly, the $\delta^{13}C$ value of -26.85% was greatest at the 0-30 cm depth, while by land use the oil palm aged 5 years had the greatest $\delta^{13}C$. Conversely, the $\delta^{15}N$ value of 4.21% was signifi cantly greater at the 60-90 cm depth compared to the 30-60 (1.78%) and the 0-30 cm (-2.03%) depths. The negative value of $\delta^{15}N$ revealed the sources (N was a product of multiple variables such as N fi xation, precipitation, rainstorm, and the use of chemical fertilizers), and the limited nitrogen content in the study area. In conclusion, this study demonstrated that the conversion of secondary forest to plantation enhanced the mineralization of soil organic matter and increased SOC concentrations at the sub soil. Therefore, the conversion of the secondary forest to the oil palm plantations must have resulted in a positive effect by contributing to greater soil organic carbon content.

Keyword: δ13C and δ15N stable isotopes; Carbon cycle; Land use; Agricultural soils; Soil depth