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## Seasonal dynamics of soil carbon and nitrogen stocks with various coffee agroforestry systems in Thailand

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### Abstract

Agroforestry is an alternative agricultural system that can help reduce deforestation, soil erosion, and other environmental issues caused by deforestation. This combination of forest and agriculture can serve as a carbon and nitrogen sink and source. However, seasonal change alters the capacity to store carbon (C) and nitrogen (N) in soil. Therefore, the purpose of this study was to evaluate seasonal dynamics of soil carbon and nitrogen stocks in different coffee agroforestry systems. The study site was conducted at the Nhong Hoi Highland Agricultural Research Station in Chiang Mai province, Thailand. This study included four land use types: (L1) forest, (L2) coffee monoculture, (L3) coffee grown with forest, and (L4) coffee grown with fruit trees (Persimmon). The data was collected in two seasons including rainy and cold seasons. For soil carbon and nitrogen stocks, soil samples were taken at three soil depths: 0–20, 20–40, and 40–60 cm. Soil physico-chemical, and biological properties were analyzed. Moreover, litter traps were used to capture fallen biomass from associated plant species. The results indicated that seasonal changes had no effect on the dynamics of soil carbon and nitrogen stocks (0 – 60 cm) ( $p > 0.05$ ). During the rainy season, L3 had the highest soil carbon stock (71.21 t C ha<sup>-1</sup>) at 0–20 cm, while L4 had the lowest (37.41 t C ha<sup>-1</sup>) ( $p < 0.05$ ). L3 had the trend of having highest soil carbon stock, but there was no statistically significant difference among land use types at 20 – 40 cm and 40 – 60 cm. While seasonal dynamics had the effect on soil nitrogen stock (0 – 60 cm) ( $p = 0.021$ ), rainy season contributed to higher soil nitrogen stock as compared to cold season. N fertiliser application in coffee agroforestry systems led to higher soil nitrogen stock during rainy season (9.64 t N ha<sup>-1</sup>), while cold season had 7.82 t N ha<sup>-1</sup>. During rainy season, L3 had the highest soil nitrogen stock at 0 – 20 and 20 – 40 cm, which the values were 6.09 and 3.58 t N ha<sup>-1</sup>, respectively. However, L1 had the highest soil nitrogen stock in all soil depths during cold season.

**Keywords:** Agroforestry systems, Arabica coffee, highland, northern Thailand