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

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Introduction

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.

Material and Method

- **The study site was conducted at the Nhong Hoi Highland Agricultural Research Station in Chiang Mai province, Thailand (18°55'19.6"N 98°48'55.0"E)**

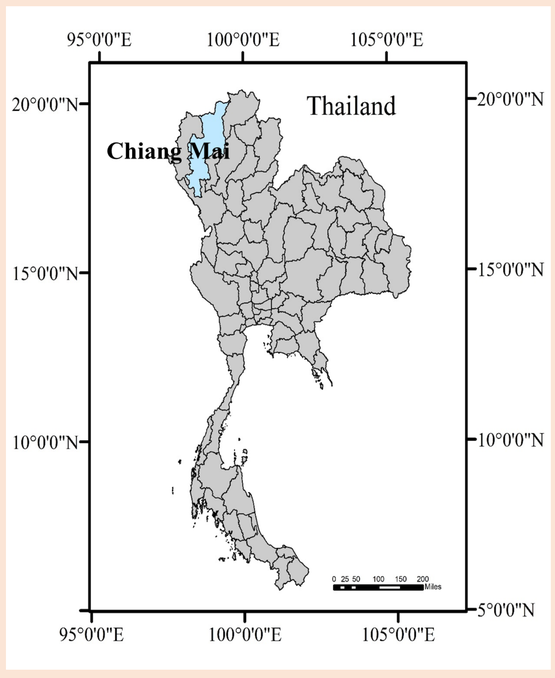

Fig. 1 Location

- **This study included four land use types at three depths:**

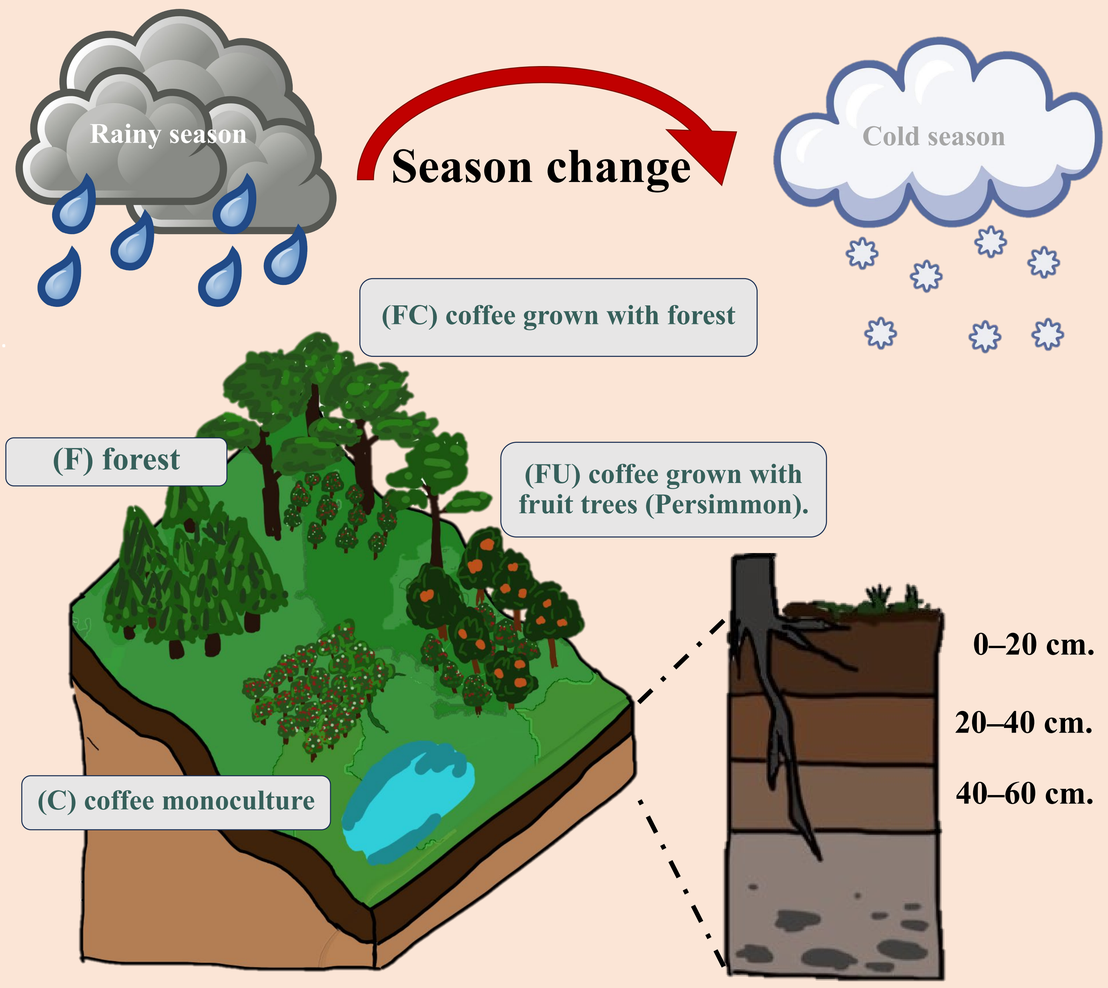

Fig. 2 Sampling model

- **Some soil physico-chemical properties analysis at 3 different soil depts: 0-20 cm, 20-40 cm, and 40-60 cm:**
  - Bulk density
  - Soil moisture content
  - Total carbon (C/N combustion)
  - Total nitrogen (C/N combustion)
- **Litter fall (Litter trap)**

Results

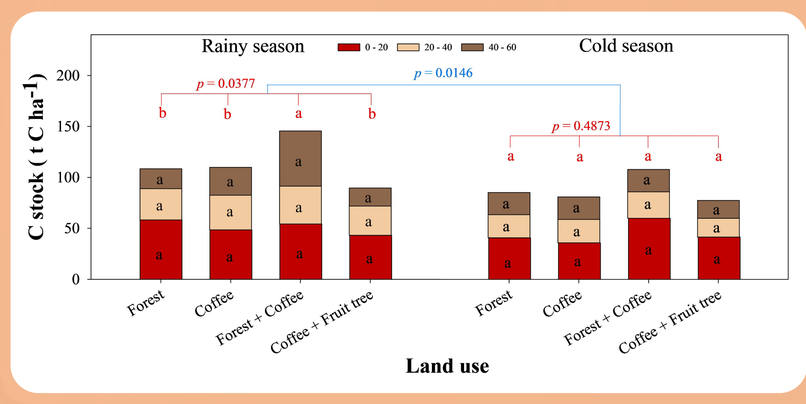

Fig. 3 Mean values of carbon stock across the different land uses, and soil depths in rainy and cold season

The results indicated that seasonal changes had negative effect on the dynamics of soil carbon (0 – 60 cm) ($p < 0.05$). FC had the trend of having highest soil carbon stock, but there was no significant difference among land use types at 0 – 20 cm, 20 – 40 cm, and 40 – 60 cm.

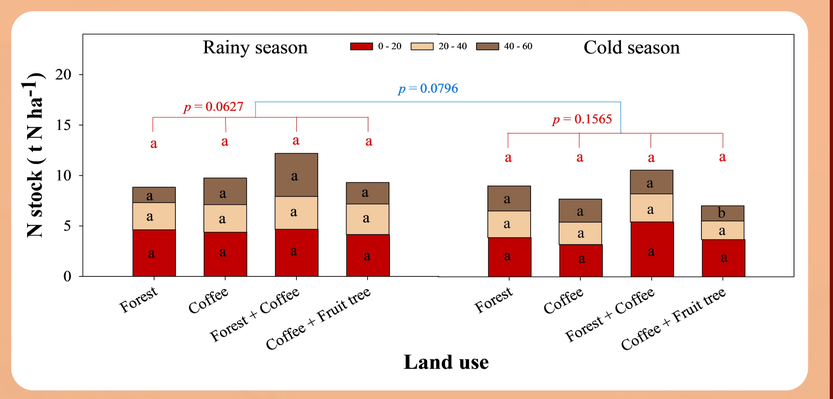

Fig. 4 Mean values of nitrogen stock across the different land uses, and soil depths in rainy and cold season

Seasonal dynamics had the no effect on soil nitrogen stock (0 – 60 cm) ($p > 0.05$), rainy season had a greater soil nitrogen stock than the cold season. During rainy season, FC had the highest soil nitrogen stock at 0 – 20, 20 – 40, and 40 – 60 cm which the values were 4.67, 3.25, and 4.28 t N ha^{-1}, respectively.

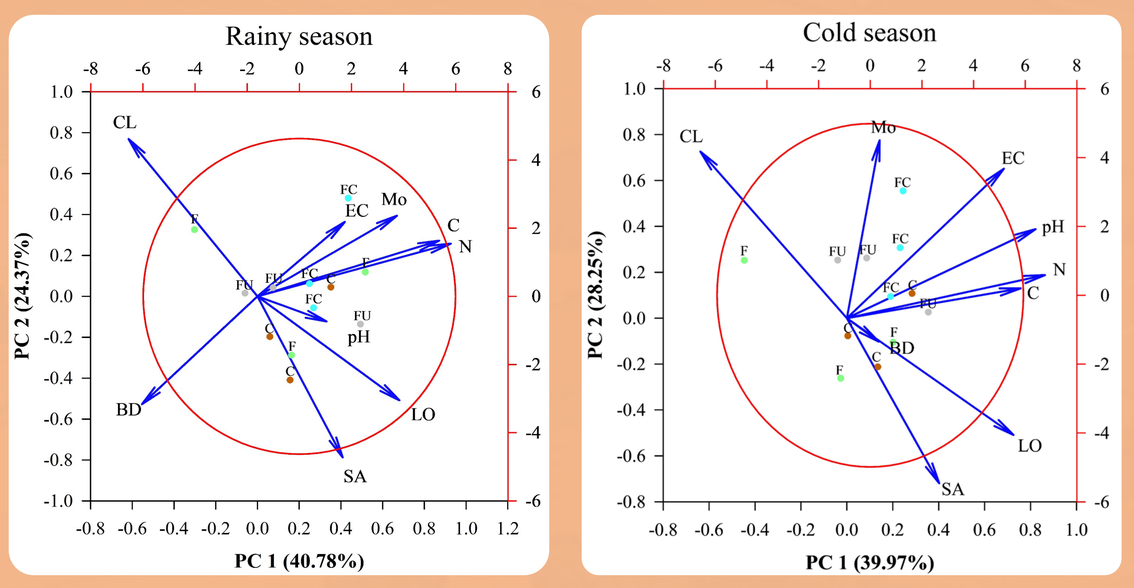

Fig. 5 Principal component analysis (PCA) relationship of soil parameter rainy and cold season. BD: bulk density, C : carbon stock, N : nitrogen stock, Mo: moisture, CL: clay, LO: silt, SA: sand, F: forest, C: coffee monoculture, FC: coffee grown with forest, FU: coffee grown with fruit tree (persimmon).

Conclusions

Seasonal changes do not clearly affect carbon and nitrogen stock. In addition, it was found that agroforestry systems affected nitrogen retention in cold season. The agroforestry system where coffee grown with forest was found to have the highest nitrogen retention and is likely to store the highest amount of carbon in the future.

Acknowledgement

This research was financially supported by Faculty of Agriculture and Chiang Mai University

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