Converting natural forests to different coffee cropping systems affects soil nitrogen transformation in tropical Thailand

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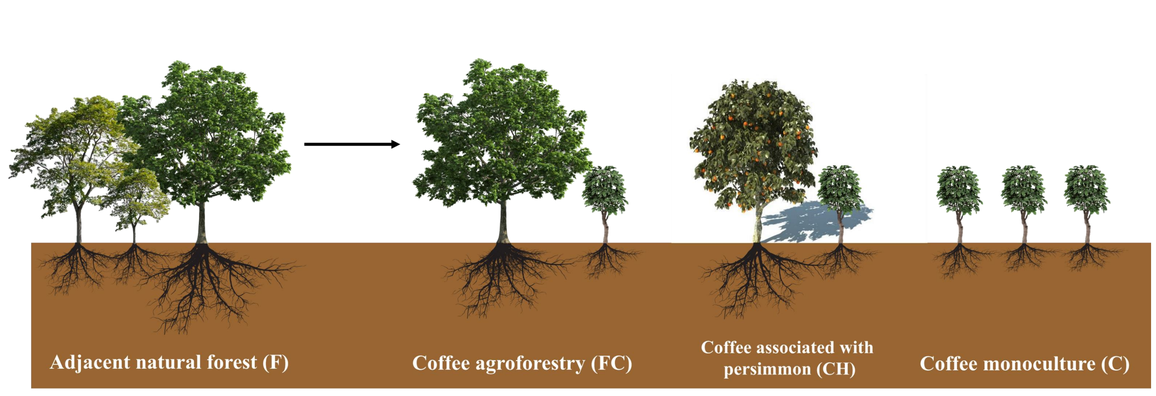
Introduction

- The widespread conversion of natural forests to coffee plantations has become a significant challenge in northern Thailand.
- However, knowledge regarding the changes in soil nitrogen following the conversion of natural forests into coffee plantations remains unclear.
- Therefore, this study aimed to investigate the effect of natural forest conversion to different coffee cropping systems on soil N pools and microbial N transformation rates.

Materials and methods



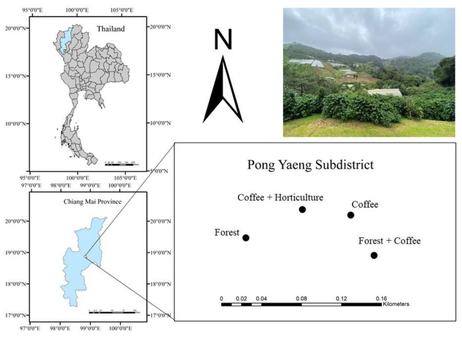


Fig. 1. Location of the study sites and the distribution of the field sample sites in the Nong Hoi Highland Agricultural Station in Pong Yeang Subdistrict, Muang District, Chiang Mai Province, Thailand

Soil sampling

Disturbed soil samples from two depths (0 – 20 and 20 – 40 cm) were collected from four land uses.

Soil analysis

- Soil total N (STN)
- Ammonium (NH_4^+)
- Nitrate (NO_3^-)
- Inorganic N (IN)
- Dissolved organic N (DON)
- Microbial biomass N (MBN)
- Soil N transformation rates were determined using a laboratory incubation.

Conclusion

- Our findings clearly show that converting forests into coffee cropping systems significantly increased NH_4^+, NO_3^-, IN, and DON content while decreasing MBN (except in coffee agroforestry).
- The conversion from forest to all coffee cropping systems enhanced soil nitrification rates, resulting in a significant increase in susceptibility to soil N loss.
- Lower N/I ratios were observed in coffee agroforestry, indicating its potential to reduce the risk of N loss compared to other coffee cropping systems.

Results

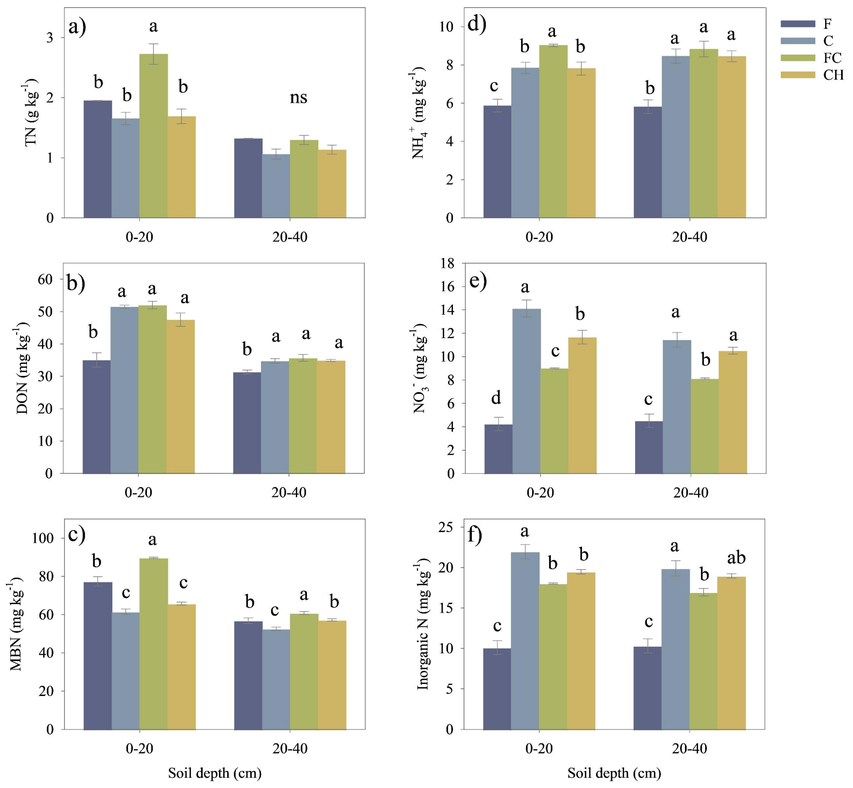


Fig. 2. Effects of conversion from mixed deciduous forests to the different coffee cropping systems on the soil (a) total N, (b) dissolved organic N, (c) microbial biomass N, (d) ammonium, (e) nitrate and (f) inorganic N content. Different lowercase letters within each panel indicate significant differences between land-use types in each soil layer.

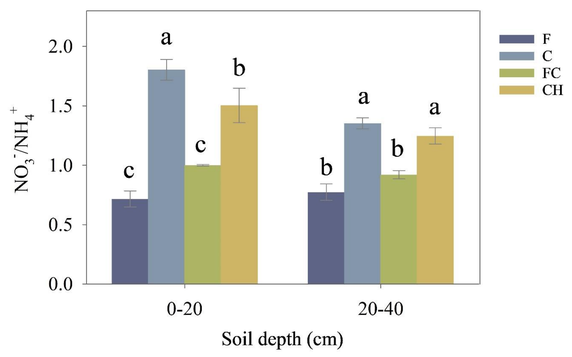


Fig. 3. Changes in soil N availability variables including NO_3^-/NH_4^+ following the conversion of mixed deciduous forests into different coffee cropping systems

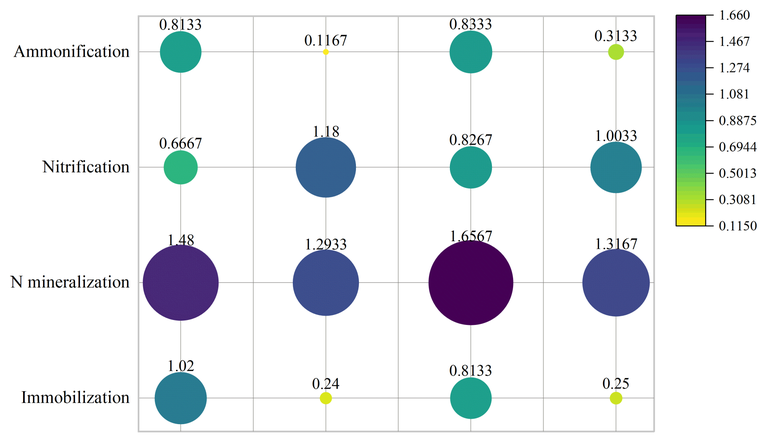


Fig. 4. Changes of soil N transformation rates including net ammonification, N mineralization, nitrification and immobilization following the conversion of mixed deciduous forests into different coffee cropping systems.

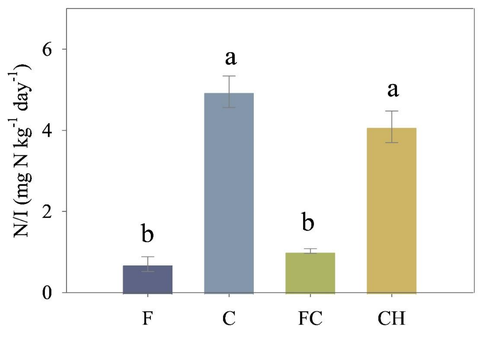


Fig. 5. Changes in nitrification (N) / immobilization (I) values following the conversion of mixed deciduous forests into different coffee cropping systems.

Acknowledgement

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