Study reveals how C:N:P stoichiometry responds to agricultural land use and climate

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Carbon (C), nitrogen (N), and phosphorus (P) are three bioelements with maximal accumulations in areas of abundant life. C:N:P stoichiometry in soils greatly determines nutrient availability for plants and soil

microorganisms, and further reflects the functioning of terrestrial ecosystems.

Soil C:N:P ratios are very susceptible to human activities (e.g., fertilization) and climate factors (e.g., temperature and precipitation). However, how the soil C:N:P stoichiometry is affected by upland and paddy cropping over broad geographical scale remains largely unknown.

A research group led by Prof. Su Yirong from the Institute of Subtropical Agriculture (ISA) of the Chinese Academy of Sciences conducted a study to examine the soil C:N:P stoichiometry in woodland (as control), agricultural upland and paddy from four climate zones (tropics, subtropics, warm temperate, and mid-temperate) across eastern China. The study was published in *Soil and Tillage Research* on Dec. 30.

The researchers collected 720 surface soil samples from 240 sites with adjacent woodland, agricultural upland, and paddy at a depth of 0-15 cm. Total C, N, and P contents and their ratios were determined.

They found that among climate zones, C and N contents and C:N ratios decreased in the order of mid-temperate > tropics > subtropics > warm temperate, whereas C:P and N:P ratios followed the order of subtropics > mid-temperate and tropics > warm-temperate.

"Compared to woodland, upland agriculture decreased the C content, but increased P content, resulting in the decreases of C:N, C:P, and N:P ratios. Hence, uplands are relatively limited by C and N but enriched with P, particularly in warm temperate zone," said Prof. SU.

By contrast, the C, N, and P contents in paddy soils were all increased compared to woodland soils, but larger N and P increase leads to the decreases in C:N and C:P ratios. The higher P content, and consequently lower C:N:P ratios in both agricultural soils are the consequences of

intensive fertilization.

As a whole, the direction of soil C, N, and P contents and their stoichiometric ratios in response to agricultural use was similar in the four climate zones: P increased, but C:N:P ratios decreased. The effects of agricultural use on C:N:P stoichiometry were greater in warmer and wetter zones.

This study provides a comparable dataset on the alteration of soil C, N, and P balances in the main Chinese grain-producing areas subjected to long-term intensive cultivation, which is useful to optimize future agricultural management.

More information: Shengmeng Zheng et al. Stoichiometry of carbon, nitrogen, and phosphorus in soil: Effects of agricultural land use and climate at a continental scale, *Soil and Tillage Research* (2020). DOI: 10.1016/j.still.2020.104903

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