UNRAVELLING SPATIAL HETEROGENEITY OF SOIL LEGACY PHOSPHORUS IN SUBTROPICAL GRASSLANDS

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Agriculturally-driven changes (e.g., P fertilization, manure application) have resulted in pronounced P accumulations in soils – known as 'soil legacy P.' These legacy P reserves serve as long-term non-point sources, inducing downstream eutrophication and ecosystem services degradation. While there is considerable scientific and policy interest in legacy P, its fine-scale spatial heterogeneity, underlying drivers, and scales of variance remain unclear. Here we present an extensive field sampling and analysis of 1,438 surface soils (0-15 cm) across two typical subtropical grasslands – Intensively-Managed (IM) and Semi-Natural (SN) – managed for livestock production. We ask: (*i*) What is the spatial variability and hotspots of soil legacy P? (*ii*) Does soil legacy P vary primarily within pastures, among pastures, or between pasture types? (*iii*) How does soil legacy P relate to land management and soil characteristics? and (*iv*) What is the relationship between soil legacy P and aboveground plant tissue P concentration? Our results showed that soil legacy P (total P, Mehlich-1 and Mehlich-3 extractable P representing labile P pools) varied substantially across the landscape. Soil organic matter, pH, available Fe and Al, elevation, and grassland management were crucial predictors for spatial patterns of soil P, although models were more reliable for predicting total P than labile P. Our analysis further demonstrated that total variance in soil legacy P was greater in IM than SN grasslands, and intensified human activities rescaled spatial patterns of soil legacy P. Our results suggest that broad pasture- or farm-level best management practices may be limited, especially for high-intensity grasslands. Rather, management to curtail legacy P should be implemented at fine scales and spatially target P 'hotspots.' Our research improves understanding of patterns, drivers, and variances of soil P, and can inform models to evaluate and predict impacts of landscape management to mitigate P loadings and losses under shifting environmental conditions.

PRESENTER BIO: Dr. Qiu is an Associate Professor of Landscape Ecology and Ecosystem Service at the University of Florida, in the School of Forest, Fisheries, and Geomatics Sciences. Through varied research projects, his work aims to understand how global environmental changes affect ecosystem services in agricultural and urban landscapes.