



Science
Societies

Soil phosphorus mapped across China's drylands to guide future management

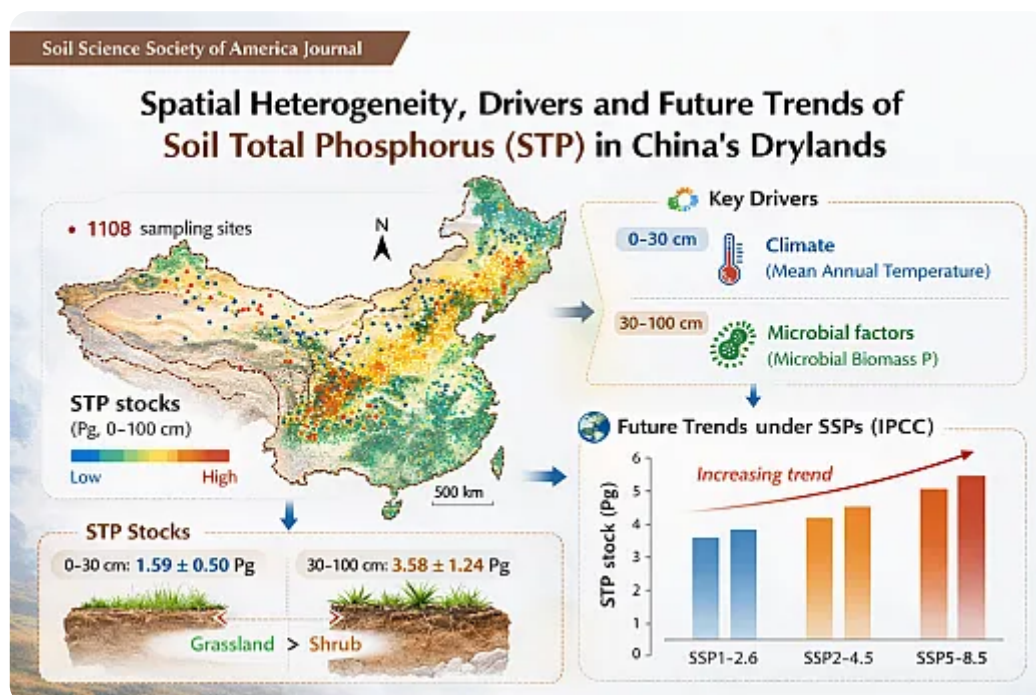
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Guide National Geopark in Qinghai, China. Photo courtesy of Adobe Stock.

Drylands cover about 40% of Earth's land surface and support more than a third of the global population, yet these regions are highly vulnerable to climate change and human disturbance. Phosphorus is an essential nutrient for plant growth, but unlike carbon and nitrogen, its behavior in dryland soils remains poorly understood, limiting our ability to manage soil fertility and predict ecosystem responses in these sensitive areas.

Researchers compiled soil phosphorus data from more than 1,100 sites across China's drylands and tested five machine learning models to map where phosphorus is stored and identify what controls its distribution. The best performing model revealed that surface soil phosphorus (0–30 cm) is primarily driven by temperature, while deeper phosphorus (30–100 cm) is more closely linked to microbial activity. In addition, the findings show that grassland soils hold the largest phosphorus stocks compared to other dryland land types, and that stocks are likely to increase under future climate scenarios. This new high-resolution map provides a critical baseline for guiding fertilization, restoring degraded soils, and managing phosphorus sustainably in China's drylands under global change.



Machine learning models compared soil properties of over 1,000 sites across China's drylands and determined that grasslands have the highest soil total phosphorous (STP) stocks compared to other dryland land types, especially shrublands. In addition, STP stocks in surface soils (0–30 cm) were found to be influenced mainly by temperature, as opposed to deeper soils (30–100 cm), which were influenced by soil microbes. Future trends under the Intergovernmental Panel on Climate Change's Shared Socioeconomic Pathways (IPCC-SSPs) predict that phosphorous stocks will increase over time in three climate scenarios (from left to right: "low," "intermediate," and "very high" greenhouse gas emissions). Image courtesy of Xiaobing Zhou, Chinese Academy of Sciences.

Dig deeper

Zhang, S., Chen, Y., Zhou, X., & Zhu, B. (2026). Spatial heterogeneity of soil total phosphorus in drylands of China: Analysis of drivers and simulation of climate scenarios. *Soil Science Society of America Journal*, 90, e70202.

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