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Using a data-driven network to understand the drivers of soil organic carbon dynamics across the tropic

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Maintaining soil organic carbon (SOC) content is recognized as an important strategy for a well-functioning soil ecosystem. The UN Convention to Combat Desertification (UNCCD) recognizes that reduced SOC content can lead to land degradation, and ultimately low land and agricultural productivity. SOC is almost universally proposed as the most important indicator of soil health, not only because SOC positively influences multiple soil properties that affect productivity, including cation exchange capacity and water holding capacity, but also because SOC content reflects aboveground activities, including especially agricultural land management. To be useful as an indicator, it is crucial to assess the importance of both inherent soil properties as well as external factors (climate, vegetation cover, land management, etc.) on SOC dynamics across space and time. This requires large, reliable and up-to-date soil health data sets across diverse land cover classes. The Land Degradation Surveillance Framework (LDSF), a well-established method for assessing multiple biophysical indicators at georeferenced locations, was employed in nine countries across the tropics (Burkina Faso, Cameron, Honduras, India, Indonesia, Kenya, Nicaragua, Peru, and South Africa) to assess the influence of land use, tree cover and inherent soil properties on soil organic carbon dynamics. The LDSF was designed to provide a biophysical baseline at landscape level, and monitoring and evaluation framework for assessing processes of land degradation and the effectiveness of rehabilitation measures over time. Each LDSF site has 160 – 1000 m^2 plots that were randomly stratified among 16 - 1 km^2 sampling clusters. A total of 6918 soil samples were collected (3478 topsoil (0-20 cm) and 3435 subsoil (20-50 cm)) within this study. All samples were analyzed using mid-infrared spectroscopy and 10% of the samples were analyzed using traditional wet chemistry to develop calibration prediction models. Validation results for soil properties (soil organic carbon (SOC), sand, and total nitrogen) showed good accuracy with R^2 values ranging between 0.88 and 0.96. Mean organic carbon content was 21.9 g kg^{-1} in topsoil and 15.2 g kg^{-1} in subsoil (median was 18.3 g kg^{-1} for topsoil and 10.8 g kg^{-1} in subsoil). Forest and grassland had the highest and similar carbon content while bushland/shrubland had the lowest. Sand content played an important role in determining the SOC content across the land cover types. Further analysis will be conducted and shared on the role of trees, land cover and texture on the dynamics of soil organic carbon and the implications for LDN reporting, land restoration initiatives as well as sustainable land management recommendations.