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Most carbon is grass-derived in tropical savanna soils, even under woody or forest encroachment

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Tropical and subtropical savannas have been increasingly targeted for increased carbon (C) storage via increasing tree cover. These projections typically assume large gains in soil carbon accompanying increasing tree cover, assumptions which may not reflect real changes in soil C under woody encroachment or afforestation. Studies have shown that productive grasses dominate C inputs into soils and that changes in ecosystem structure can sometimes result in losses of grass-derived carbon, but we only poorly understand the contributions of grass-derived C to total soil organic C (SOC) and the determinants of SOC responses to increasing tree cover in savannas. Here we show, using data from a semiarid savanna in Kruger National Park, South Africa, that both SOC concentration and grass-derived C in surface soils (0-20 cm) are predicted by grass biomass and soil texture, but not by tree basal area, stem density, or tree cover. More broadly across tropical savannas, grass-derived C contributes more than half of the SOC within the whole 1-m soil profile even under full tree cover. Although increasing tree cover increases SOC storage marginally, both SOC gain and loss are commonly observed across broad gradients of rainfall and soil sand content. These results highlight the continued high contribution of grasses to savanna SOC and the uncertain effects of increasing tree cover on SOC storage, challenging the widespread assumption that increasing tree cover has ubiquitous benefits to enhance SOC storage.