TITLE

INCREASING SOIL ORGANIC CARBON TO MITIGATE GREENHOUSE GASES AND INCREASE CLIMATE RESILIENCY FOR CALIFORNIA

CITATION

Flint, L., Flint, A., Stern, M., Mayer, A., Vergara, S., Silver, W., Casey, F., Franco, F., Byrd, K., Sleeter, B., Alvarez, P., Creque, J., Estrada, T., Cameron, D. (U.S. Geological Survey). 2018. Increasing Soil Organic Carbon to Mitigate Greenhouse Gases and Increase Climate Resiliency for California. California's Fourth Climate Change Assessment, California Natural Resources Agency. Publication number: CCCA4-CNRA-2018-006.

ABSTRACT

Rising air temperatures are projected to continue to drive up urban, agricultural, and rangeland water use, straining both surface and groundwater resources. Scientific studies have shown that managing farms, ranches, and public lands to increase soil carbon can increase soil water holding capacity and increase hydrologic benefits such as increased base flows and aquifer recharge, reduced flooding and erosion, and reduced climate-related water deficits. Coincident improvements in forage and crop yields are also indicated, while simultaneously sequestering carbon, reducing atmospheric greenhouse gases and mitigating climate change. This study was developed to consider the multiple benefits of increasing the organic matter content of soils across California's working lands.

Study results indicate that a one-time ¼" application of compost to rangelands can lead to carbon sequestration rates in soils that are maximized after approximately 15 years, and more than offset greenhouse gas emissions stimulated by the compost addition for at least five decades longer. Modeled increases in total soil organic matter of 3% enhanced hydrologic benefits across 97% of working lands, and reduced climate change impacts. Economic valuation indicated all benefits increasing over time, demonstrating a large potential for the California carbon market to support incentives in regionalizing the impacts in the coming decades. Socioeconomic and related land use pressures pose barriers to implementing management practices to increase soil organic matter by driving conversion of rangeland to urban or to more greenhouse-gas emission intensive agriculture. Results can be effectively used with land use change scenarios to identify where on California's working lands hydrologic benefits of soil organic matter enhancement coincide with development risk, highlighting counties in California in which there may be resilience to climate change when strategic soil management and land conservation are combined.

HIGHLIGHTS

- Field and model results indicate that a one-time ¼" application of compost to California's working lands (rangelands and crop lands) leads to carbon sequestration rates in soils that are maximized after approximately 15 years, and more than offset greenhouse gas emissions stimulated by the compost amendment for at least five decades longer. Regionalization of compost applications to only 6% of rangelands in California resulted in an estimate of 8.4 – 8.7 million metric tons of CO2 equivalents at maximum sequestration, 15 years after compost amendment.
- Increases in total soil organic matter of 3% increased the soil water holding capacity by up to 4.7 million acre-feet across all working lands in California, with hydrologic benefits greatest in locations with enough precipitation to fill increases in soil storage capacity. The benefits of increasing soil organic matter included a reduction of climate change impacts to hydrologic variables in comparison to no-action soil management. Reductions in climate impacts averaged over the state for a wet future were 1-8% in comparison to baseline, and reductions for a dry future were 1-3% in comparison to baseline, but many locations had reductions in climate change impacts of up to 50% by the end-of-century.
- Economic valuation of benefits due to changes in soil organic matter included provisioning services associated with above-ground forage productivity, and regulating services associated with below-ground carbon sequestration and groundwater recharge. Estimated benefits from all services increased over time in the future, and analyses demonstrated a large potential for the California carbon market in the coming decades.
- Socioeconomic and related land-use pressures pose barriers to implementing management practices to increase soil organic matter by driving conversion of rangeland and cropland to development for more greenhouse gas emission intensive agriculture. Results can be effectively used with land-use change scenarios to identify where on California's working lands hydrologic benefits coincide with development risk, highlighting counties in California that may have locations providing resilience to climate change when strategic soil management and land conservation are combined.
- Analyses indicate potential hydrologic benefits from soil management on Williamson Act lands are an order of magnitude greater than potential losses related to future development, totaling over 700,000 acre-feet annually state-wide in a wet climate scenario. Existing barriers to management can potentially be overcome by strengthening existing efforts/infrastructure/programs, developing flexible and diverse funding mechanisms and tailored outreach programs to landowners.
- Increased soil organic matter can be achieved in multiple ways to increase soil water holding capacity, forage and crop yields, increase base flows and aquifer

recharge, reduce flooding and erosion, increase carbon sequestration, and reduce climate-related water deficits, therefore developing hydrologic resilience to climate change while simultaneously reducing atmospheric greenhouse gases. Prioritized investment in California's working landscapes will yield multiple ecosystem service benefits by v targeting conservation and management actions on grasslands in locations or counties that can gain the most benefit.

ACCESS

For access to the full report, please email Susan.wilhelm@energy.ca.gov

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