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Smallholder agriculture takes root in climate action: Evaluating soil organic carbon monitoring

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Abstract

Voluntary carbon market (VCM) schemes facilitate funding for projects that promote sustainable land management practices to sequester carbon in natural sinks such as biomass and soil, while also supporting agricultural production. The effectiveness of VCM schemes relies on accurate measurement mechanisms that can directly attribute carbon accumulation to project activities. However, measuring carbon sequestration in soils has proven to be difficult and costly, especially in the context of the fragmented smallholdings predominant in global agriculture. The cost and accuracy limitations of current methods to monitor soil organic carbon (SOC) impede the participation of smallholder farmers in global carbon markets, where they could potentially be compensated for adopting sustainable farming practices that provide ecosystem benefits. This study evaluates nine different approaches for SOC accounting in smallholder agricultural projects. The approaches considered involve the use of proximal and remote sensing, along with process model applications. Our evaluation centres on stakeholder requirements for the Measurement, Reporting, and Verification (MRV) system, using the criteria of accuracy, level of standardisation, costs, adoptability, and the advancement of community benefits. By analysing these criteria, we highlight opportunities and challenges associated with each approach, presenting suggestions to enhance their applicability for smallholder SOC accounting. The contextual foundation of the research is a case study on the Western Kenya Soil Carbon Project. Remote sensing shows promise in reducing costs for direct and modelling-based carbon measurement. While it is already being used in certain carbon market applications, transparency is vital for broader integration. This demands collaborative work and investment in infrastructure like spectral libraries and user-friendly tools. Balancing community benefits against the detached nature of remote techniques is essential. Enhancing information access aids farmers, boosting income through improved soil and crop productivity, even with remote monitoring. Handheld sensors can involve smallholders, given consistent protocols. Engaging the community in monitoring can cut project costs, enhance agricultural capabilities, and generate extra income.

Keywords: Carbon accounting, carbon farming, soil monitoring, soil organic carbon