

Carbon Farming: Monitoring Soil Carbon in Smallholder plots, Insights from Kenya

Scan to access full study



Okoli, Adaugo and Birkenberg, Athena
Department of Social and institutional change in agricultural development,
University of Hohenheim, Germany

1. Problem Statement

- Carbon markets could finance improved agricultural soil management *if* the carbon stored through such practices (Fig 1) is quantifiable.
- Quantifying soil carbon change is challenging, limiting smallholder participation in carbon markets.
- Accuracy & cost** are prioritized in the carbon monitoring literature, but in practice, **standardisation, adoptability** and **community benefits** are also important criteria determining if an approach works well.



▲ Fig 1: Example agricultural practices that reduce emissions and/or store carbon in soil & biomass



▲ Fig 2: A smallholder agroforestry farm in the Western Kenya carbon project

2. Research Questions

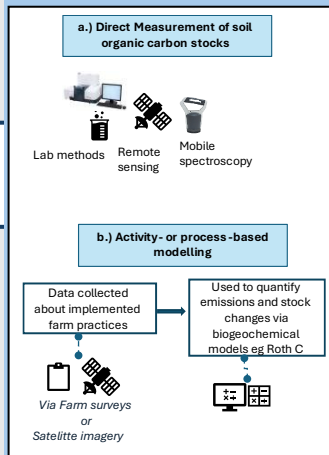
- Which existing approach for monitoring soil carbon change addresses the multiple needs of carbon project stakeholders as well as requirements of standards?
- Which gaps must be addressed to improve smallholder participation in carbon markets?

4. Finding Highlights

- Evaluating 'approaches' which comprise *who* and *how* of data collection and analysis, is **more beneficial than just evaluating individual technologies**
- Field-based approaches integrating farm surveys or other interaction with farmers were preferred by landowners which proves **key to sustaining projects long-term**.
- Remote sensing can reduce measurement costs, but **lacks feedback systems to maintain benefits and ensure long-term project adoption**.
- Effective use of remote & proximal sensing also requires **joint efforts towards open-source soil libraries**, as reference sampling is too costly for individual projects.
- Empowering smallholders involves not just their adopting practices but **engaging in monitoring**, which **saves costs and builds local skills**. This **requires simple, locally applicable SOPs** for consistent results.

3. Methods

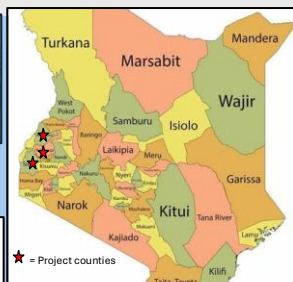
- Case study of Western Kenya Carbon Project
- Semi-structured Interviews conducted April – May 2021
- 116 interviews, including farmers, project developers and technical experts.
- Thematic coding of literature & interview data to score monitoring approaches according to identified criteria



▲ Fig 3: Schematic explaining 2 different 'domains' of soil carbon quantification approaches



▲ Fig 4: Conducting the Stakeholder interviews



▲ Fig 5: Case study location in Western Kenya

| | Description | Accuracy | Cost reduction | Standardization | Community benefits | Adoptability |
|-----------------------------------|--|----------|----------------|-----------------|--------------------|--------------|
| Wet oxidation | Traditionally-taken soil samples tested in a lab | ●●●●● | ● | ●●●●● | ●●●●● | ●●●●● |
| MIR-spectroscopy | Traditionally-taken soil samples tested in a lab | ●●●●● | ●●●●● | ●●●●● | ●●●●● | ●●●●● |
| Remote sensing | Soil information predicted from satellite reflectance imagery. | ●● | ●●●●● | ● | ● | ●● |
| Proximal sensing - farmer led | Soils scanned in-field by trained farmer representatives | ●●●●● | ●●●●● | ●● | ●●●●● | ●●●●● |
| Proximal sensing - commercial | Soils scanned in-field by experts | ●●●●● | ●●●●● | ●● | ●●●●● | ●●●●● |
| Activity Models - farmer reported | Land management data submitted by farmers | ●●●●● | ●● | ●●●●● | ●●●●● | ●●●●● |
| Activity Models - full census | Land management data collected by enumerators | ●●●●● | ● | ●●●●● | ●●●●● | ●●●●● |
| Activity Models - sample data | Land management data collected by enumerators | ●●●●● | ●●●●● | ●●●●● | ●●●●● | ●●●●● |
| Activity Models - Remote data | Land management data collected via remote-sensing | ●●●●● | ●●●●● | ● | ●● | ●●●●● |

◀ Fig 6: Comparison of different monitoring approaches based on the identified criteria

Legend

Accuracy ●●●●●

Cost reduction ●●●●●

Standardization ●●●●●

Community benefits ●●●●●

Adoptability ●●●●●

scoring low to high