# Understanding soil organic carbon dynamics at the landscape scale in East Africa: Hotspot mapping

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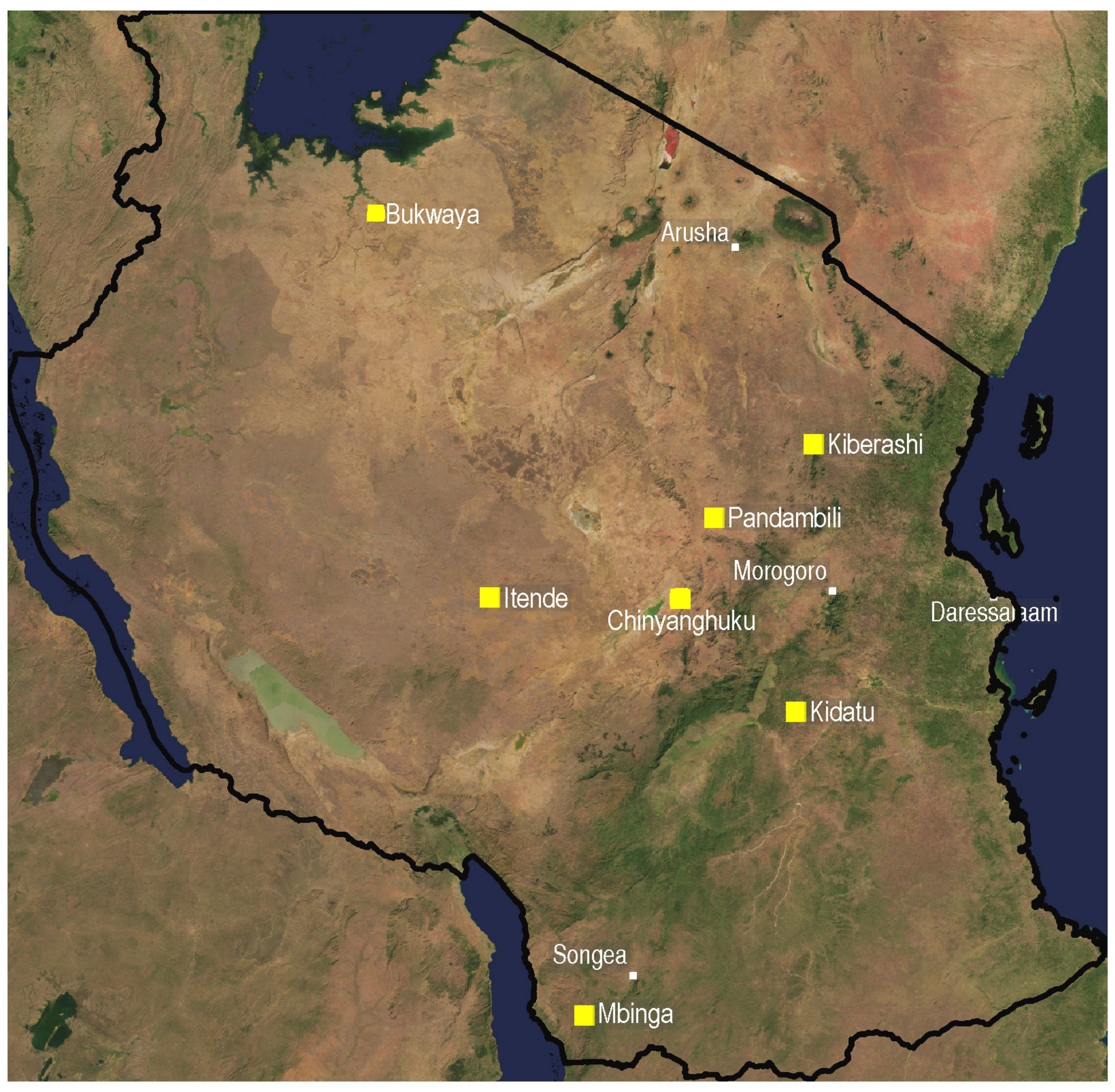
## Objective

To assess the variation of soil organic carbon (SOC) across different landscapes in East Africa, using a systematic sampling approach, in order to target land-use planning activities.

## Methods

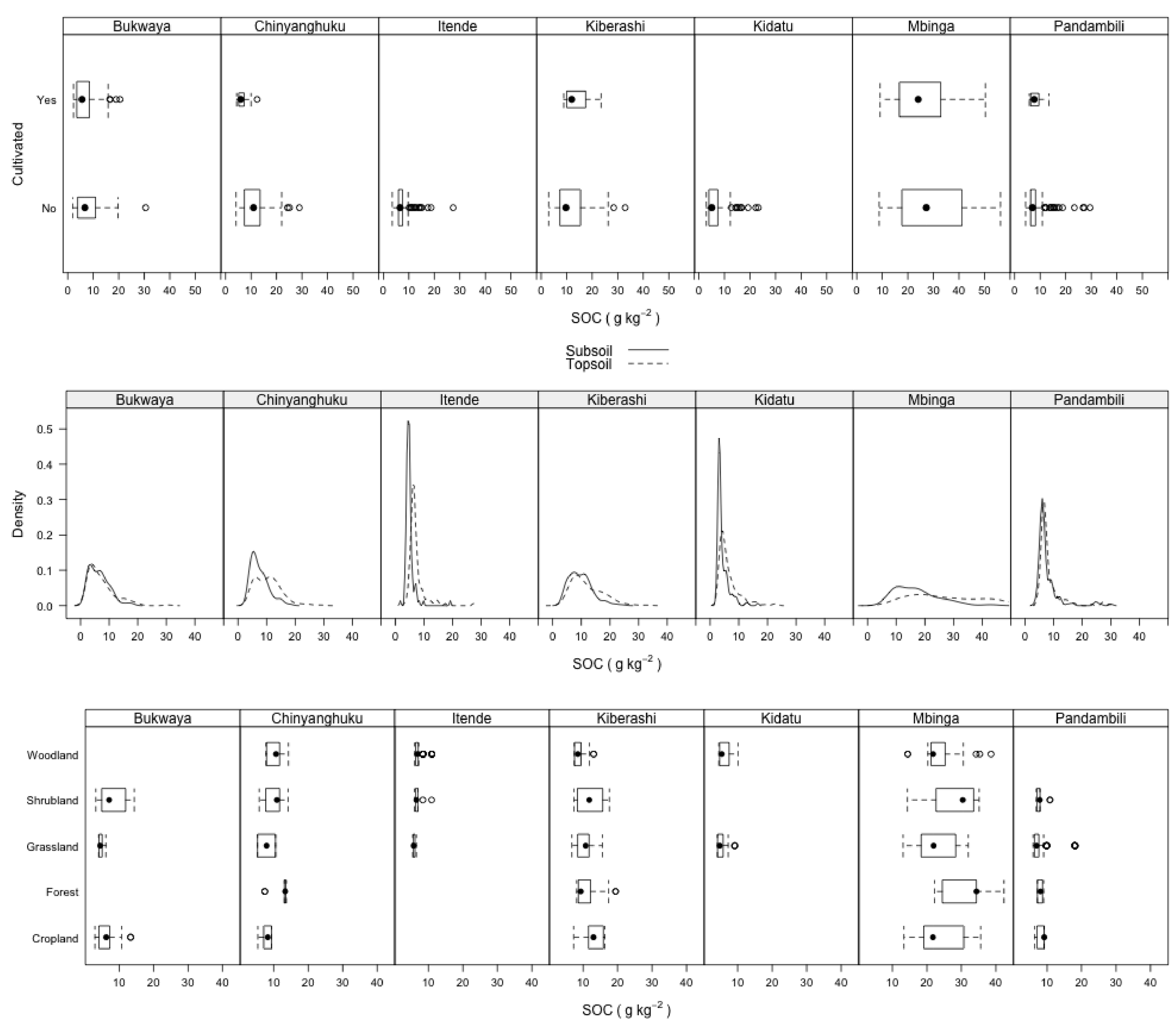
A spatially stratified, hierarchical randomized sampling design (the Land Degradation Surveillance Framework) was implemented at seven sites in Tanzania. Each site is 100 km$^2$ and has 160 plots, where topsoil (0-20 cm) and subsoil (20-50 cm) samples were collected, 1,993 plots were included in the current study. Each plot has four subplots where erosion prevalence was observed, current and historic land use were recorded and vegetation measurements were made.



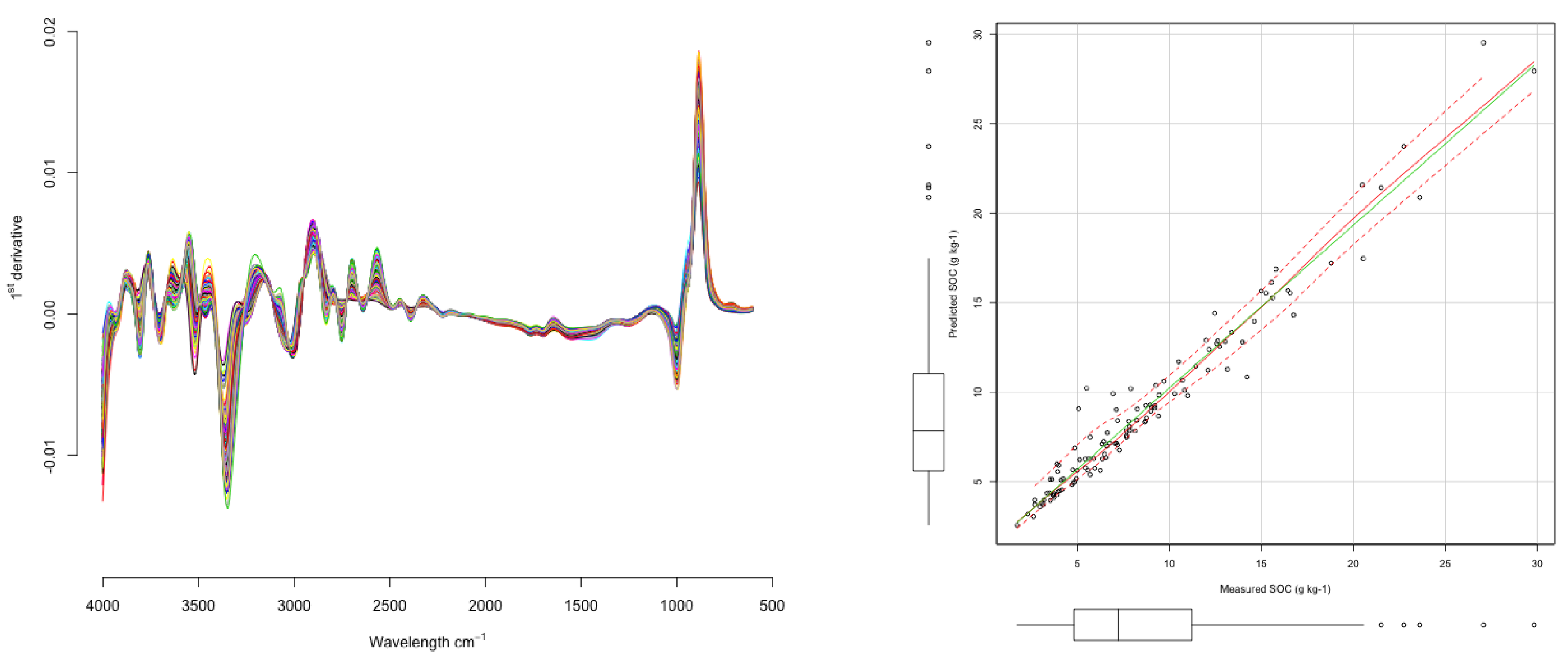

**Location of the seven AfSIS sentinel sites in Tanzania** (yellow squares) (above).

## Results - Land cover and SOC

Average topsoil organic carbon was 10.9 ± 8.6 g C kg$^{-1}$ (n=1058) and average subsoil organic carbon was 8.3 ± 5.6 g C kg$^{-1}$ (n=935) (density plots left center). Cultivated plots had an average of 1.05 g kg$^{-1}$ ($p<0.05$) less topsoil organic carbon compared to non-cultivated plots (boxplots above). Model results estimated that forest had the highest SOC concentration 10.1 (SE 1.2) g kg$^{-1}$, ($p<0.05$) (boxplots above) compared to other land covers.

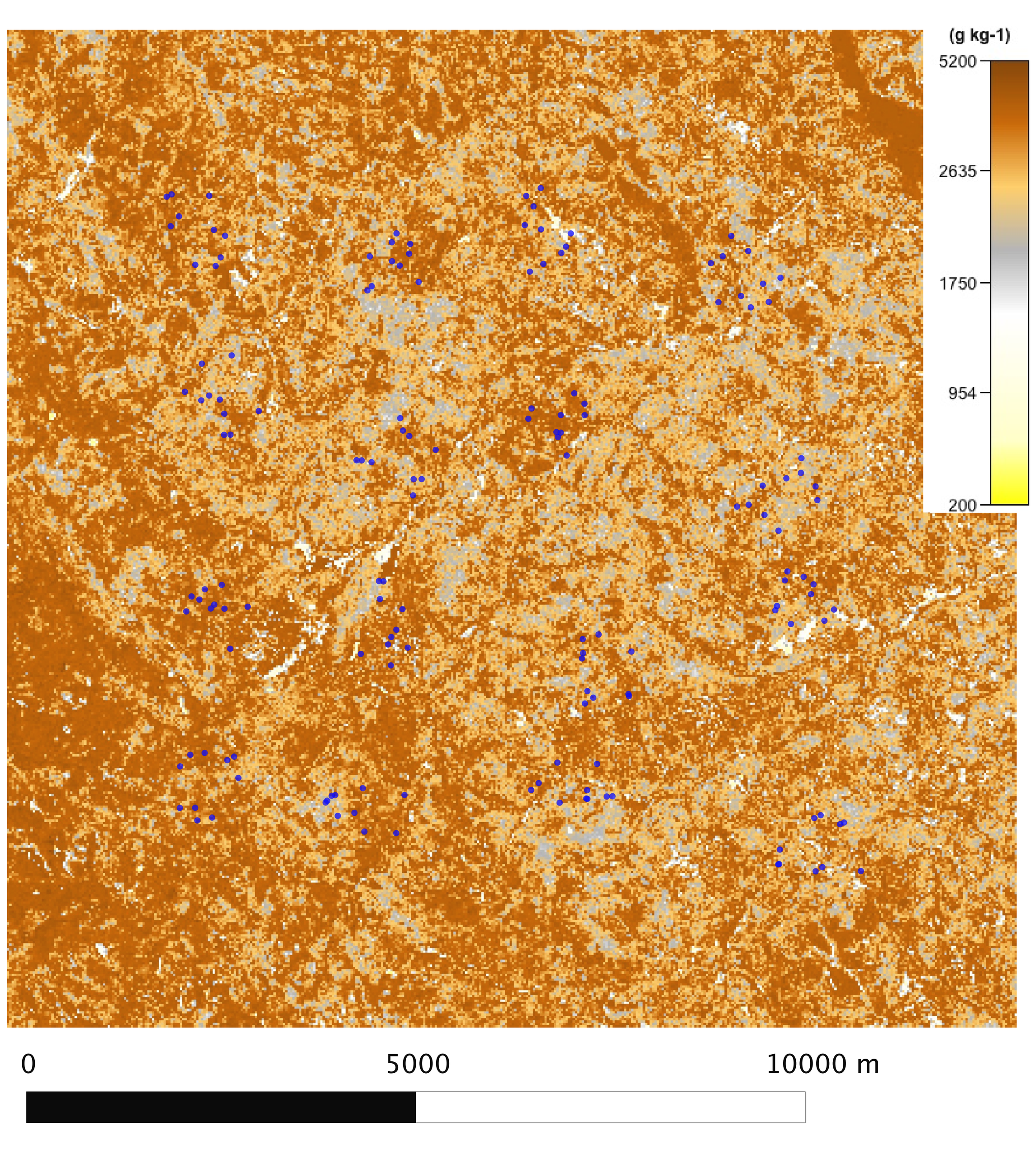



## MIR Spectroscopy




**Mid-infrared spectroscopy was used to predict SOC values**. All samples were scanned using MIR at the ICRAF-Nairobi laboratory, 10% of the samples were subjected to carbon analysis. Figures above show the first derivative of the MIR spectra for Kiberashi site and the relationship between measured SOC values and the predicted values from MIR.

## Results - SOC Mapping




**Map of topsoil SOC in Mbinga sentinel site (above)** (values are multiplied by 100). Estimates are based on Landsat ETM+ (2007).

The SOC map on the left demonstrates the utility of statistical models and satellite imagery in estimating SOC values across the landscape. These maps can be used to identify areas that are low in SOC for targeting of land management interventions.

## Results - Assessing Variability

SOC is highly variable across landscapes. Many landscape features and land management strategies influence SOC values, including for example, regular burning at Kidatu and continuous maize farming in Mbinga (below). A detailed understanding of landscape complexity, including changes in SOC, is necessary.


**Average SOC concentrations to 50 cm** per plot (n=160) at the Kidatu (Selous Game Reserve) (above left) and Mbinga agricultural site (above right). While between site variation is high, it is important to understand within site variability.