
A Protocol for Measurement and Monitoring Soil Carbon Stocks in Agricultural Landscapes
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Can we measure and monitor soil carbon cost effectively?

Monitoring soil carbon important for multiple objectives:

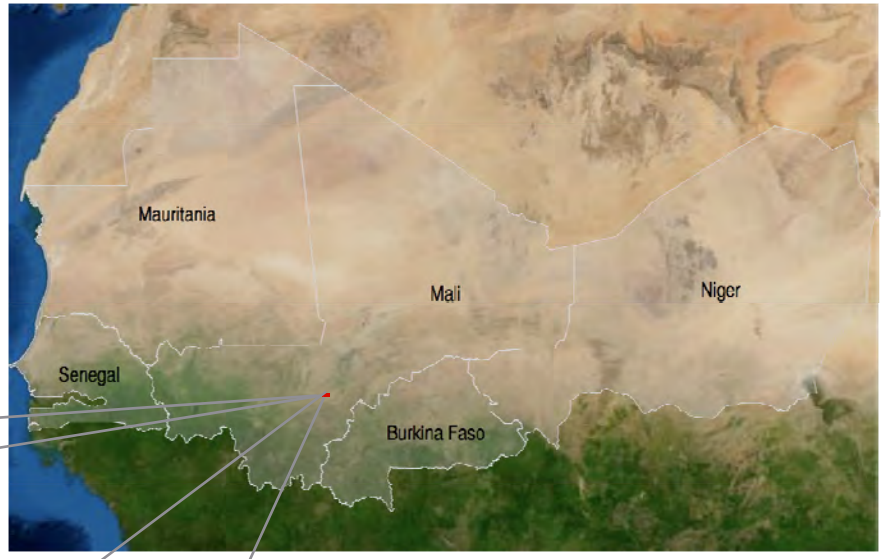
- critical soil health indicator
- models currently difficult to apply in data poor countries
- carbon trading/credits

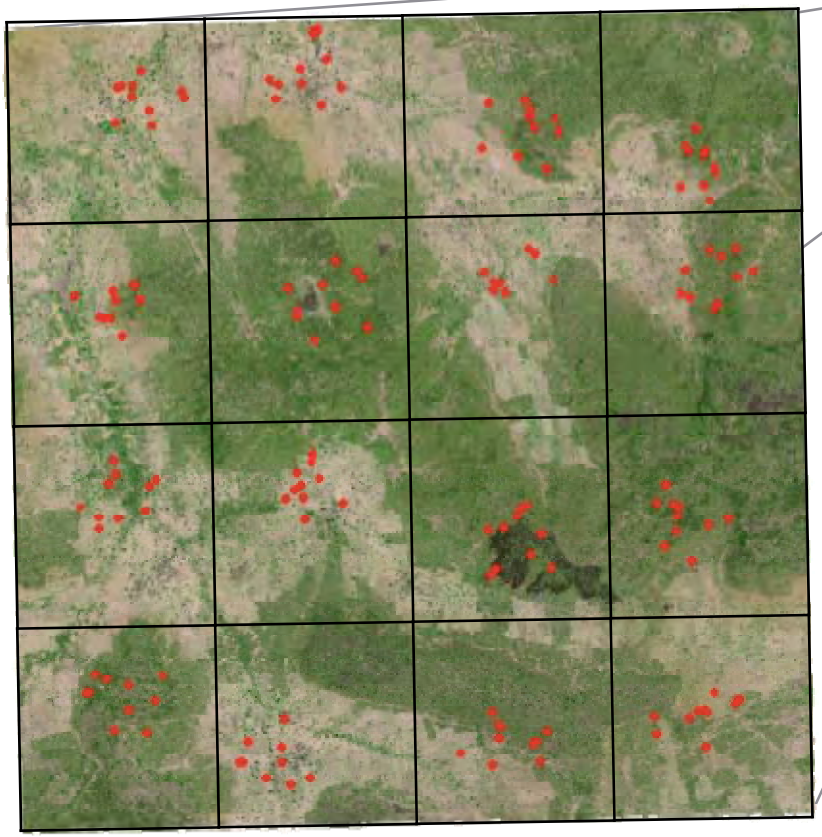
Sampling challenges

- Large local scale spatial variability
- Remote areas/marginal soils
- Long travel times; often on foot
- Mechanized or core sampling impossible

AfricaSoils Sentinel Site

a spatially stratified, hierarchical, randomized sampling framework





Sentinel site (100 km^2)

16 Clusters (1 km^2)

10 Plots (1000 m^2)

4 Sub-Plots (100 m^2)

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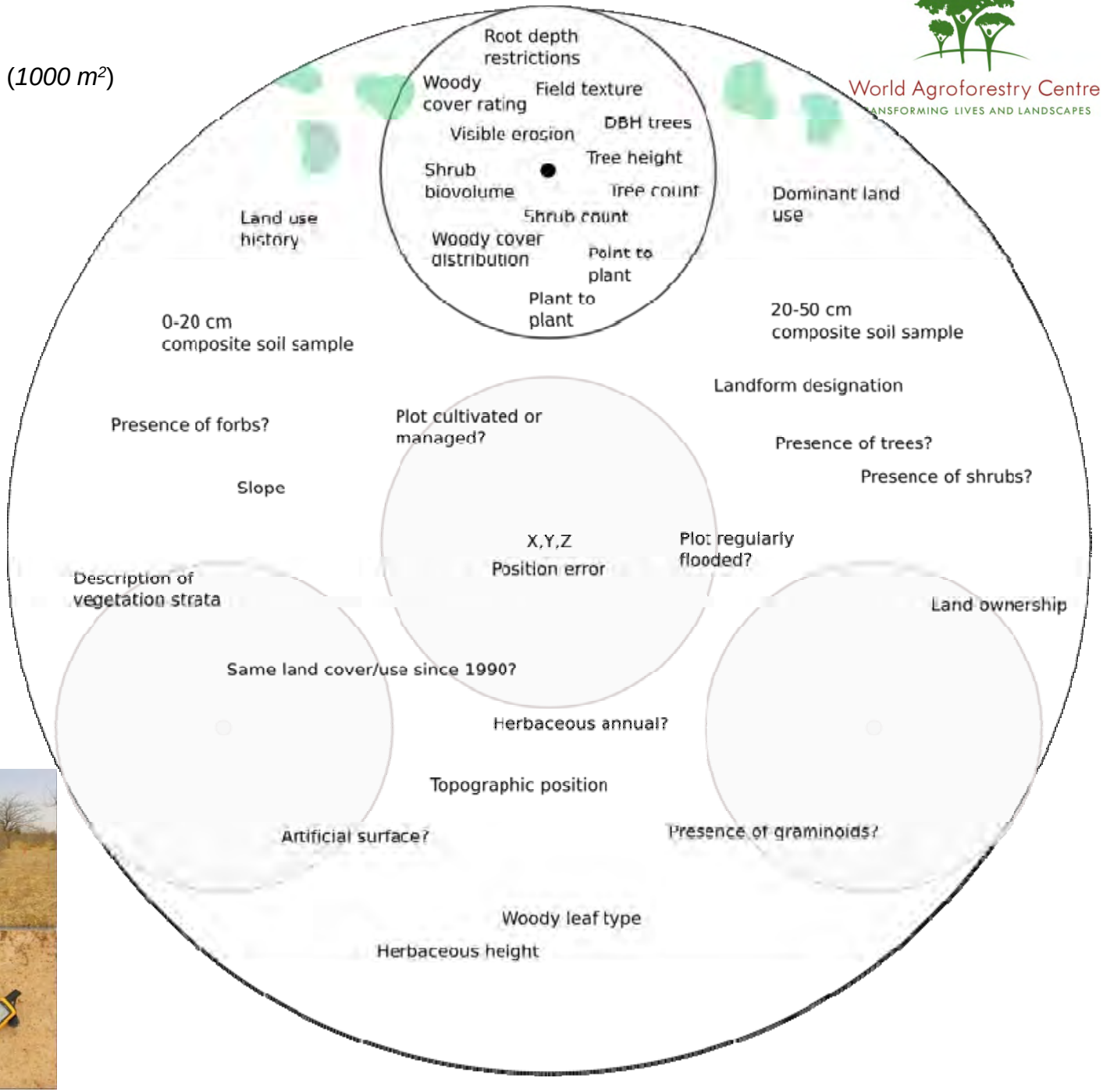
Sampling plot (*1000 m²*)

sub-plots (*100 m²*)



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Soil Infrared Spectroscopy for rapid soil characterization

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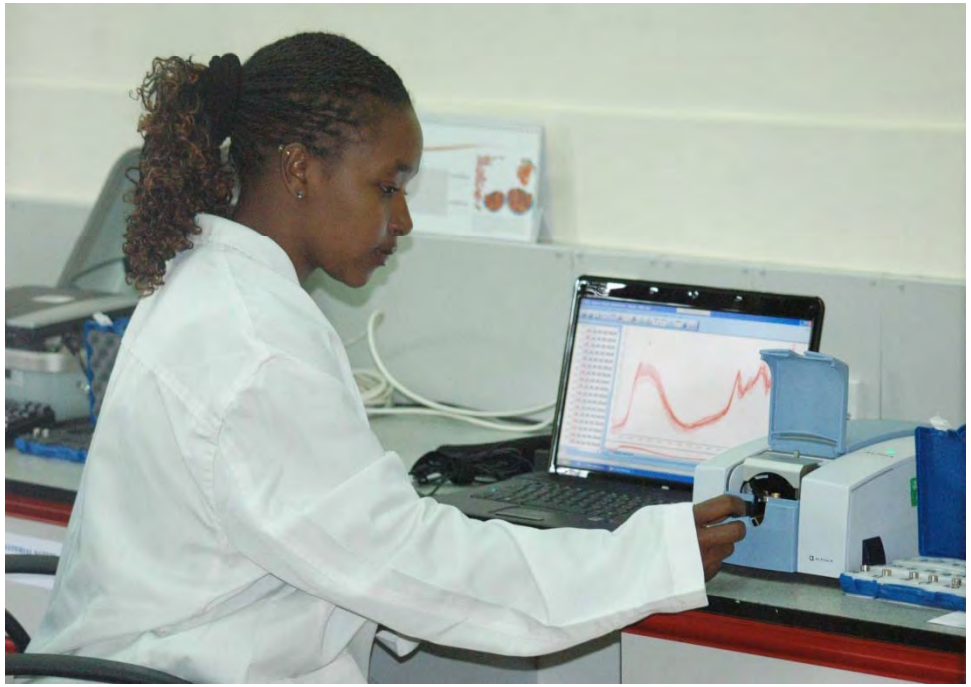
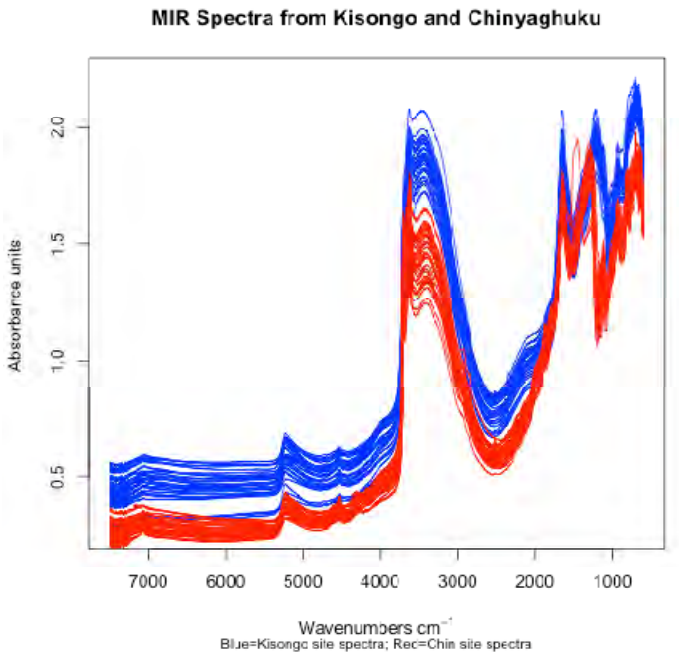
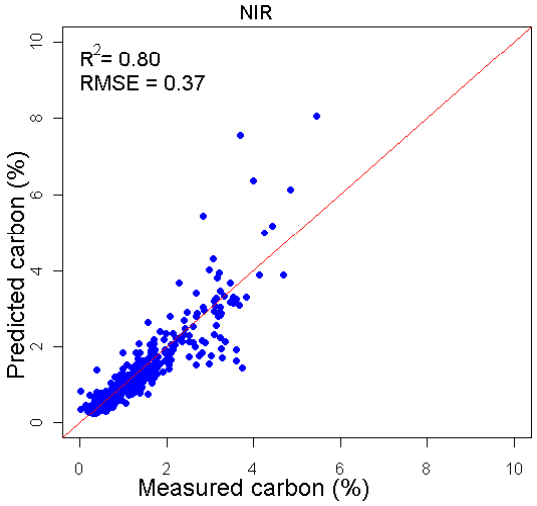


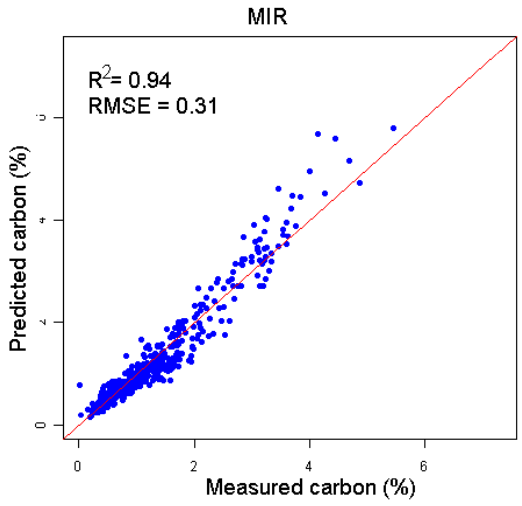


- Rapid
- Low cost
- Reproducible
- Predicts many soil functional properties

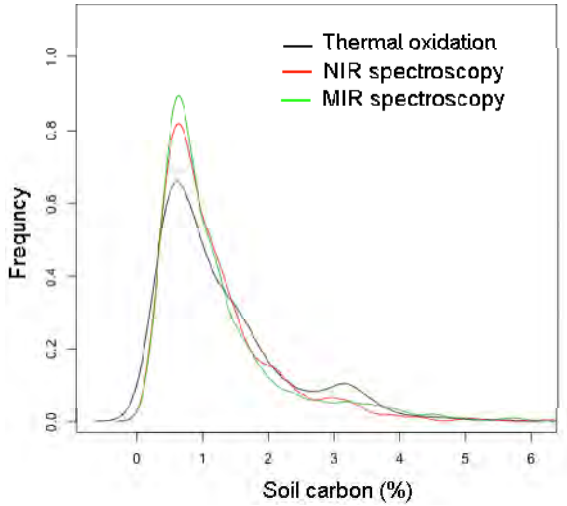
Predicting SOC stocks using soil infrared spectroscopy



(a)



(b)



(c)

Partial least squares (PLS) regression analysis:

(a) NIR and (b) MIR cross-validation
(c) density plot showing the reference data using the thermal oxidation and the predicted values using NIR and MIR spectroscopy

Application test site

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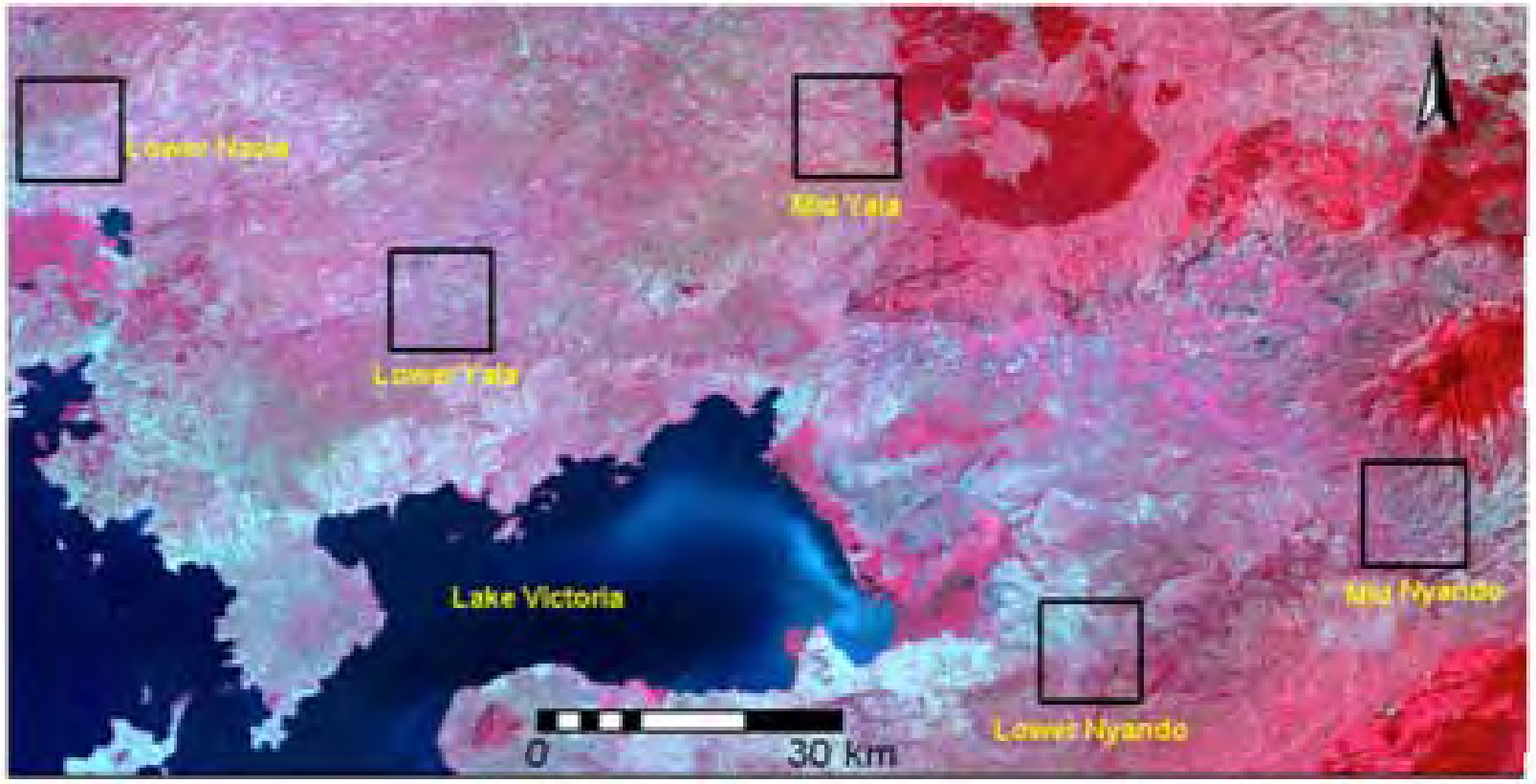

The five sentinel sites in western Kenya. The background is a Landsat MSS (1973) False Colour Composite

SOC stocks

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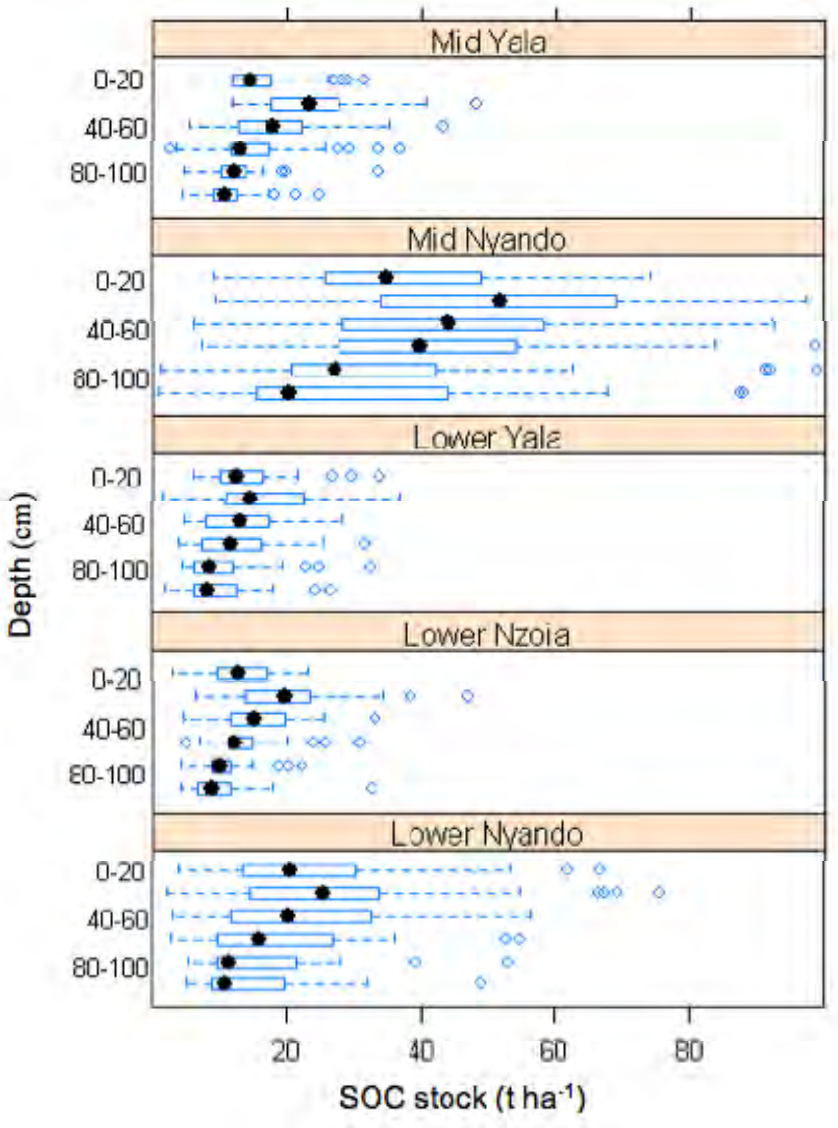

SOC stocks (t ha^{-1}) in Western Kenya

SOC stocks is highest in the subsoil (20-40 cm) than for the topsoil (10-20 cm) due to low soil mass (bulk density) in the topsoil.

Mapping SOC stocks

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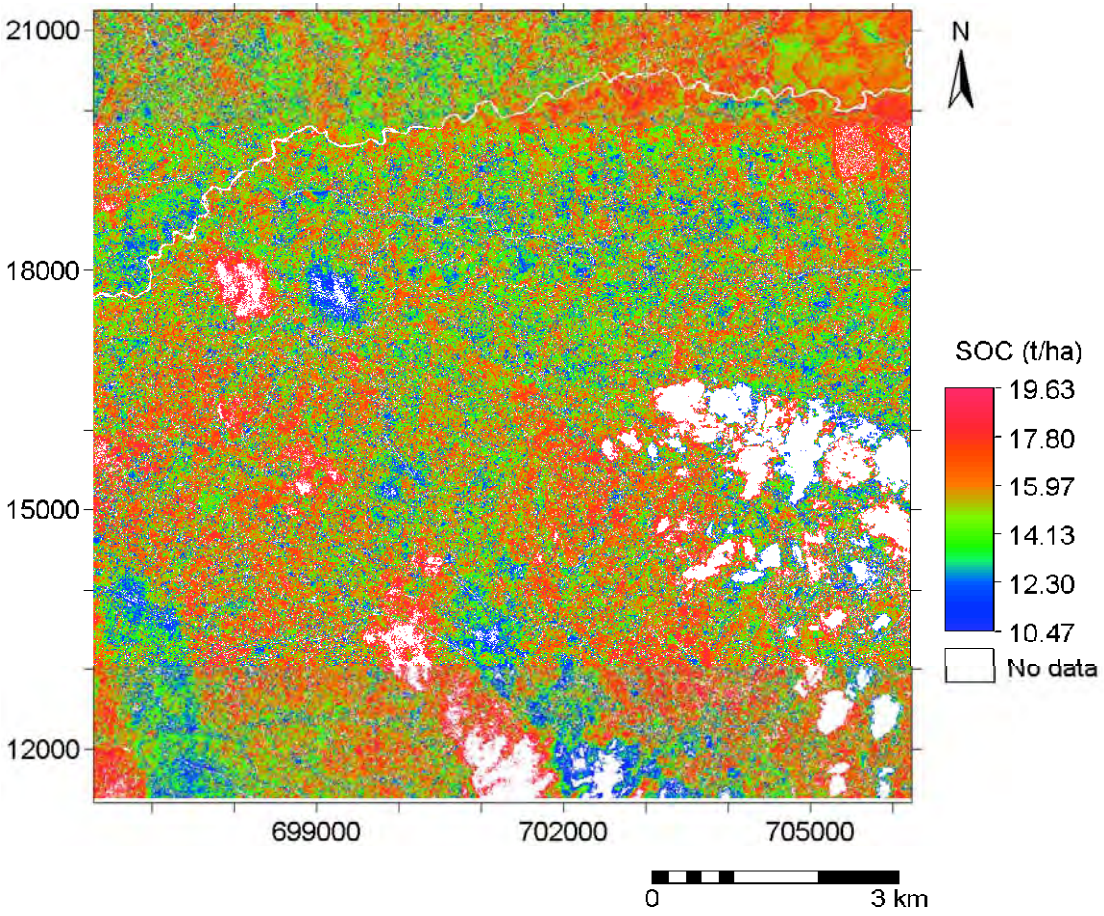


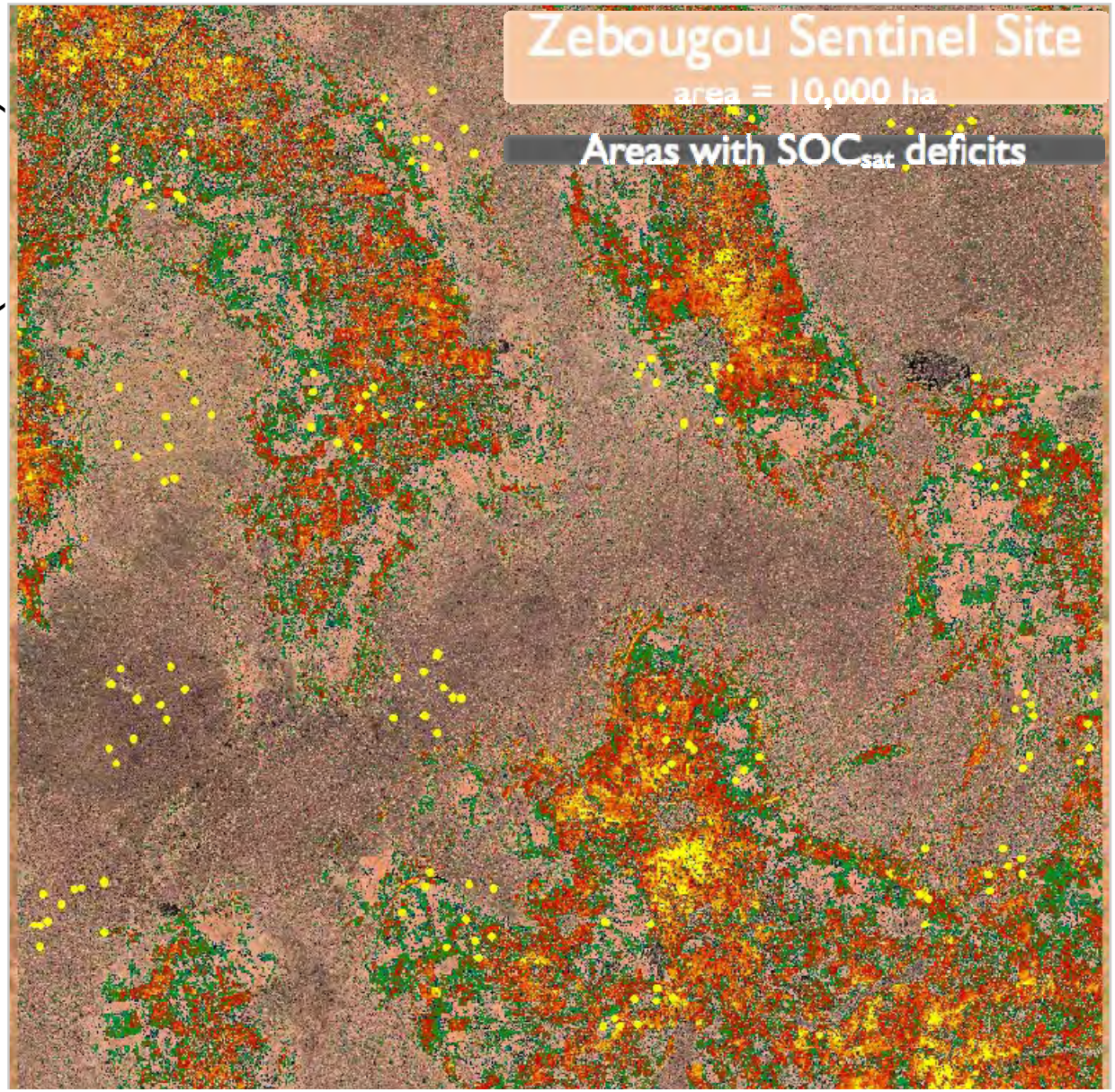
Mapping SOC Stocks using high resolution (QuickBird) satellite image

A landscape level SOC stocks mapping can be made using medium resolution satellite imagery such as ASTER and Landsat

SOC stocks in the mid Yala, western Kenya. The effect of cloud is masked as no data

Examples from UNEP-ICRAF West Africa Drylands Project

Local (site-level) C_{ref}



Quickbird

10 km

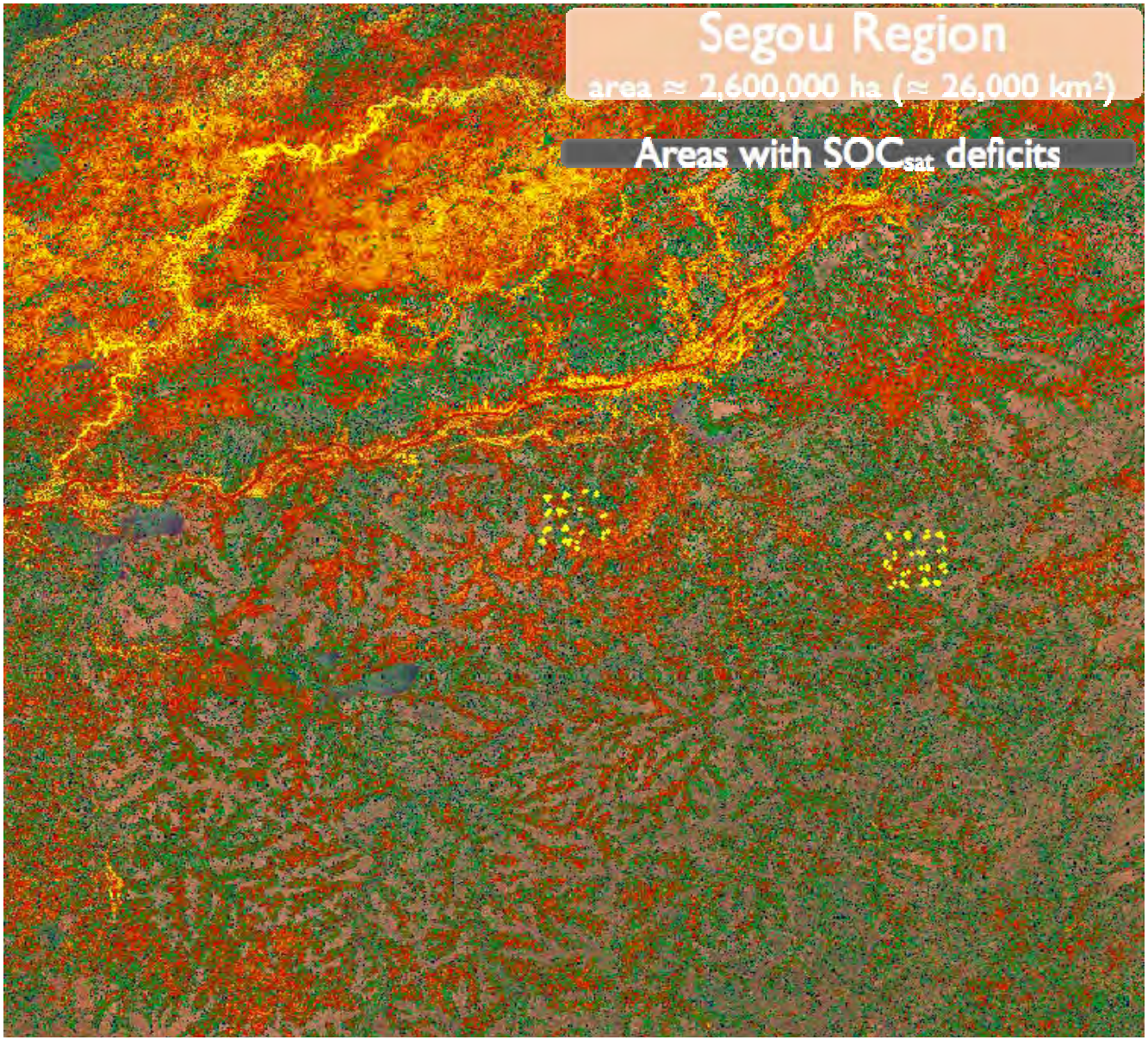
0.064% measured

Very high resolution

Extrapolation to Landsat

Examples from UNEP-ICRAF West Africa Drylands Project

Local (site-level) C_{ref}



Landsat ETM+

160 km

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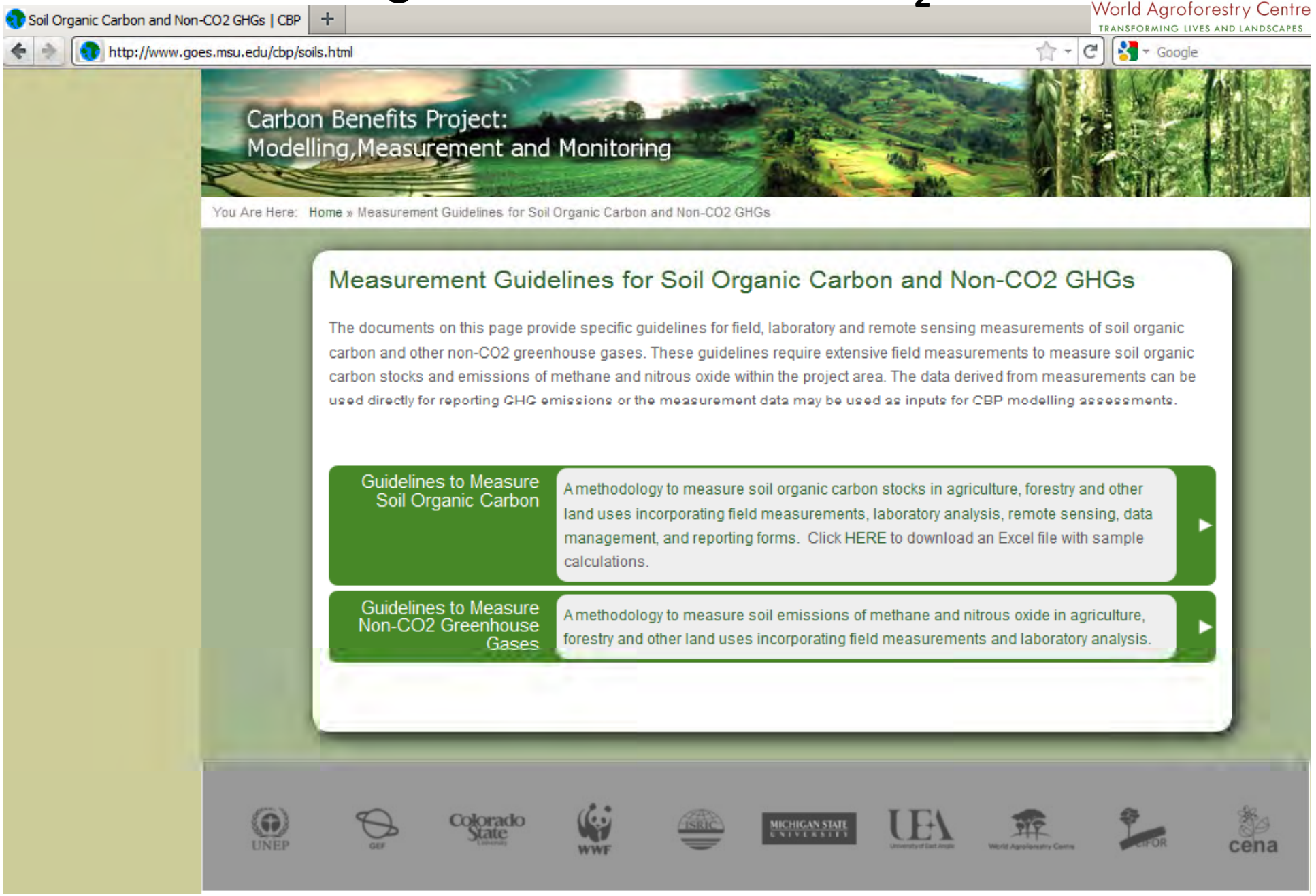
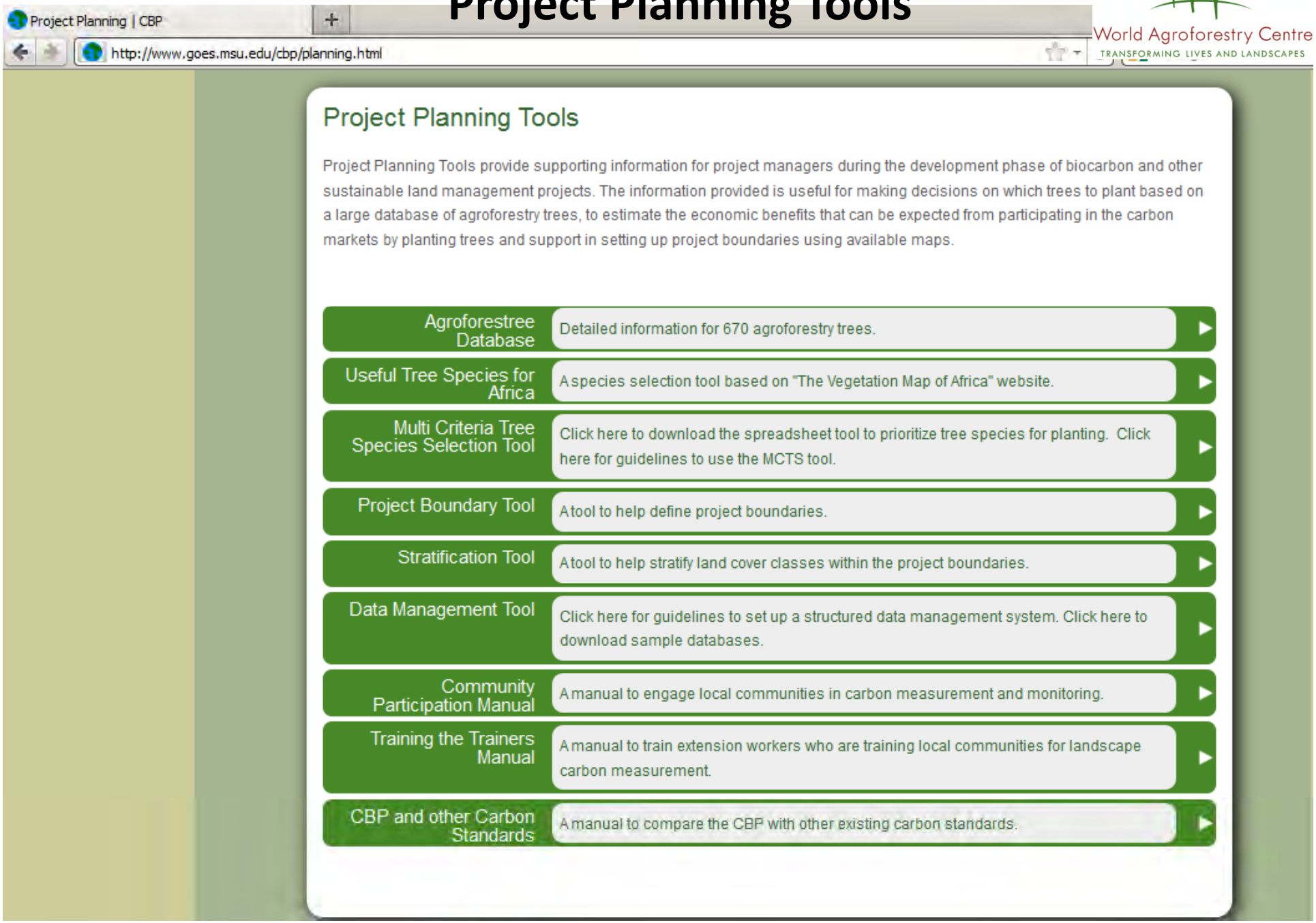
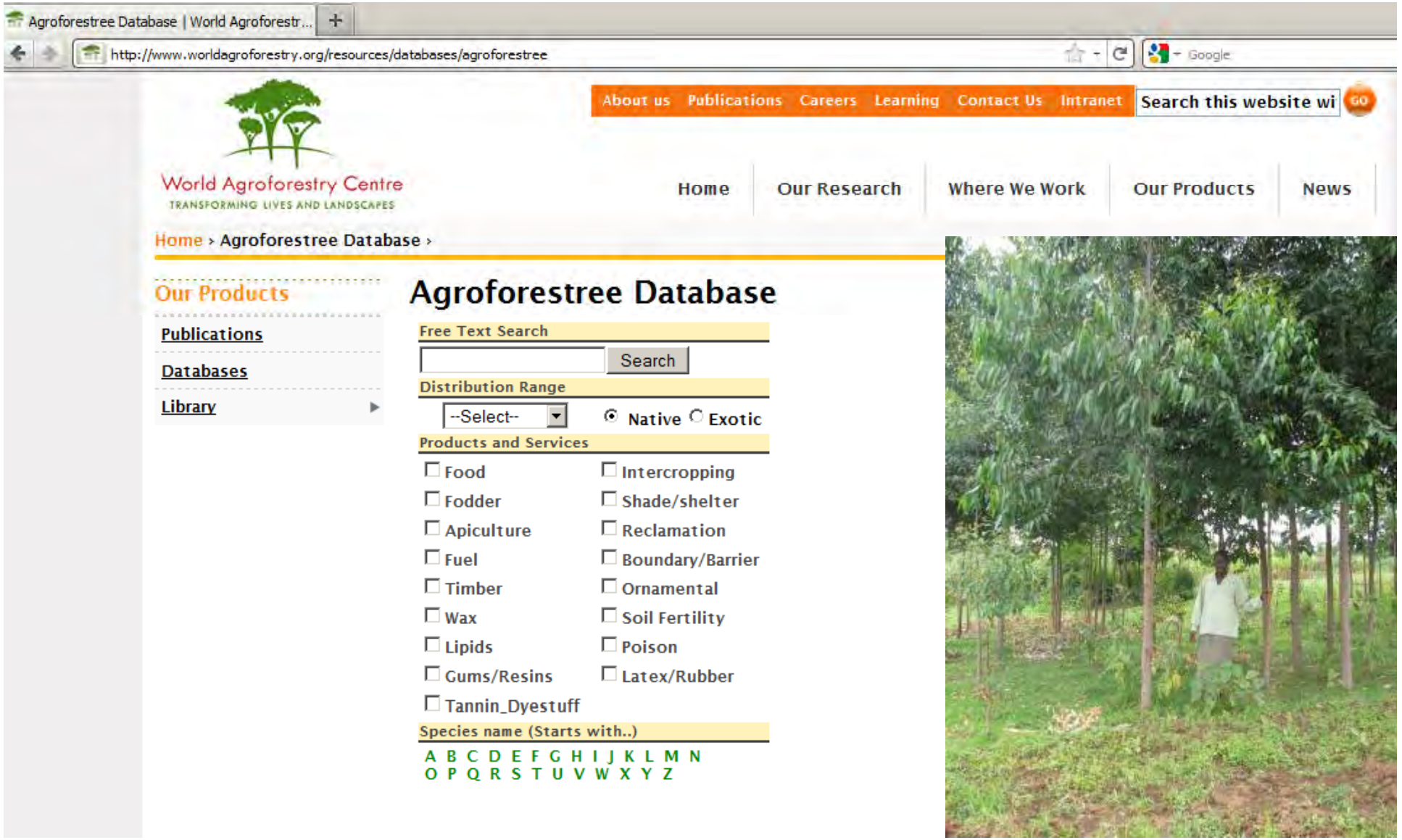
Soil organic matter and non-CO_2 GHGs



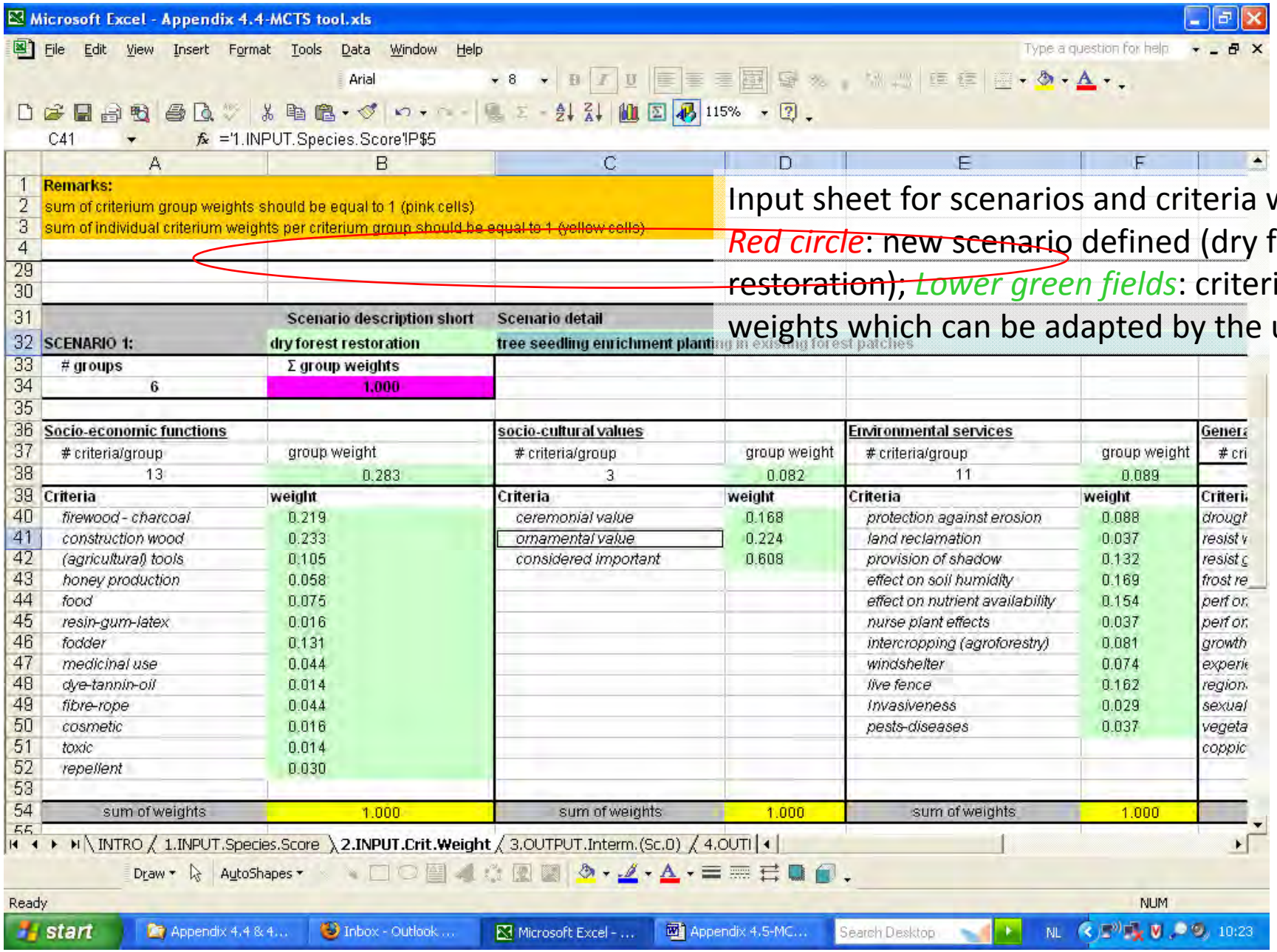
Project Planning Tools



AgroforestTree data base updated to include socioeconomic information



Decision support tool for selecting which trees to plant



Input sheet for scenarios and criteria weights. *Red circle*: new scenario defined (dry forest restoration); *Lower green fields*: criteria weights which can be adapted by the user.

¡¿ Thanks for a future !?

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