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Association for Strengthening Agricultural Research in Eastern and Central Africa

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Climate Smart Technologies for Carbon Sequestration in Eastern and Central Africa

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Presentation Outlines

- Introduction of carbon sequestration.
- Climate change impacts on agriculture in ECA.
- CSA Tech for potential C sequestration.
- Strategies for soil carbon sequestration.
- Major interventions for carbon sequestration in East & Central Africa.
- Conclusion.

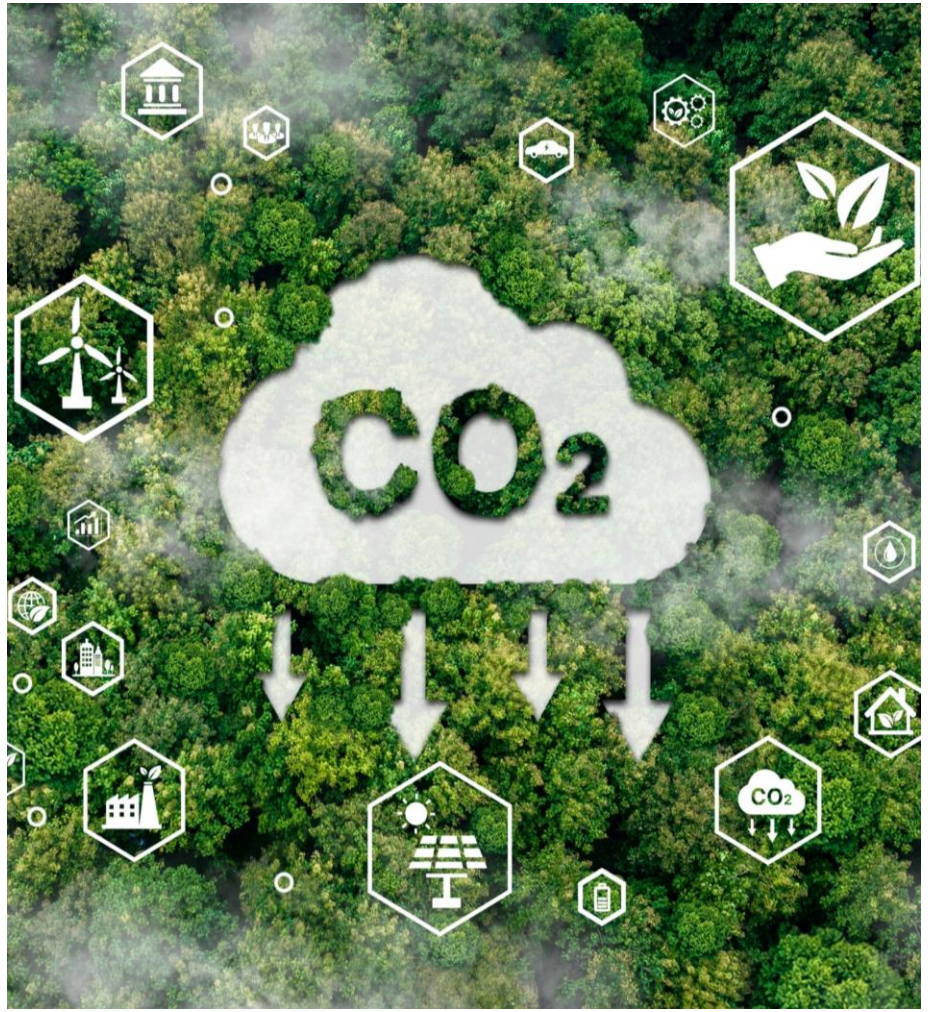
Greenhouse Effect

The greenhouse effect is a process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases, and is re-radiated in all directions.

Managing Carbon Emission

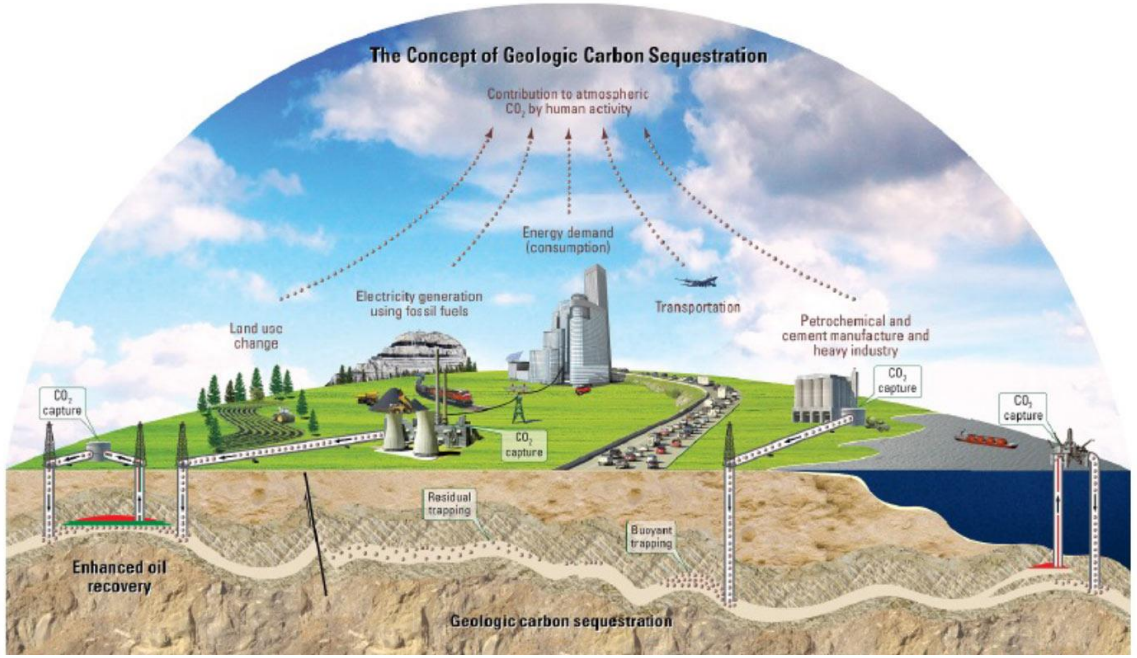
- Rising concentration of greenhouse gases has been largely attributed to expanding use of fossil fuels as an energy source, resulting in emission of CO2 to the atmosphere.
- Reducing net greenhouse gas emission is possible:

1. Reduce fossil fuel combustion by becoming more energy efficient.
2. Rely more on low-carbon energy sources.
3. Carbon sequestration.



Introduction–Definition of C Sequestration

Carbon sequestration is the process of capture and long-term storage of atmospheric carbon dioxide and may refer specifically to: “The process of removing carbon from the atmosphere and depositing it in a reservoir.”

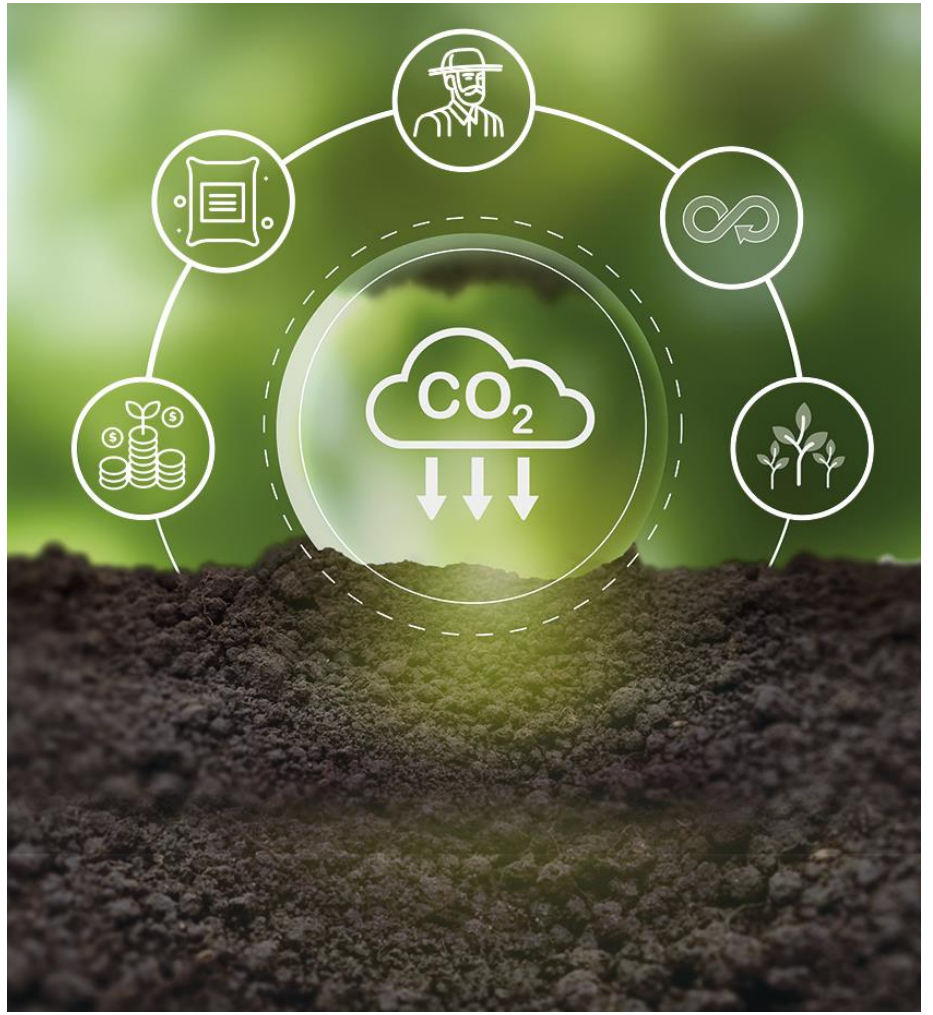


Introduction – Carbon Sequestration

- Agricultural production in ECA.
- Climate smart agricultural practices-adoption constraints.
- Soil role in food security.
- Importance of carbon sequestration.
- Climate-smart management interventions.

Reasons for Soil Carbon Sequestration

- Improvement of soil quality and properties.
- Increase soil fertility.
- Enhance crop production.
- Secure food security.
- Constitute a carbon sink that could be traded.



Climate Change Impacts on Agriculture

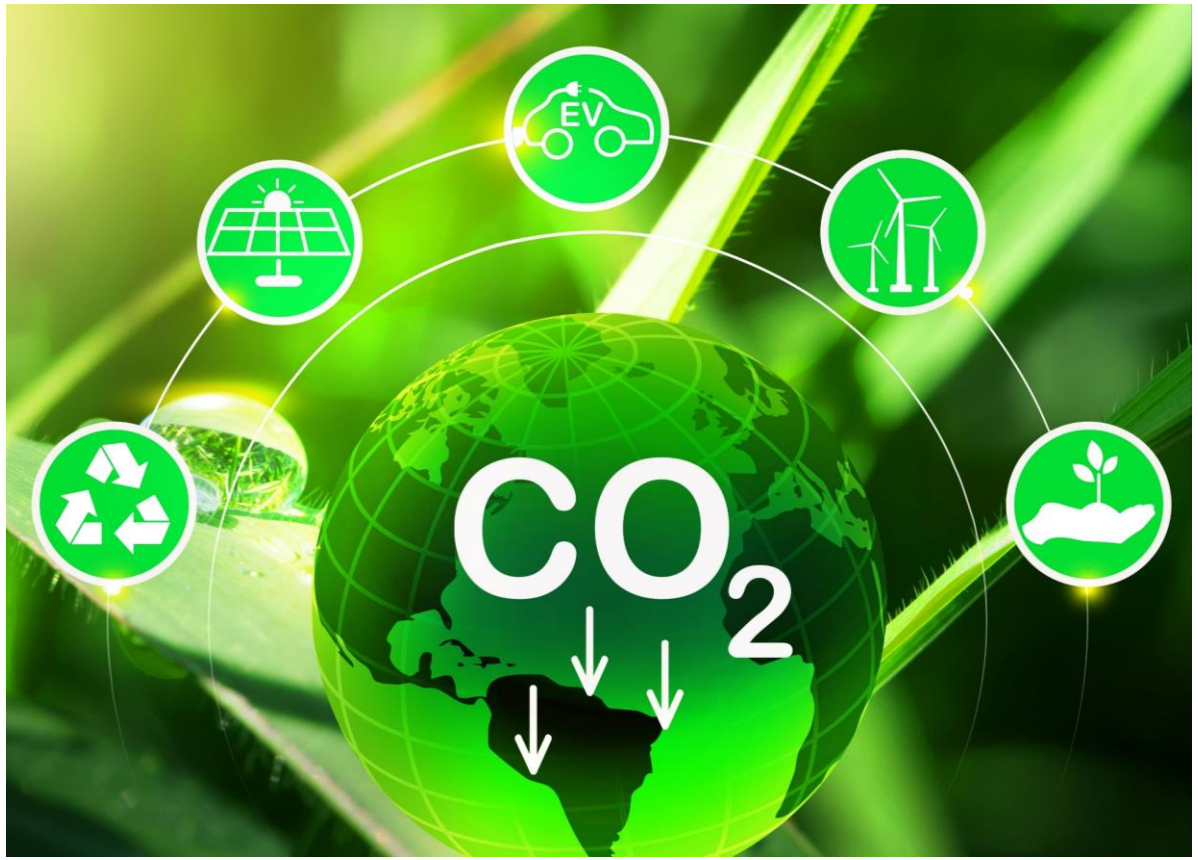
- Increasing surface runoff resulting in soil erosion.
- Loss and degradation of the agricultural field.
- Frequent outbreak of crop pests and diseases.
- Decline in species diversity.
- Increased frequency of droughts and/ dry spells.
- Erratic or unpredictable rainfall.
- Heat stress affecting both cattle and crop growth
- Upward shifting of production zones in mountainous for temperate crops.

Climate Change Impacts on Agriculture

Drought affected sorghum crop in bosnia village, baidoa, somalia. Photo credit: zakaria haji

CSA Tech. for Potential Carbon Sequestration

- Soil Conservation.
- Crop Rotation.
- Area Enclosures.
- Conservation Agriculture.
- Rotational Grazing.
- AgroForestry System.



Carbon Sequestration — Facts

Tanzania
3.9 m ha forest lost (2010 -2017).

Gross annual forest rate app.
600,000 ha yr^{-1}

20 – 50% soil carbon lost in **SSA** (Nat. forest into cropland).

Mono-cultivation accelerate SOM decomposition
20 – 67% soil carbon loss.

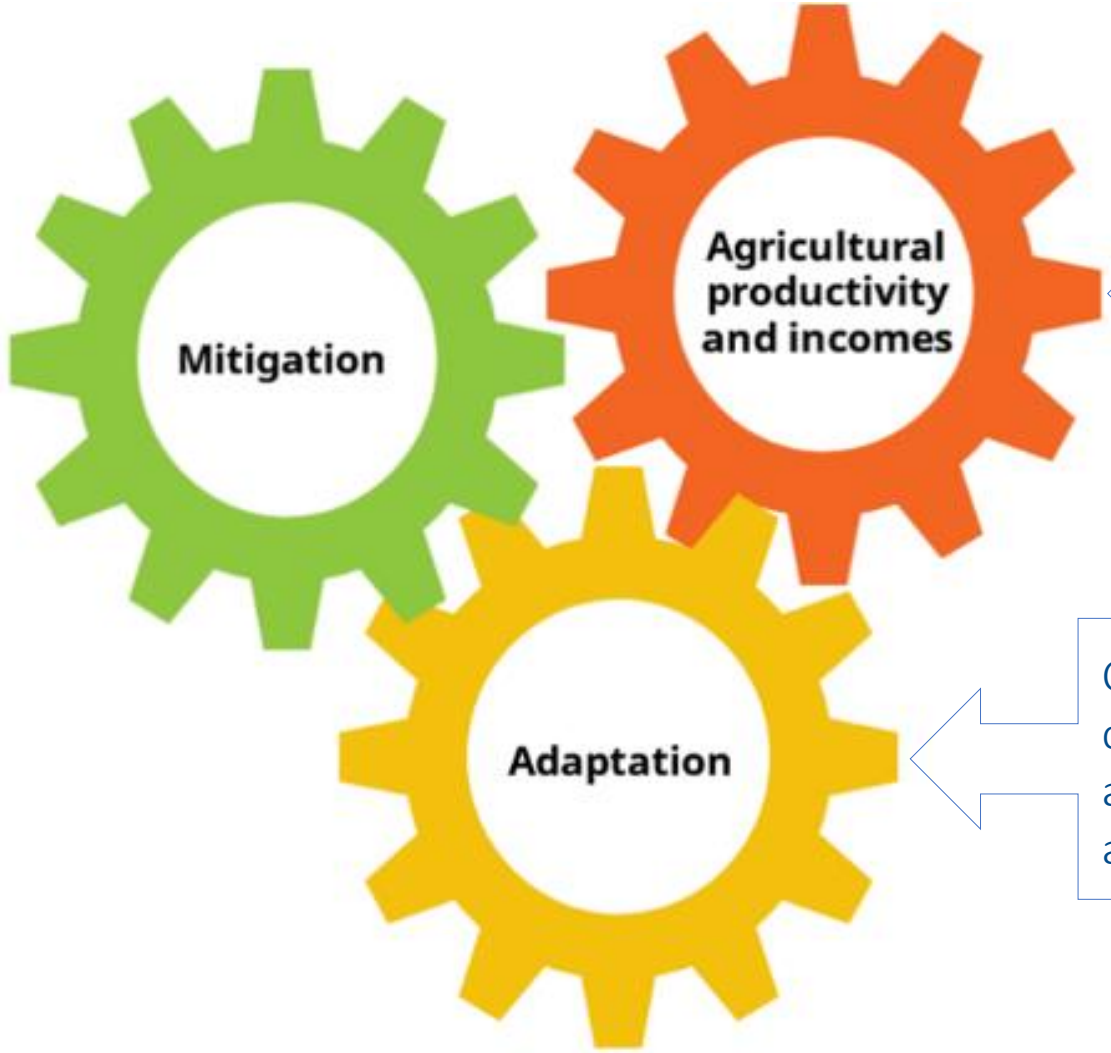
Rotational Grazing SCS
2.2 Mg C ha^{-1} yr^{-1}

CSA practices reduce emissions by
87-420 Mg co_2 eq ha^{-1}

Traditional versus Climate-smart Technologies

Agricultural practices	Current agricultural practices	Climate-Smart Agriculture
Land and farm management	Expand agricultural (deforestation and converting grasslands to cropland). Repeated and heavy tillage are commonly used	Increase land utilization by converting degraded land to cultivable land. Reduces land degradation by using zero or minimum tillage).
Crop varieties	Rely on a few crops and/or a few high yielding improved and hybrid crop varieties and improved breeds.	Use a mix of traditional and improved locally adapted/resilient varieties. Breeds to maintain output, increase yields and ensure their stability in the face of climate change.
Agrochemical inputs	Relentless use of chemical fertilizers, pesticides, and herbicides.	Integrated management approaches. Priority is given to the application of organic fertilizers including compost, manure, and green manure. Rotate crops with legumes to fix nitrogen and reduce the use of chemical fertilizers.
Mixed cropping (Intercropping)	Planting of pulse crops and grains, such as maize and legumes, maize, and beans, etc.	Intercropping maize with early or late maturing soyabean varieties

CSA Pillars

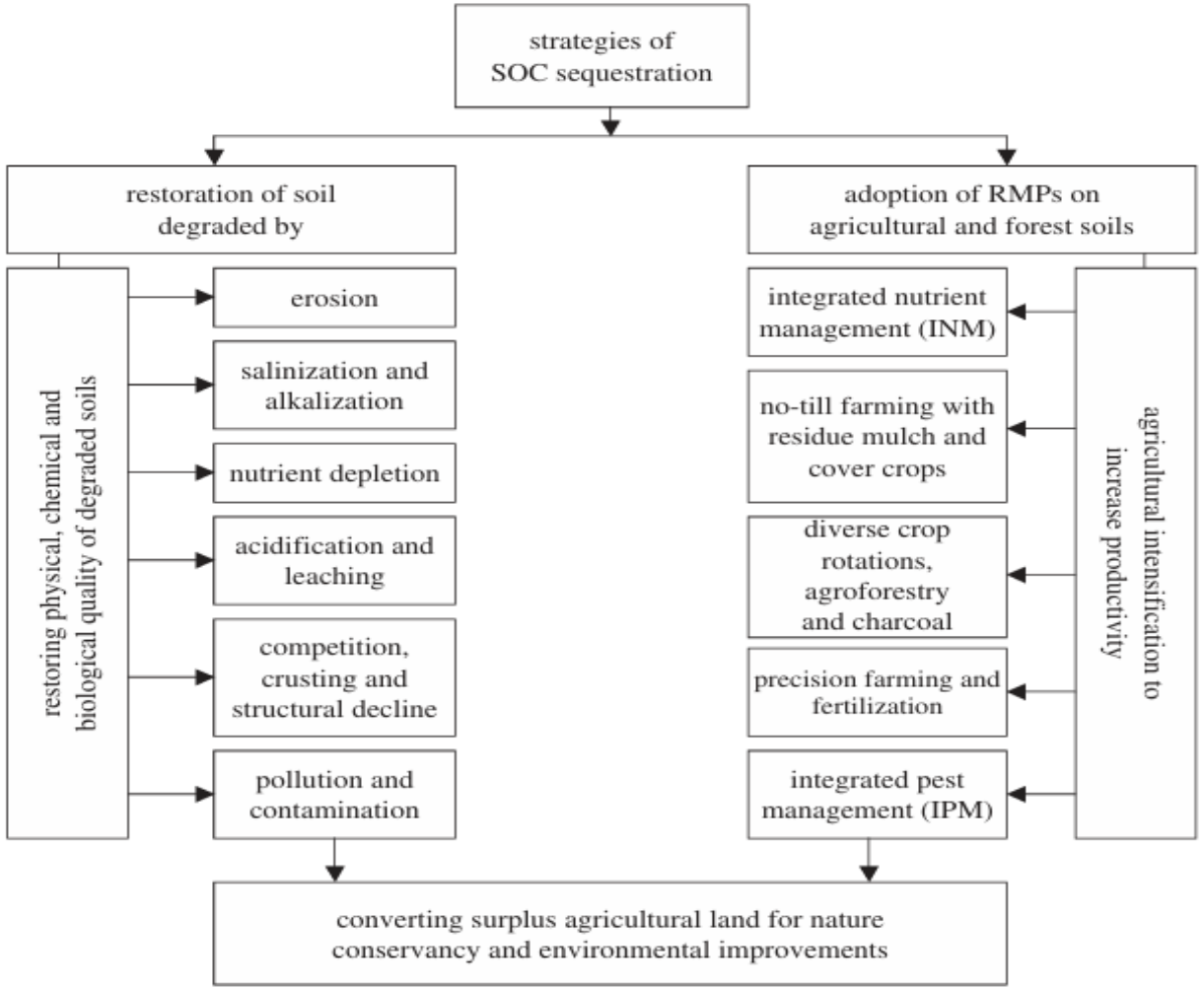


GHG emissions reduction end removal enhancement

incomes, food security, and development

Climate change adaptation and resilience

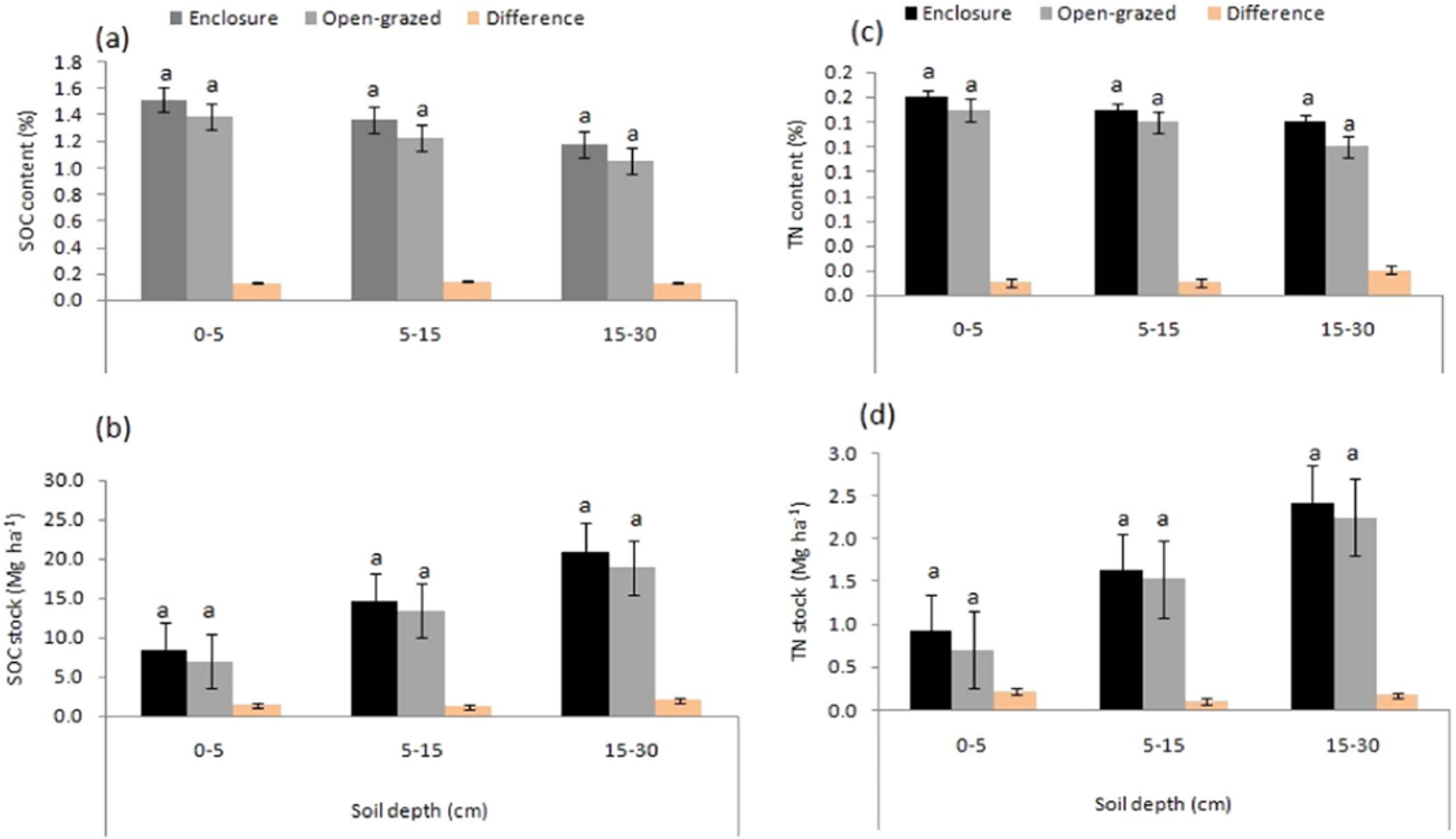
Strategies for Soil Carbon Sequestration



Management strategies for soil carbon sequestration

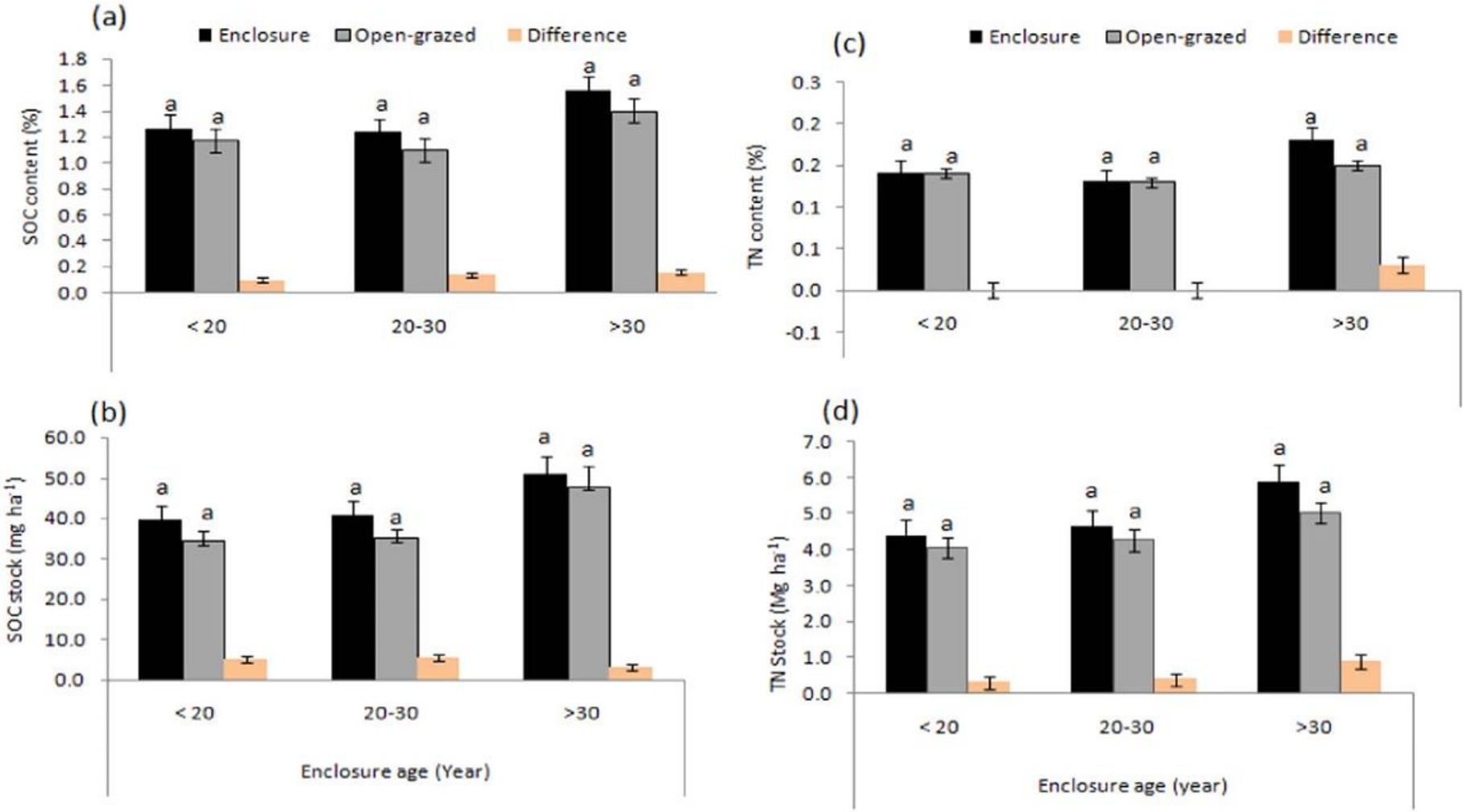
R. Lal (2008), Phil. Trans. R. Soc. B, 363, 815–830.

Effects of enclosure management on carbon sequestration — Ethiopia



K. Feyisa et al. (2017), Catena 159, 9–19.

Effects of enclosure management on carbon sequestration — Ethiopia



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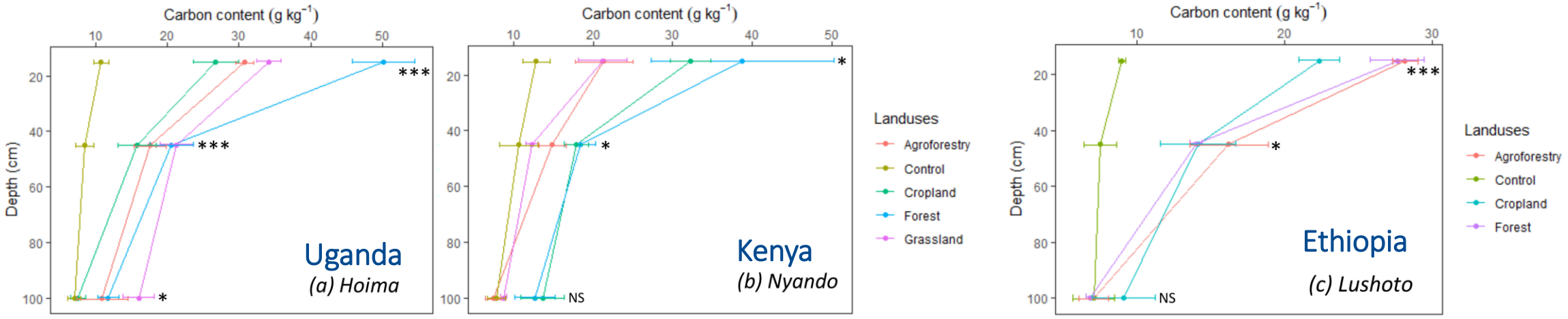
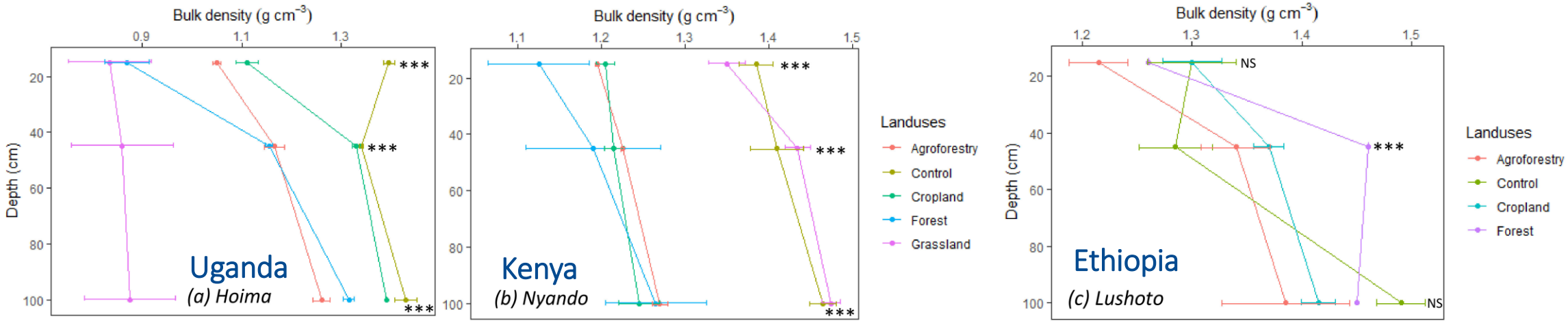
Soil organic carbon content under different management strategies



Soil organic carbon content in the deep soGil profile (0–100 cm).

G. Ambaw et al. (2020), Climate, 8, 124, 1 – 12.

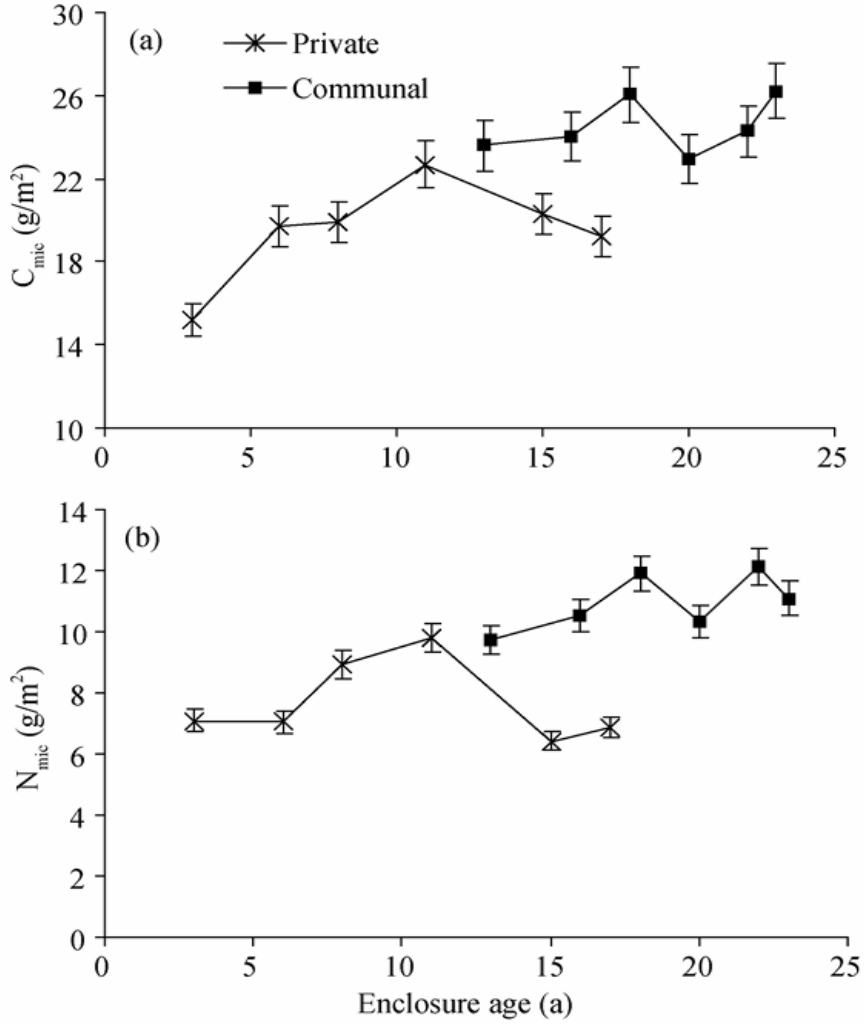
Soil organic carbon content under different management strategies

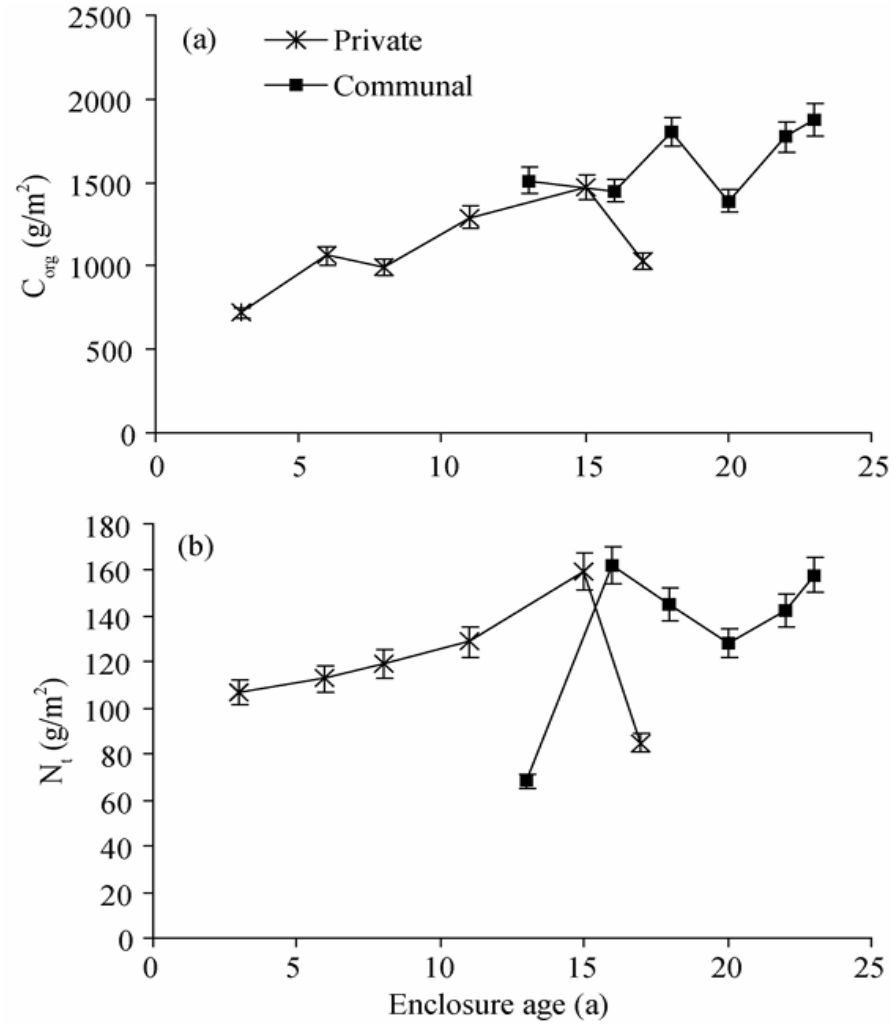


Total Bulk density at different soil depths (0–100cm).

G. Ambaw et al. (2020), Climate, 8, 124, 1 – 12.

Impact of enclosure management on soil properties and microbial biomass — Kenya

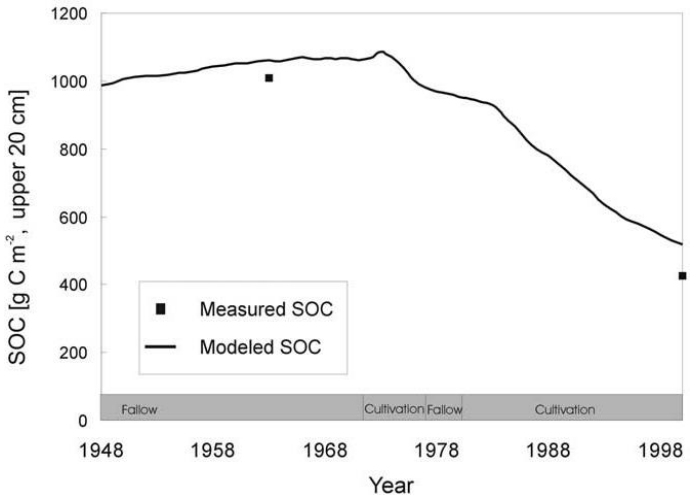


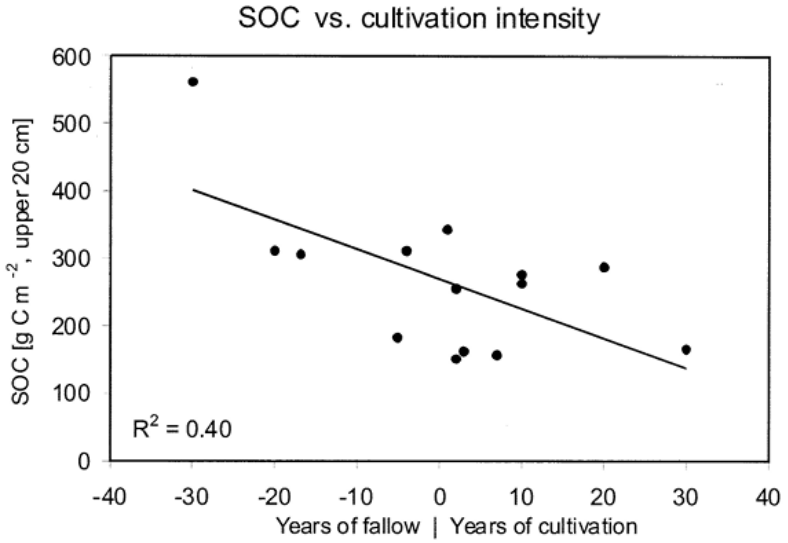


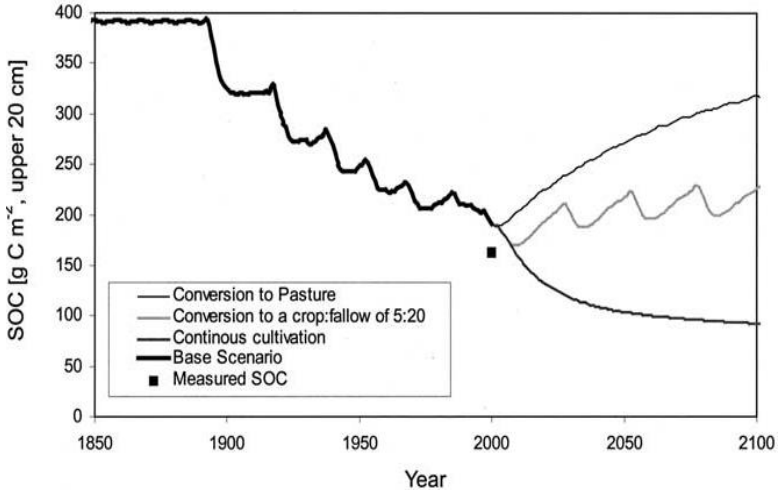
Topsoil microbial C and N stocks (Left) and Topsoil organic C and total N stocks of the private and communal enclosures

Stephen M MUREITHI et al. (2014), JOURNAL OF ARID LAND, 6, 561–570

Modeled and measured SOC at the study area — Sudan



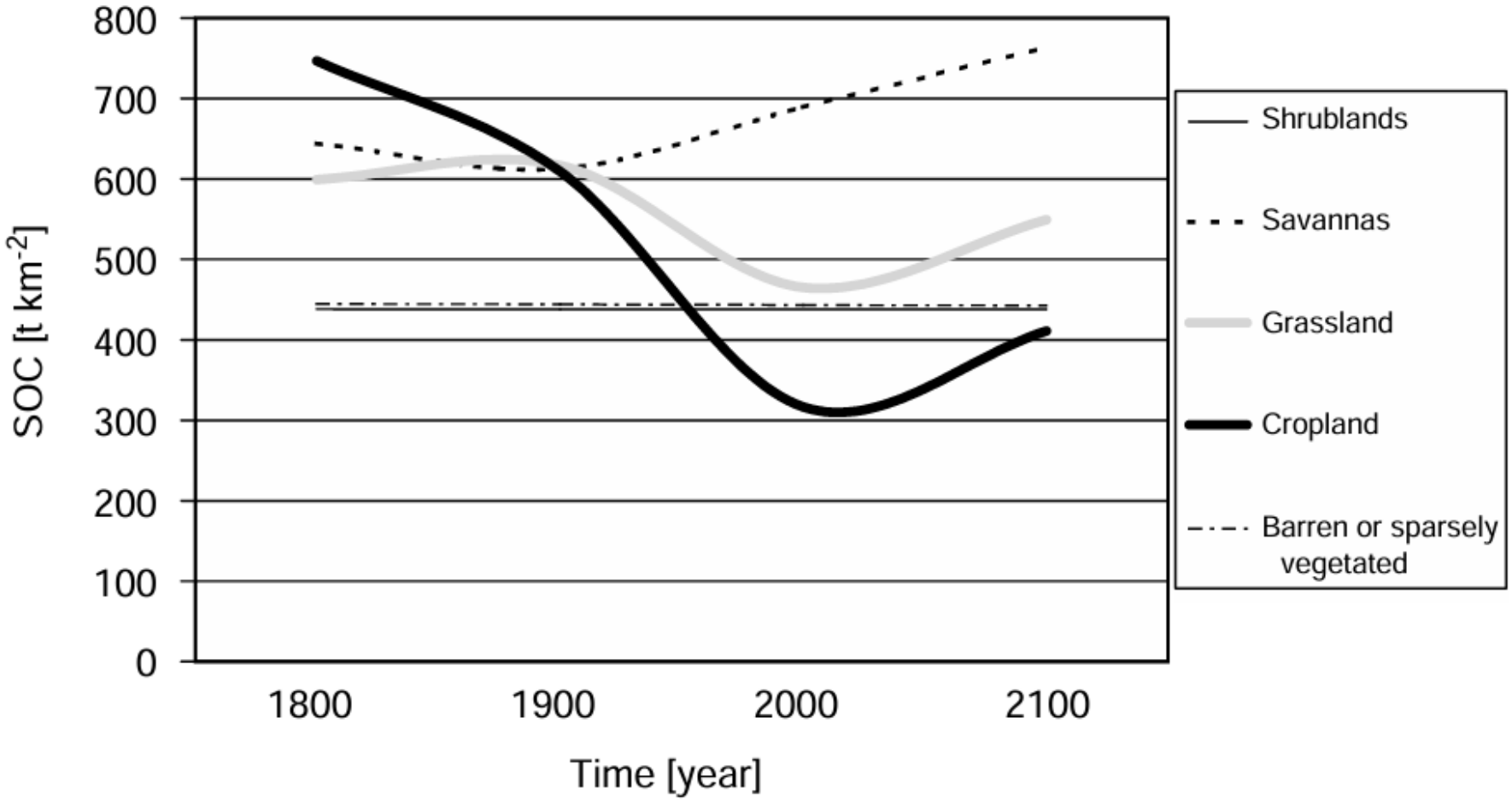




Fallow, cultivation/fallow and cultivation practices – Sudan.

J. ARDO¨ & L. OLSSON (2004), Enviro. Manag., 33: pp. S318–S329.

Average soil organic carbon change over time per land-use — Sudan



J. ARDO¨ & L. OLSSON (2003), J. of Arid Enviro., 54: 633–651

Conclusion

- Greenhouse gas concentration in the atmosphere are increasing and the threat of global change requires our attention.
- Strategies to sequester carbon will also likely restore degraded land and avoid further degradation.
- A diversity of agricultural management practices can be employed to sequester more carbon in the soil (e.g. conser agric., agro-forestry, manag. Practices, IPM, etc.).
- Various OM management systems lead to various soil fertility and soil C stocks.
- Biomass is the main source of C inputs into soil, land degradation is a factor of loss.
- Tradeoff between SC storage and soil fertility (soil productivity).

Acknowledgement





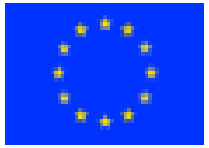












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