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Regenerative practices: impact on soil organic carbon sequestration in West Africa

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OUTLINE

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- ❖ Soil carbon sequestration potential of Africa
- ❖ Best practices in Ghana/West Africa

- ❖ Case studies
- ✓ The African dark earth phenomenon
- ✓ Conservation agriculture (CA)
- ✓ Carbon stock of unique thicket vegetation on Vertisol
- ✓ Trade–offs

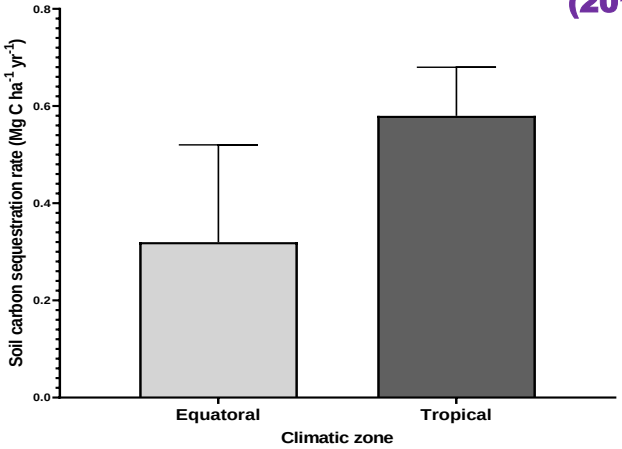
Carbon sequestration potential of Africa

- **Potential through croplands, natural savannas, forests**
- **C sequestration potential of 143 Tg through conservation agriculture (Gonzalez-Sachenz et al. 2019).**
- **Lower values (20-60% less) also reported (Corbeels et al. 2019).**

No till = 0.60 Mg/ha/yr; (Dahan et al. 2014)

Cover cropping = 0.44 Mg C /ha/yr (Joshi et al. 2023)

Mulch tillage =1.4 Mg C /ha/yr (Sharma et al. (2016)



Corbeels et al. (2019)

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Case Studies

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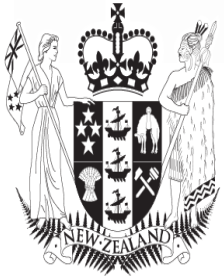
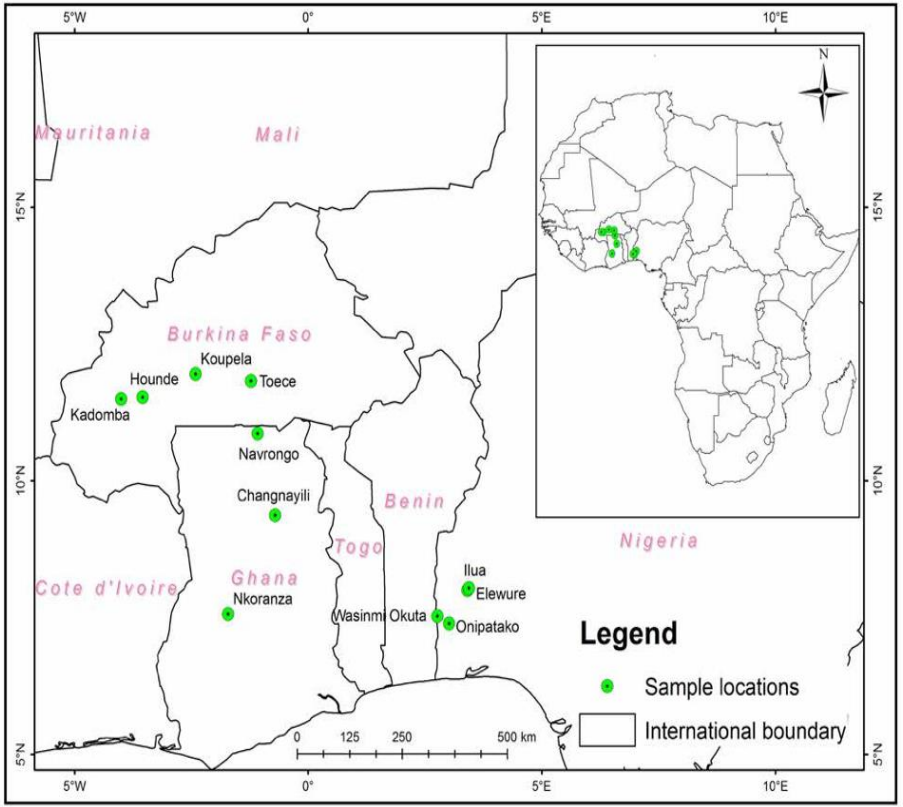
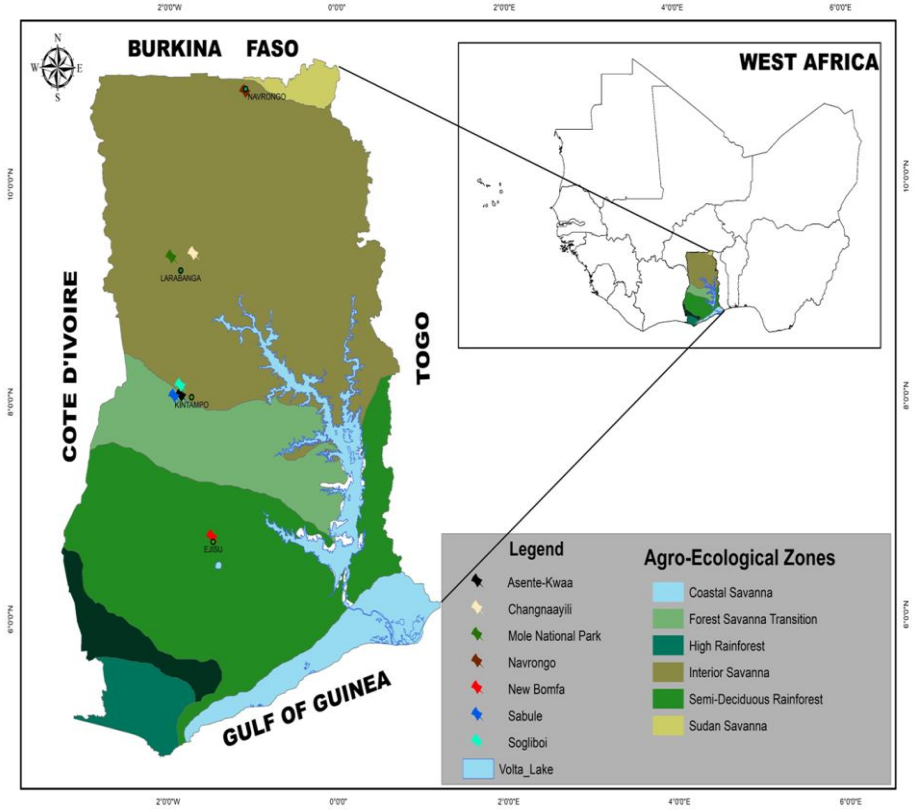


Study Sites





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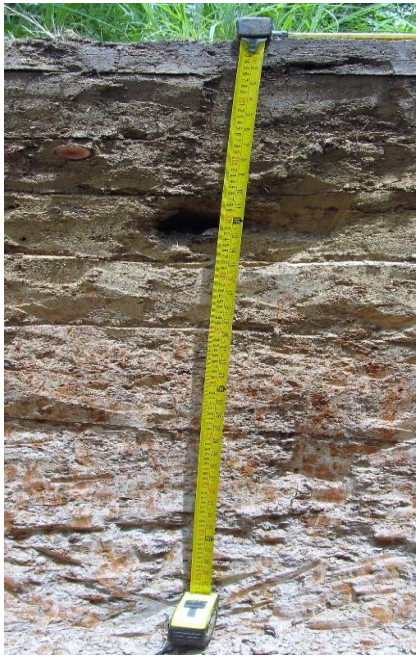
Soil type of study sites



Stagnic Plinthic Lixisol at Hounde, Burkina Faso

Stagnic Pisoplinthic Plinthosol at Navrongo, Ghana

Lixisol at Sogliboi, Ghana

- Soils generally Lixisols and Plinthosols

EJP Soil C-arouNd, 2024

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African Dark earths (AfDEs)

- ❖ **Formation:**
- ✓ **Indigeneous inputs of organic materials**
- ✓ **Plant species selection**
- ✓ **Protection from fire**

- ❖ **Carbon rich AfDEs are great indigenous innovations for building climate resilience ecosystems**

- **Important for achieving the ”4p1000” and the re-carbonizing soil initiatives (Rumpel et al. 2020, FAO/ITPS, 2021)**

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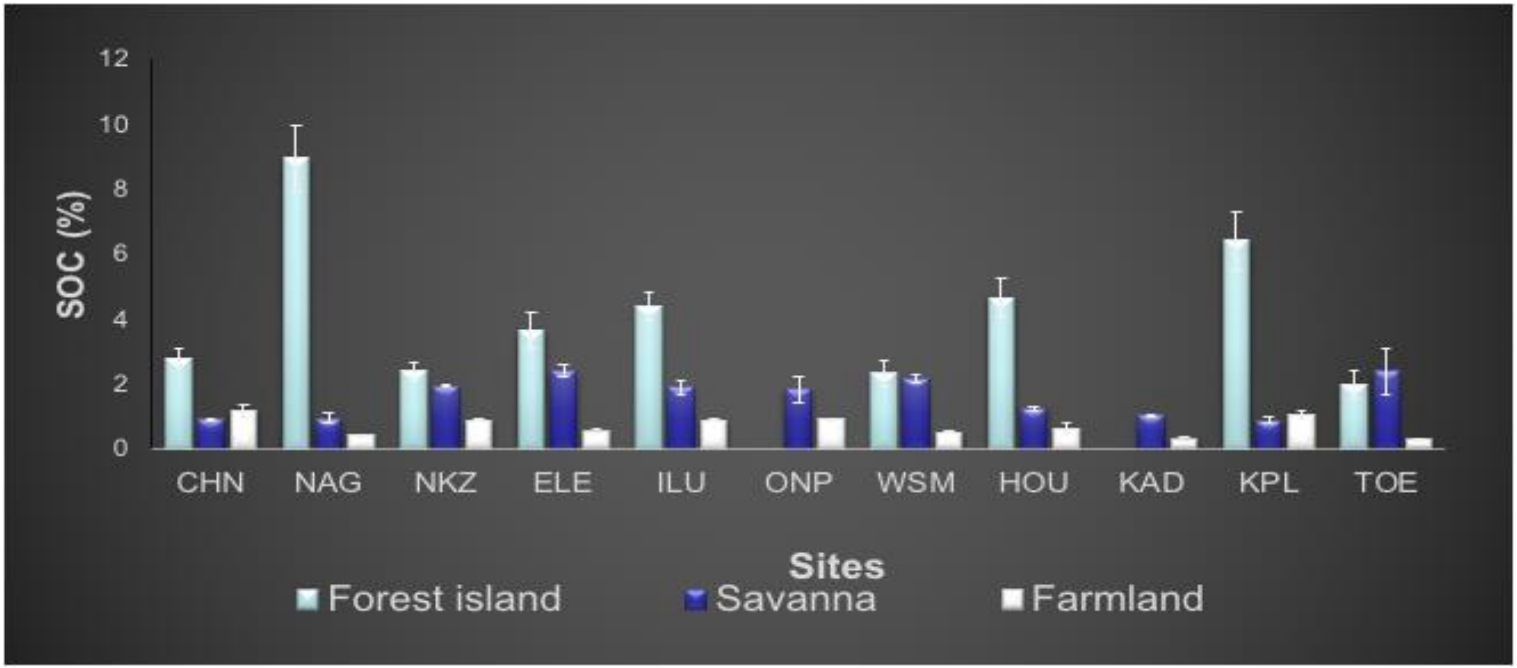
Soil carbon distributions in Forest Islands across W/Africa



Soil C distributions in selected Forest Islands and adjacent ecosystems. CHN: Changanayili, NAG: Navrongo; NKZ: Nkoranza (GH); Ele: Elewure; ILU: Ilua; ONP: Onipataku, WSM: Wasinmi Okuta; HOU: Hounde, KAD: Kadomba, KPL: Koupela; TOE: Toece; bars: standard deviations. Melenya and Logah et al. unpubl.

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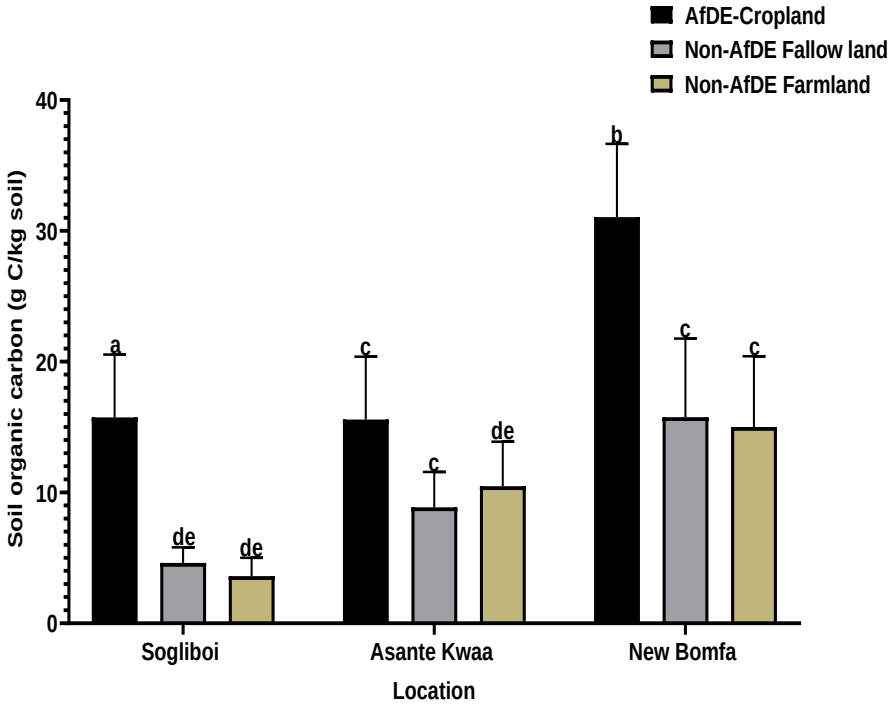
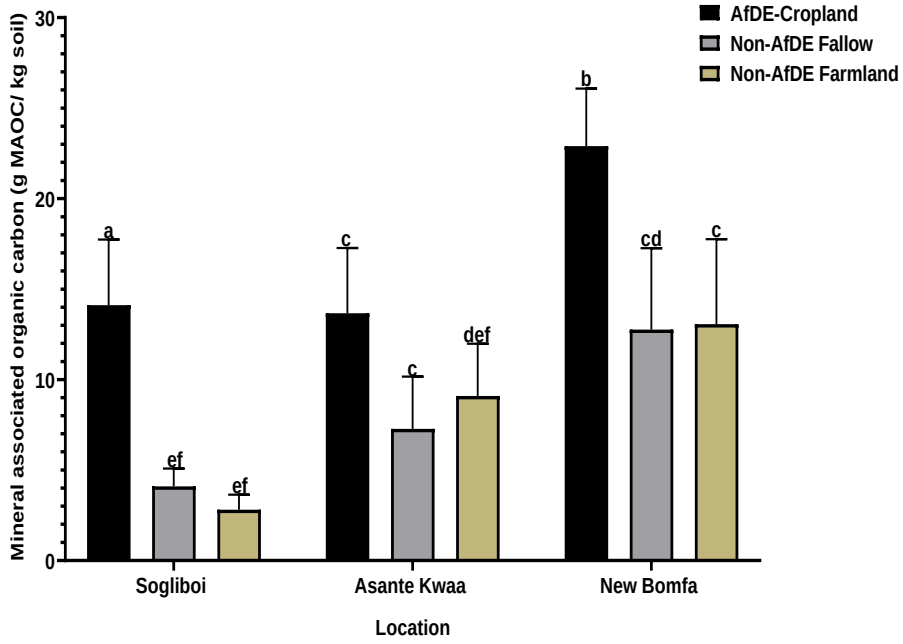
Soil organic carbon distributions in AfDEs in Ghana





Bulk soil organic carbon

Mineral associated organic carbon (MOAC); AfDE = African dark earth

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Higher (3×) soil C status in AfDE than non-AfDE

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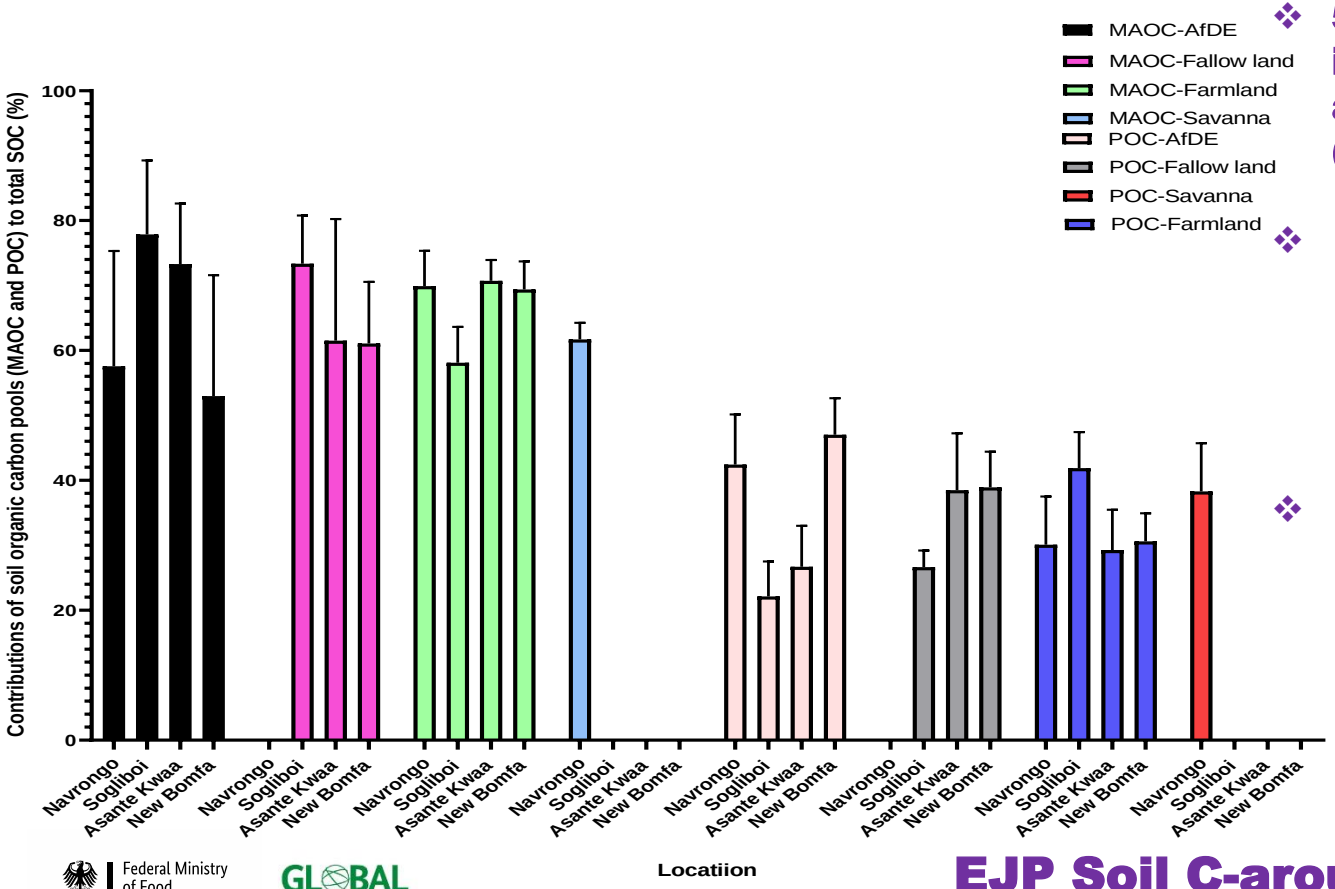
Persitence of SOC in AfDEs



- 55-75% of C stabilized in the mineral associated pool (MAOC) in AfDEs
- Due to its persistence in soils, global efforts are geared towards increasing the MAOC pool
- Trade off between storing C in MAOC and POC pool?

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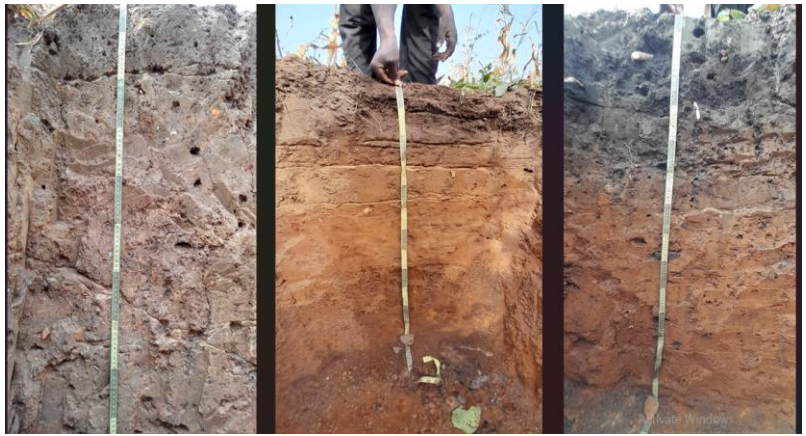
AfDEs and food securtiy?

- **Higher yield on AfDE (Baidoo, Logah et al. unpub.)**
- **Lower CO_2 emission on AfDEs (Prelim results, not shown)**
- **Soil profile of two dark earths (left and right) and non-dark earth (middle) in farmland at Sogliboi, Ghana**



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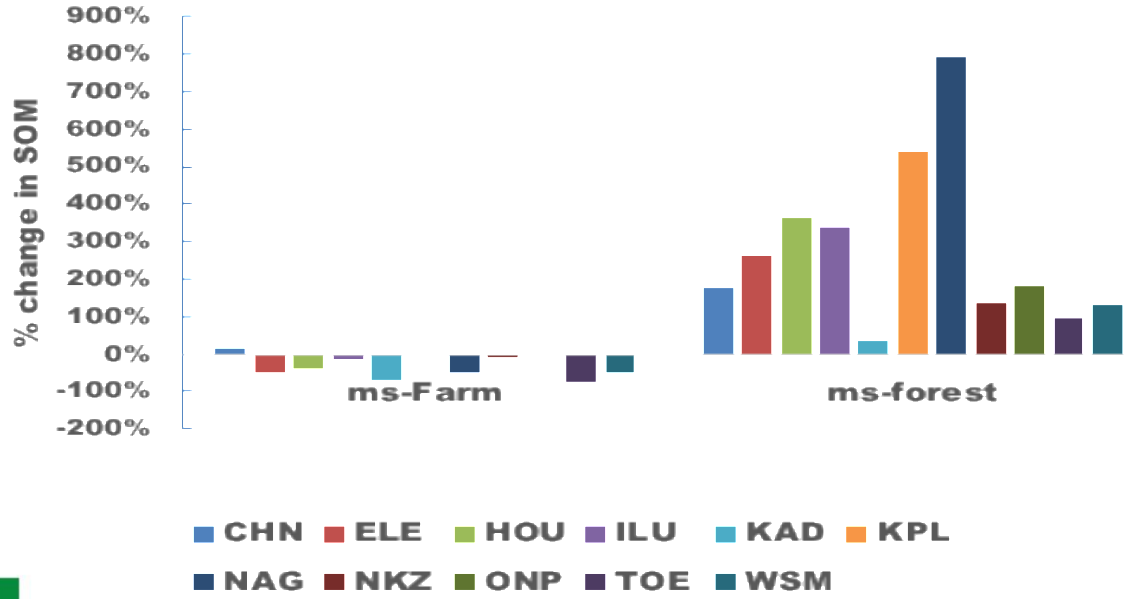
Trade-offs in land use change in W/A



- **Topsoil organic matter varied from decline (-74%) to enrichment (16%) when savanna was converted to arable land (ms-farm)**
- **SOM increased considerably when savanna was converted to forest island**

(Mesele and Logah et al. 2024, Plant & Soil)

Trade-offs in land use change in West Africa; Mesele …Logah et al. (2024), Plant & Soil

ms-farm =Land conversion from savanna to agricultural land; ms-forest =Land conversion from savanna to forest island; CHN: Changanayili, NAG: Navrongo; NKZ: Nkoranza (GH); Ele: Elewure; ILU: Ilua; ONP: Onipataku, WSM: Wasinmi Okuta; HOU: Hounde, KAD: Kadomba, KPL: Koupela; TOE: Toece:

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Thicket areas and soil C sequestration on Vertisol

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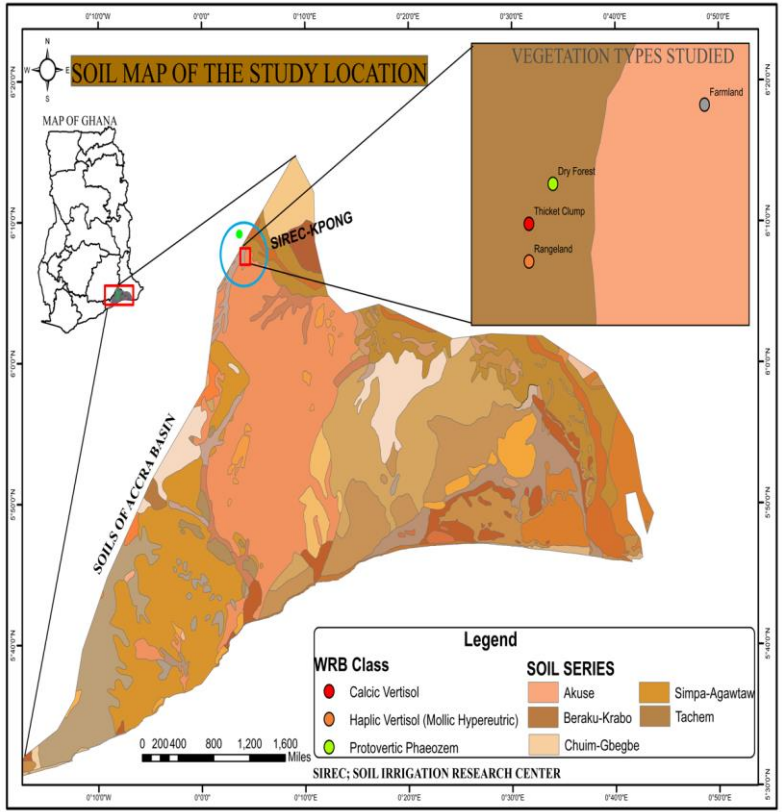
Thickets on Vertisols in Accra plains



Thicket before fire

Thicket after fire

The thickets are fire inpenetratable and increases soil carbon sequestration

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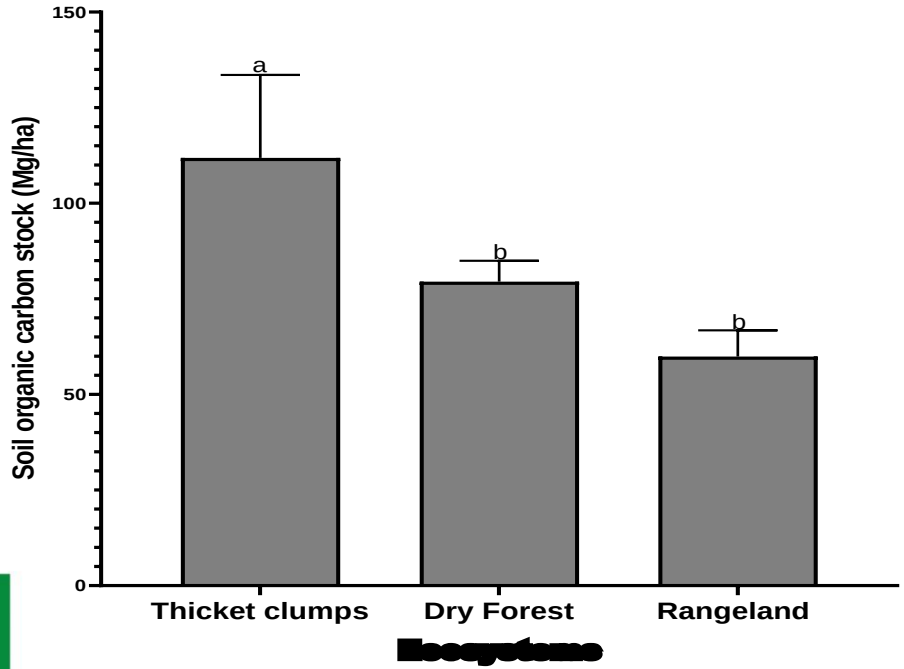
Soil carbon sequestration in thickets on vertisol



(Baidoo and Logah ... 2024, Geoderma Regional)

- Thicket areas stored ca. 40 % more soil carbon than dry forest on Vertisol
- Calls for their preservation

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Conclusion

- **Regenerative practices increased soil carbon sequestration and persistence in West Africa.**
- **About 55-75% of C is stabilized in the mineral associated pool (MAOC) in AfDEs**
- **Enhanced carbon sequestration in AfDE holds promise for farm productivity and greenhouse gas reductions**
- **Need for intentionality and connectivity among stakeholders (policy makers, research institutions, etc.) for farming a sustainable bioeconomy**

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Acknowledgment

Ministry for Primary Industries
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AN ALLIANCE FOR THE CLIMATE
AgriDENZ
Dialogue on climate and agriculture between New Zealand and Germany

Horizon 2020 Programme

EJP SOIL
European Joint Programm

GLOBAL RESEARCH ALLIANCE ON AGRICULTURAL GREENHOUSE GASES

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Thank you for listening