Afforestation of savannah with cocoa agroforestry systems impact on soil organic carbon content and stock and other soil properties

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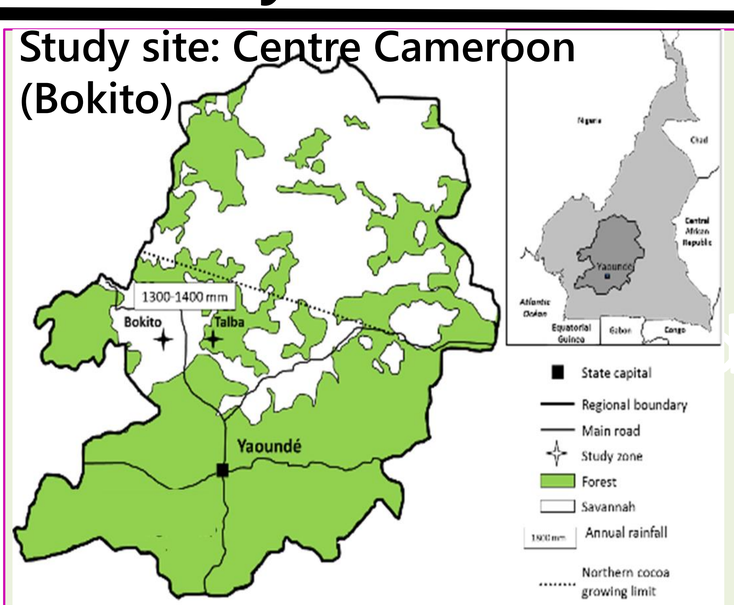
1. Context & objective

- Afforestation of degraded savannah with cocoa agroforestry systems (cAFS) has been reported as a successful farmer practice and a sustainable production option in Cameroon.
- Yet the effects on soil C and nutrient dynamics are unknown.

How does afforestation of savannah with cAFS affect long-term soil carbon sequestration and other soil properties?

2. Study site and methodology

Study site: Centre Cameroon (Bokito)



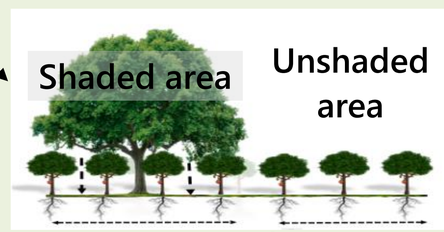
Previous land use

Savannah

Land use change

Annual cropland

Cocoa monoculture



Cocoa AFS (20 and 60 years old)

Nearby forest

Variables measured

Top 10 cm soil layer: texture; C content; bulk density, nutrient content (pH, N, P, exchangeable bases, CEC)

Soil organic matter fractionation: C content in particle size fractions:

- **0—20 µm (more stable carbon pool),**
- **20 - 50 µm**
- **50—2000 µm (labile carbon pool)**

Studied shade tree species in cAFS:

Canarium schweinfurthii, Dacryodes edulis, Milicia excelsa, Ceiba pentandra, Albizia adianthifolia

3. Results Highlights

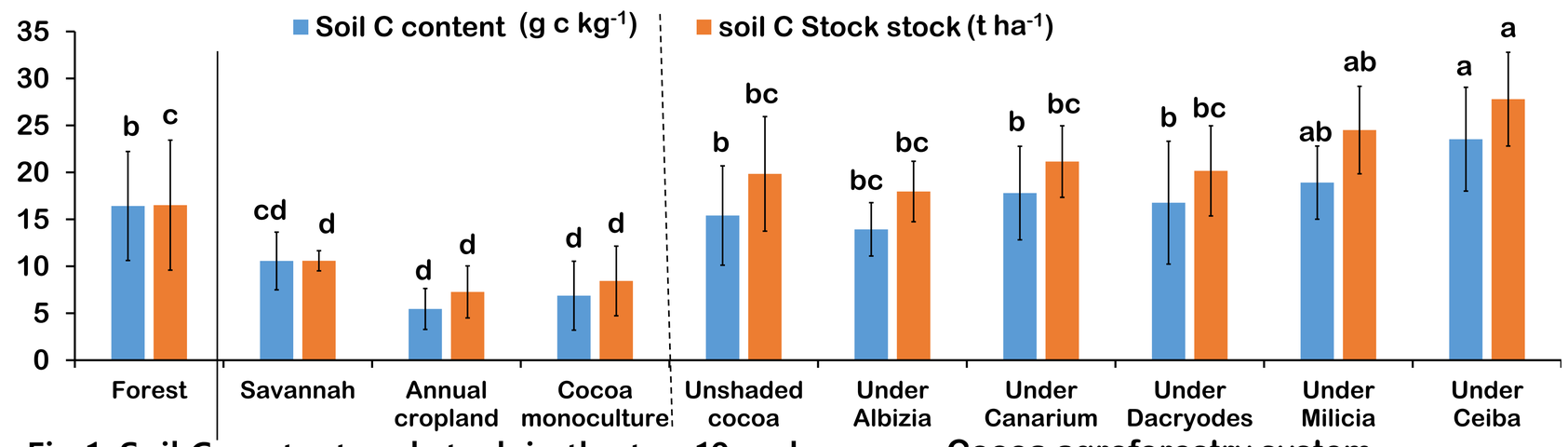


Fig 1: Soil C content and stock in the top 10cm layer

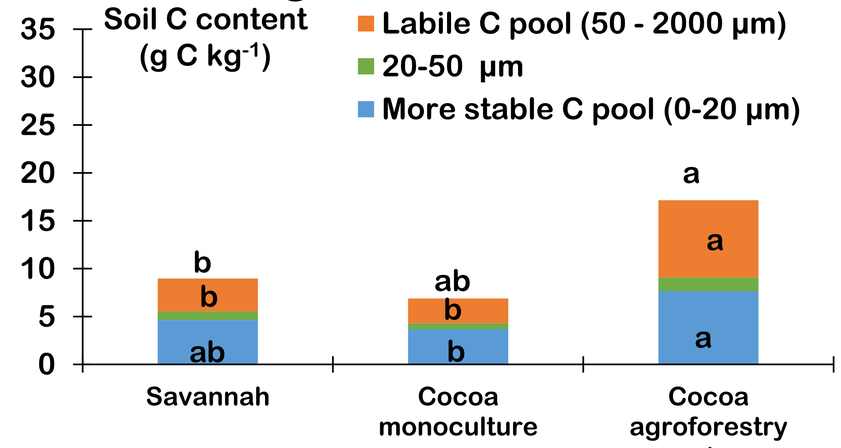


Fig 2: Soil C content in soil particle size fractions

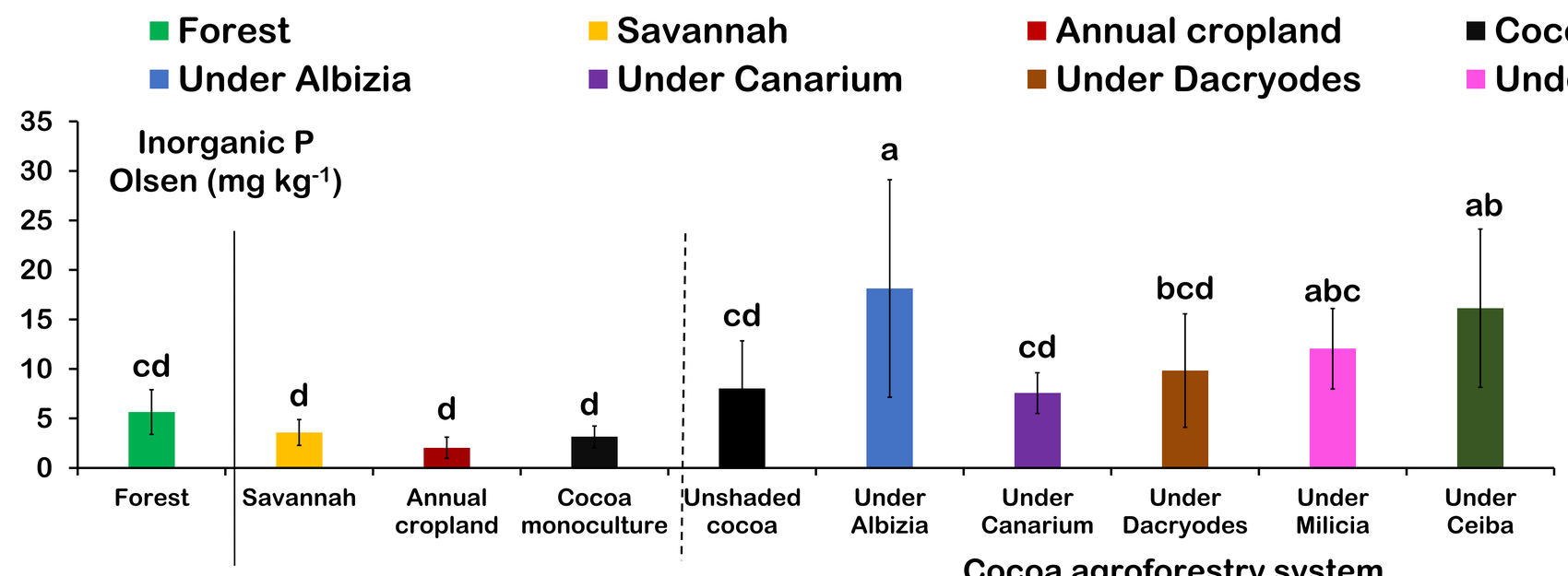


Fig 3: Soil Inorganic P (Olsen) in the top 10cm layer

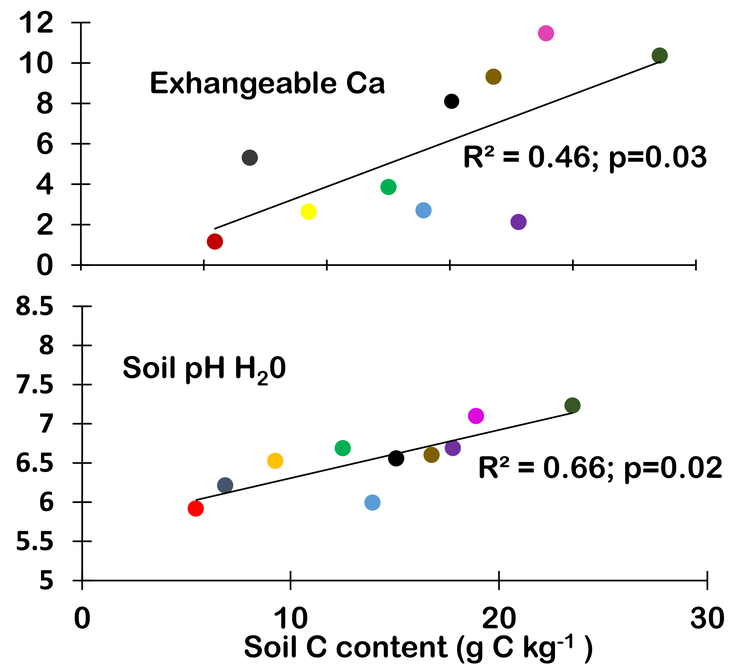


Fig 4: Relationship between Soil C content, Exch. Ca and pH

3. Conclusion & perspectives

- Twenty to sixty years after conversion of savannah to cAFS, soil C content and stock significantly increased to levels found in nearby secondary forest (Fig 1).
- Afforestation of savannah with cAFS resulted in C content increase in both labile and stable soil carbon pools (Fig 2).
- Generally, the different soil properties (soil pH, Olsen P content, exchangeable Ca and sum of bases) were also improved in cAFS compared to savannah (Fig 3) and these parameters were positively linked to soil C (Fig 4) .
- We generally observed no significant change in soil carbon and other soil parameters in annual cropland and young cocoa monoculture in comparison to savannah.
- The increase in soil C as well as the improvement of other soil properties in cAFS could be due to higher cumulative litter inputs in cAFS than in other land uses.
- The highest soil C and pH increases under *Ceiba pentandra* and *Milicia excelsa*, compared to other species, confirmed local farmer preferences for these species in cocoa farms.
- Using specific shade trees in cAFS will ensure diversification, improved soil fertility and sustainability of cocoa production.
- Afforestation of savannah with cAFS appears as a sustainable production option, as it results in long term soil restoration of degraded savannahs.

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SoCa: Beyond climate, Soil Carbon sequestration to sustain tropical family farming

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