

Carbon dynamics in cacao agroforestry plantations setup after forest or savannah:

A chronosequence analysis in a forest - savannah transition zone in Cameroon

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Introduction

Previous studies in the forest-savannah transition zone of Bokito in Central Cameroon have shown that smallholder farmers were able to realize afforestation by creating cacao plantations on savannah land (Fig: 1)^{1,2}. Compared to plantations setup after forest in the same region, cocoa production levels and associated tree species densities were found to be comparable on the long-term¹. In the light of climate change, afforestation of savannah with cacao plantations could be of great potential due to its significant storage of carbon.

Methods

Field studies were conducted in Bokito in the central region of Cameroon. Plantations with an age gradient of 0 to 80 years were selected to assess aboveground carbon accumulation in cacao and associated trees as well as the soil carbon content. The two previous land-use types: savannah and gallery-forest were also included in the analysis for comparison.

Results

Total aboveground carbon (AGC) was found to be highest in the gallery-forest control plots (118 Mg ha⁻¹) and lowest in the savannah control plots (trees and herbs: 8 Mg ha⁻¹; Fig: 2).

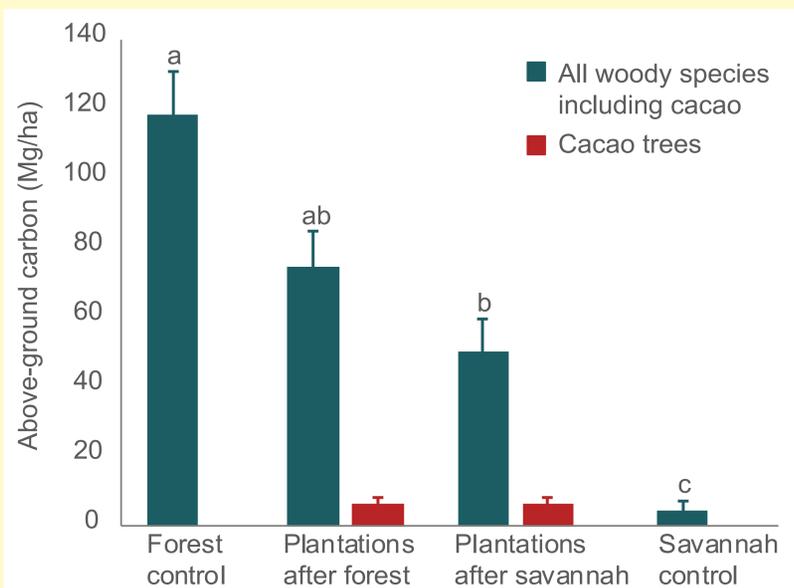


Fig. 2: Mean total above ground carbon stocks in forest- and savannah control plots, cacao plantations after forest and after savannah.

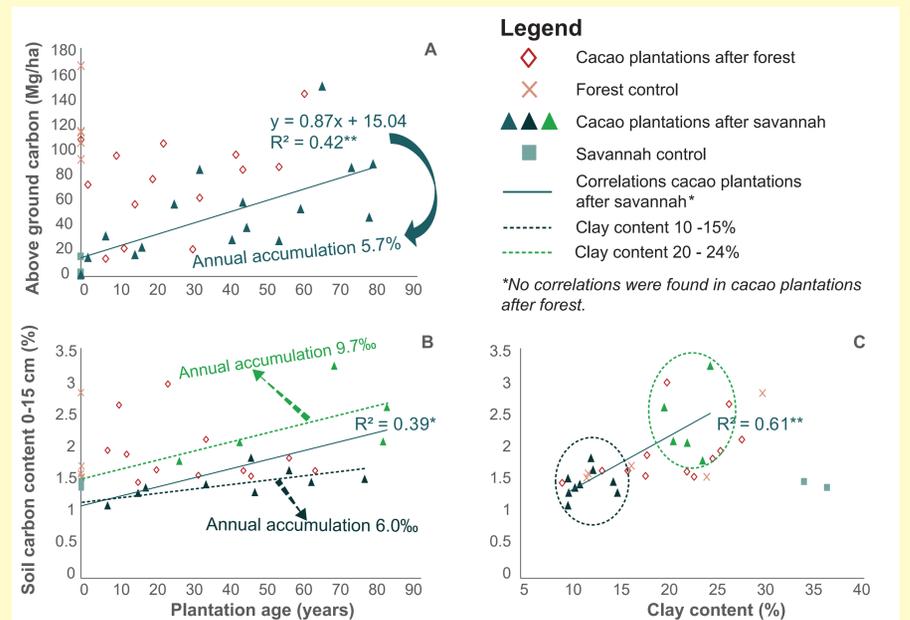


Fig 3: Changes in (A) above ground carbon stocks and (B) soil carbon content with the plantation age. (C) Correlation between soil carbon content and soil clay content.

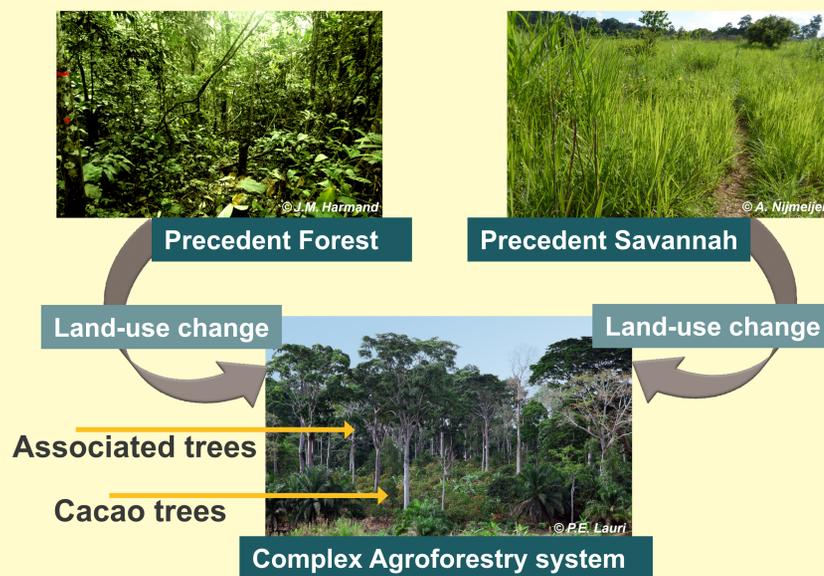


Fig. 1: What influence has converting savannah or forest to complex cacao agroforestry systems on the long-term carbon budgets?

Compared to their previous land uses, mean total AGC was around 40% lower in cacao plantations set-up after forest while AGC stocks of plantations set up after savannah have increased by 630%.

AGC of cocoa plantations after forest stayed relatively stable over time while it increased significantly ($p < 0.01$) with the age of the plantations setup after savannah (Fig: 3A). According to the soil texture, different tendencies of soil C accumulation over time were found in cocoa plantations setup after savannah, while no change in soil C content was observed after forest over time (Fig: 3B, C).

Conclusion

- Afforestation of savannah has a positive effect on the total above ground carbon with an annual accumulation of 5.7% resulting in similar carbon stocks as cacao plantations after forest in ± 60 years.
- Setting up a cacao plantation after forest decreases the mean above ground carbon stock but no significant change was shown with aging of the cacao plantations.
- For the two classes of soil texture found in the cocoa plantations setup after savannah, soil organic carbon increases with the plantation age.

References

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