

CARBON CONTENT IN CACAO AFS

Afforestation of Savannah as a Carbon Storage Opportunity in Central Cameroon

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Introduction

Afforestation of savannah areas by cacao agroforestry systems (AFS) is relatively rare¹⁻⁴. Soil and climate conditions are generally considered undesirable for this type of perennial production system⁵. However, previous studies in a forest-savannah transition zone in Central Cameroon have shown that smallholder farmers were able to afforestation on savannah land by establishing cacao plantations on it^{4,6}. Compared to plantations setup after formal forests in the same region, cocoa production levels and associated tree species densities were found to be comparable on the long-term⁴. Considering the low level of carbon storage in savannah, partly due to yearly burning of these areas, afforestation with cacao plantations could be of great potential in the light of climate change mitigation due to their increased carbon storage capacity.

Methods

Field studies are conducted in Bokito in the central region of Cameroon, this area is known as a patchwork of savannah, forest, agricultural area and AFS. Savannahs in these area are yearly burnt for hunting practices and land clearance is carried out for agricultural practices. Carbon measurements were taken in cacao plantations setup on two previous land-use types (savannah and gallery forest) with an age gradient of 0 to 80 years. Results were compared with two control groups in gallery forests and savannah. Carbon content and accumulation were assessed both in cacao trees and associated tree species as well as in plantations' soil.

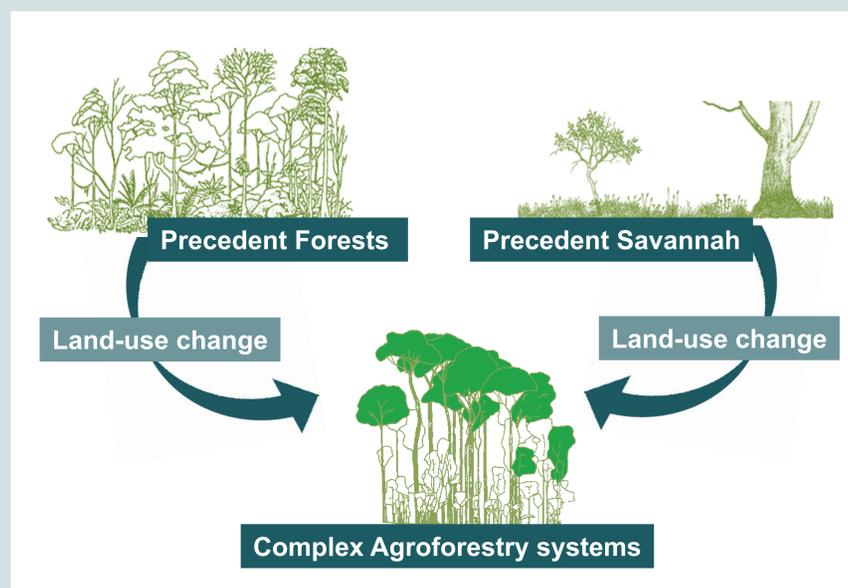


Fig. 1: What influence has converting savannah or forest to complex-cacao agroforestry systems on the long-term carbon budgets?

Results

Mean total above ground carbon is around 40% lower in cacao plantations set-up after forest compared to forest control plots. Above ground carbon stocks of plantations set up after savannah have increased by 1011% compared to the measurements that have been taken on savannah (Fig.2).

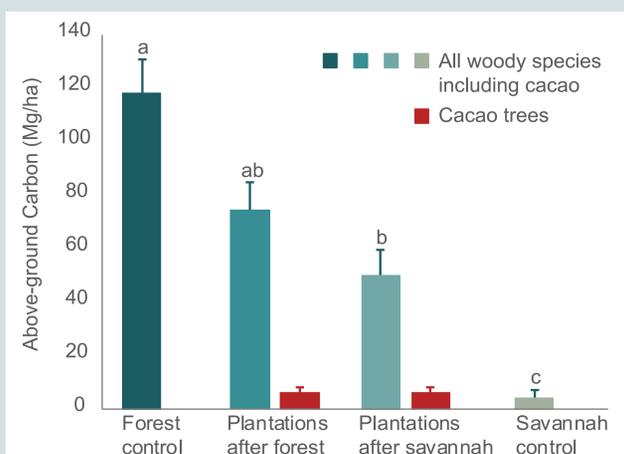
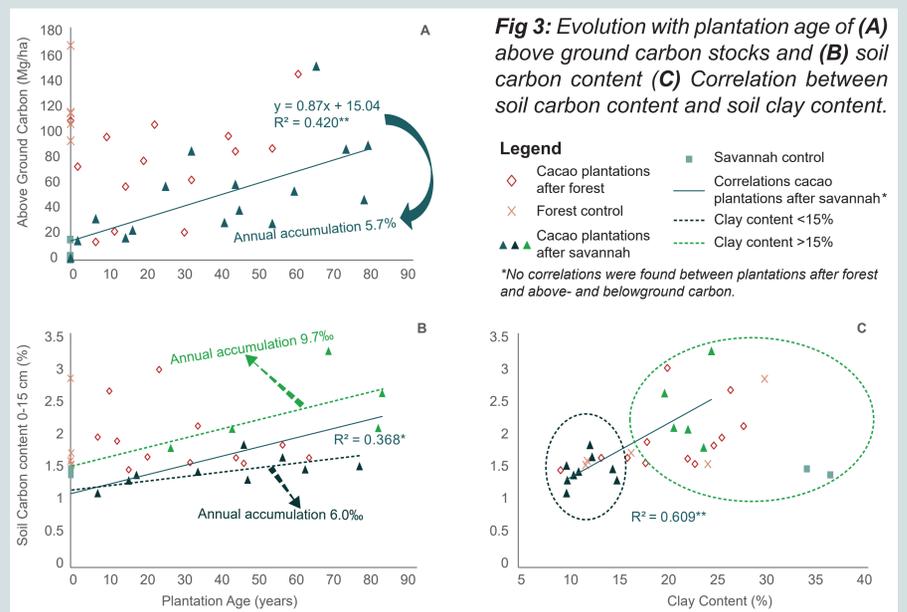


Fig. 2: Mean total above ground carbon stocks in forest- and savannah control plots, cacao plantations after forest and after savannah.

Results



The above ground total carbon and soil organic carbon (SOC) of the first 15 cm of savannah plantations are significantly correlated with the age of the plantations (Fig: 3A,B). For the same parameters no correlations were found in forest plantations and the soil layer 15-30 cm. Even though, a correlation between age and SOC was found an even stronger correlation was found between soil clay content and SOC content (Fig: 3C). When separating cacao plantations after savannah into two groups 1) low (<15%) and 2) high (>15%) clay content, SOC tended to increase at an annual rate of 9.7‰ for the plantations on soils with a high clay content and 6.0‰ for the plantations on soils with a low clay content (Fig: 3B).

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 levels 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.
- Soil carbon and soil clay content of plantations set up after savannah are strongly correlated but also correlations are found between soil organic carbon and the plantations age.

References

1. de Foresta, H. & Michon, G. The agroforest alternative to Imperata grasslands: when smallholder agriculture and forestry reach sustainability. *Agrofor. Syst.* 105–120 (1997).
2. Ruf, F. et al. From slash-and-burn to replanting: Green revolutions in the Indonesian uplands. *World Bank Regional and Sectoral Studies* (The world bank, 2004).
3. Gockowski, J., Weise, S., Sonwa, D., Tchata, M. & Ngobo, M. Conservation Because It Pays: Shaded Cocoa Agroforests in West Africa. *Habitat* 29 (2004).
4. Jagoret, P., Michel-Dounias, I., Snoeck, D., Ngnogué, H. T. & Malézieux, E. Afforestation of savannah with cacao agroforestry systems: a small-farmer innovation in central Cameroon. *Agrofor. Syst.* 86, 493–504 (2012).
5. Wood, G. A. R. & Lass, R. A. *Cocoa*. (Blackwell Science, 2001).
6. Saj, S., Jagoret, P. & Todem Ngogue, H. Carbon storage and density dynamics of associated trees in three contrasting Theobroma cacao agroforests of Central Cameroon. *Agrofor. Syst.* 87, 1309–1320 (2013).