CACAO AGROFORESTRY SYSTEM AS A STRATEGY FOR SOIL CARBON SEQUESTRATION

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INTRODUCTION

Cacao (Theobroma cacao L.) is the main agricultural commodity in many tropical countries. In Brazil, southern Bahia is the largest planted area and is in the central corridor of the Atlantic Forest, one of the main centers of endemism of this biome, which has gone through a continuous elimination and fragmentation process. Two typical cacao production systems are used by both smallholder (5–8 ha) and large farmers (approximately 300 ha) in this region: (1) traditional cultivation system, wherein the cacao plantations are implanted under natural forest; and herbaceous, shrub and individuals of the upper canopy are eliminated to provide increased light input, resulting in extensive agroforestry called 'cabrucas'; (2) cacao plantations are established in areas where all native forest has been removed. Agroforestry systems (AFS) based on cacao may play an important role in capturing carbon (C) aboveground and storing it belowground (soil) through continuous deposition of plant residues. C occlusion in soil aggregates could be a major mechanism of C protection in these soils. Therefore, this poster intends to show the potential of different cacao AFS to stock SOC and the extent of the sequestered C that is occluded in the soil aggregates.

MATERIALS AND METHODS

This study was performed in the municipality of Ilhéus (14°47 '50 'S and 39°2' 8' W), Itajuípe, (14° 40' 41''S and 39° 22' 30'' W) Una (15° 17' 20.44" S and 39° 3' 39.44" W) and Uruçuca (14° 35' 34" S and 39° 17' 02" W) in the south region of Bahia, Brazil.

The study was composed of different land use systems from the three municipality of Bahia, Brazil.

System 1	Natural Forest
System 2	Cacao+Erythrina 30 – 35-year-old
System 3	Cacao+rubber tree 12 – 35-year-old
System 4	Cacao Cabruca 30 – 35-year-old
System 5	Cacao+ rubber tree (4-year-old - before was pasture)
System 6	Cacau+ rubber tree (4-year-old - before was natural forest)
System 7	Pasture 8 – 30- year-old

Four uniform (in terms of soil homogeneity, slope, historical land-use, density and tree age) fixed plots (30 x 30 m) were delimited in the central part of each land use system and separated by at least 100 m. In each plot, trenches (1 x 1 x 1.5 m) were opened between plant rows and soil was collected at six depths (0-10, 10-20, 20-40, 40-60, 60-80 e 80-100 cm). Soil samples were separated by wet-sieving into three fraction-size classes (2000-250µm and 250-53µm). The ultrasonic method was used to quantify the occluded C in macro and microaggregates. SOC was determined by dry combustion in an automated elemental analyzer system (CHNS / O analyzer).

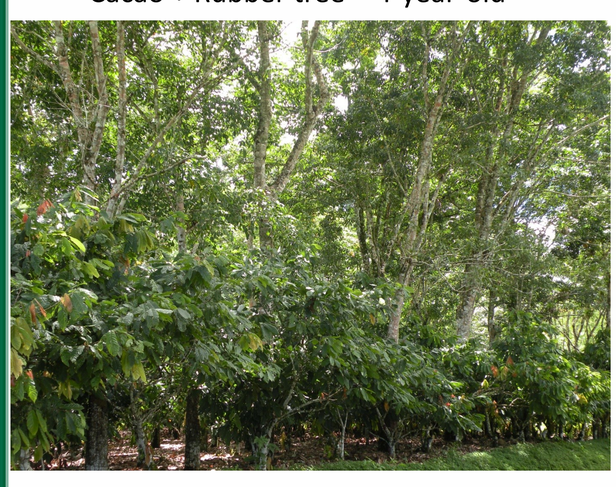
The Differences in SOC stock to 100 cm depth between cacao agroforestry (AF) and natural forest or pasture systems, was calculated according to the equation below:

$$\Delta\ AF\ (\%) = [(C_{AF}-C_{Non\ AF})/C_{Non\ AF}]*100$$

where: C_{AF} – C from agroforestry systems; $C_{Non\ AF}$ – C from natural forest or pasture.

Cacao + Rubber tree - 4-year-old

Cacao Cabruca - 30-year-old



Cacao + Rubber tree - 30-year-old

Cacao + Erythrina - 30-year-old

Litter layer and soil profile of cacao AF

Cacao litter involved by fungi, roots and soils in advanced decomposition stage

RESULTS AND DISCUSSION

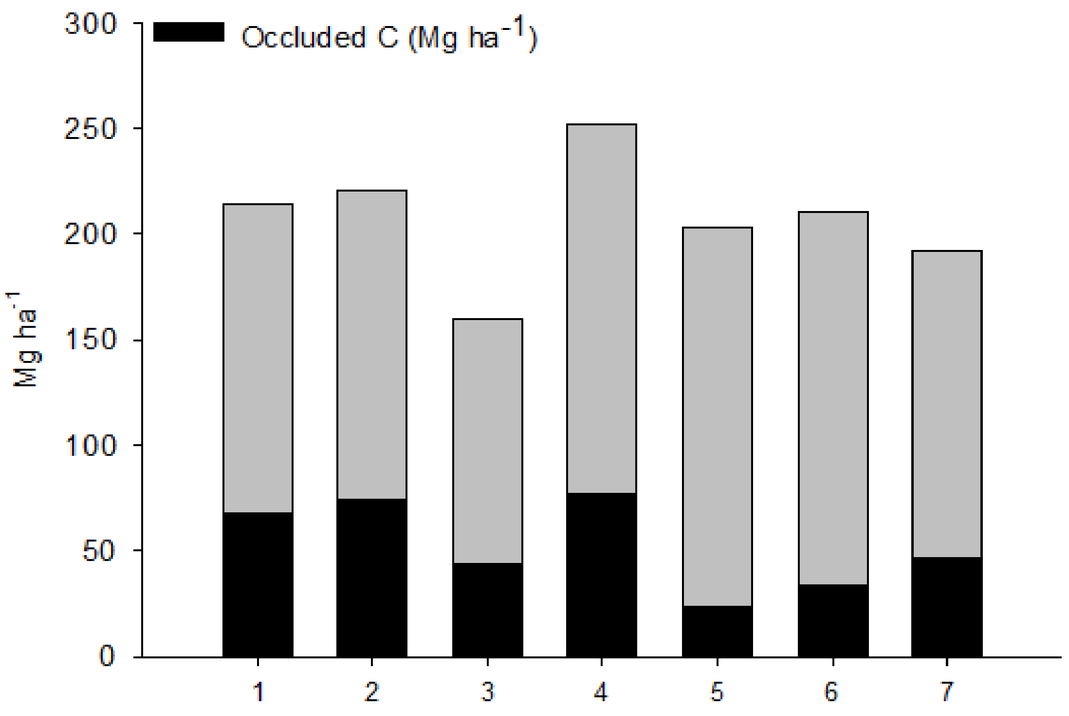


Fig. 1 SOC stocks and occluded C in aggregates (macro and microaggregates) up to 100 cm under different land use systems.

1. Natural Forest ; 2.Cacao+Erythrina; 3.Cacao+rubber tree; 4.Cacao Cabruca; 5.Cacao+ rubber tree (4 years - before PAS); 6.Cacau+ rubber tree (4 years before natural forest); 7. Pasture

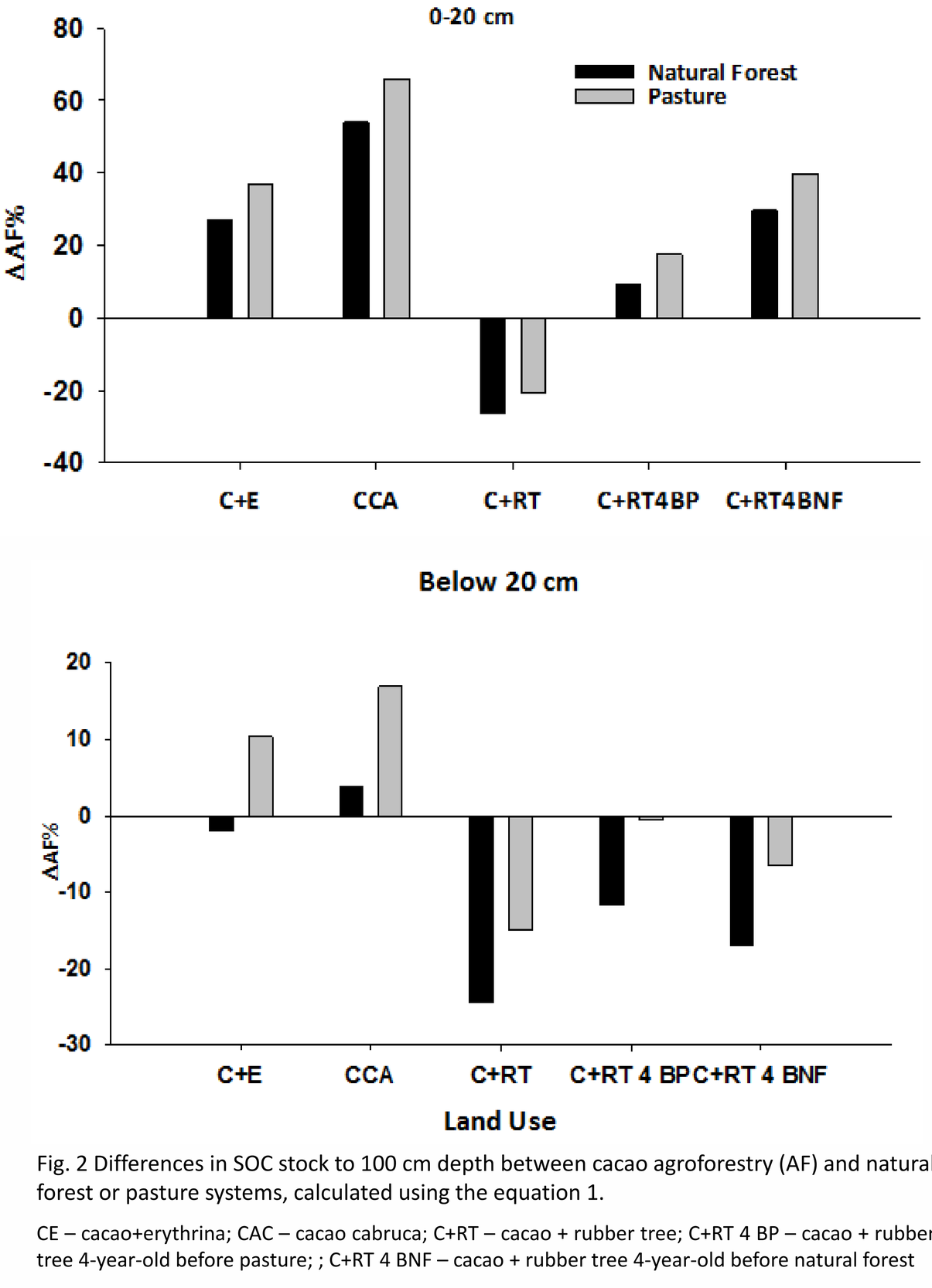


Fig. 2 Differences in SOC stock to 100 cm depth between cacao agroforestry (AF) and natural forest or pasture systems, calculated using the equation 1.

CE – cacao+erythrina; CAC – cacao cabruca; C+RT – cacao + rubber tree; C+RT 4 BP – cacao + rubber tree 4-year-old before pasture; ; C+RT 4 BNF – cacao + rubber tree 4-year-old before natural forest

CONCLUSIONS

Cacao AF showed higher potential for SOC stock up to 1m;
The oldest Cacao + rubber tree showed the lower potential for SOC stock up to 1m compared to 4-year-old cacao+rubber tree;
Pasture (and to a lesser extent forest)-to-cacao+erythrina and cacao cabruca conversion showed a high potential for SOC stock up to 1m;
The greatest contribution of cacao AF on SOC stock was mainly up to 20 cm;
The occluded C in the 30-year-old cacao AF represented 30% of total SOC stock up to 1m;
The occluded C in the 4-year-old cacao AF represented almost 15% of total SOC stock up to 1m;

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