

ANALYSIS OF THE DIVERSITY AND TIMBER POTENTIAL IN COCOA AGROFORESTRY SYSTEMS IN ALTA VERAPAZ, GUATEMALA.

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Introduction

Agroforestry improves ecosystem services to people and communities while decreasing pressure on the environment and providing several products to farmers [1]. Timber production in AFS holds immense potential in promoting environmental and economic sustainability, particularly for rural families [2]. We analyzed the timber resource in cocoa AFSs of different ages and evaluated potential for timber production from the species present in the evaluated systems.

Methodology

The study was conducted in CAFS in Alta Verapaz (Figs 1 and 2). Sampling units ($n=20$) were established and measured dasometric variables in each plot, including total height (th), commercial height (ch), and diameter at breast height (DBH) of the inventoried species (Fig 3). The presence of species was analysed using cross-tabulation and Pearson's χ^2 test to determine the frequency distribution of species among the ages of the evaluated AFSs [3].



Fig 3. Fieldwork in temporal sampling plots

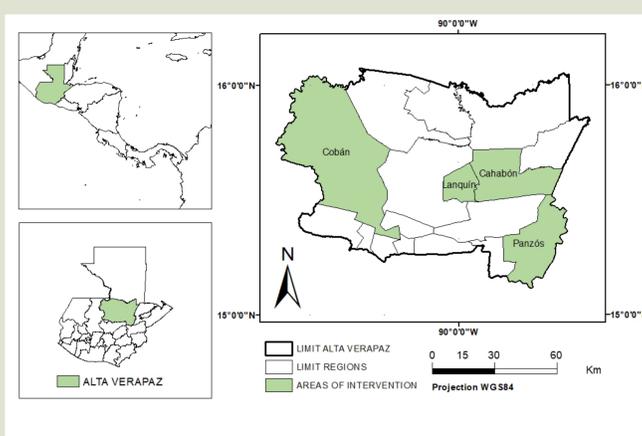


Fig 1. Sampling map



Fig 2. Cocoa AFS in the study area

Results

Eight hundred twenty-seven tree individuals corresponding to 38 species belonging to 19 botanical families were found cultivated within all sampled CAFS plots. On average, a density of 165.4 trees ha^{-1} was found, varying from 60 to 212 trees ha^{-1} (Table 1).

CAFS Age	#	Height (m)	BA ($m^2 ha^{-1}$)	Density (trees ha^{-1})	Number of taxa	
					Families	Species
3	2	11.36	9.5	202	7	10
7	3	12.78	3.7	117	11	13
10	1	12.17	13.5	212	5	6
13	1	8.58	2.2	72	3	4
14	1	11.06	3.2	124	6	8
20	1	14.23	3.2	60	3	4
25	3	14.43	10.5	196	14	23

Table 1. Average value of dendrological variables and number of taxa registered in CAFS, Alta Verapaz, Guatemala.

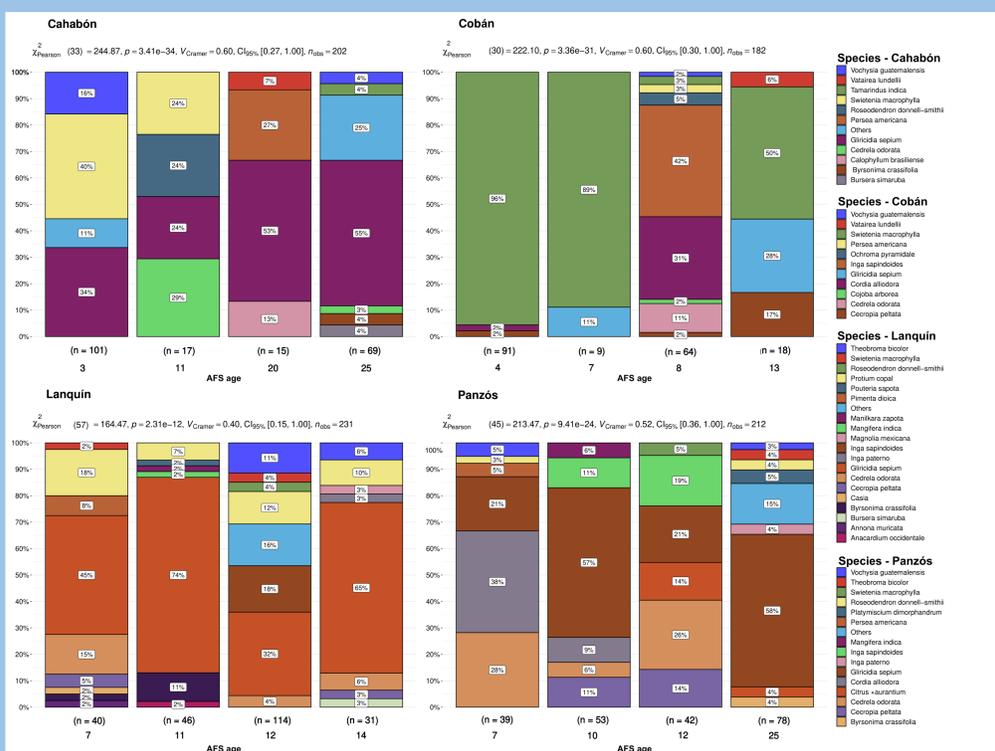


Figure 4. Frequency description and Chi-square test of species distribution by the age of cocoa agroforestry systems among the study localities.

The most represented species within the AFS were *G. sepium* (35%), *S. macrophylla* (19%), and *I. sapindoides* (8%). A pattern of species occurrence by age was observed in all zones, suggesting that species are not distributed indistinctly from the age of the CAFS in each locality ($p < 0.05$) (Fig 4). The trees occupied a basal area of 33.29 m^2 (6.65 $m^2 ha^{-1}$), and a total volume of 352 m^3 was recorded (70.4 $m^3 ha^{-1}$), of which 148.9 m^3 were for commercial use (29.7 $m^3 ha^{-1}$). The most frequent uses were firewood (38%), thin plank (30%), and poles (23%).

Conclusions

The cocoa AFS in Alta Verapaz, Guatemala, are characterized by a wide diversity of shade trees at different productive stages. The results of this study show the potential of AFS as a viable strategy for timber production. This is relevant for pmanagement and conservation strategies for cocoa agroforestry systems in the region.

References

[1] A. Manaye et al., *Carbon Balance Manag.* 16, 2–10 (2021). [2] K. De Sousa et al., *Agroforest Syst.* 9, 207–218. (2015). [3] OJ. Maza et al., *Colomb. For.* 19, 129–142 (2016).
Drawing: Abel Rodríguez