Structure and composition of cocoa agroforests in the Yangambi biosphere reserve in the Democratic Republic of Congo (DRC)

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INTRODUCTION

Cocoa agroforests (C-AFS) can help developing sustainable land use. Those with forest-like structures are of particular interest since they are able to support a large array of ecosystem services providing local households with income and contributing to food security in remote areas. This study describes the typologies of cocoa agroforests in the landscape of the Yangambi reserve, located in the northeast of the DRC.

METHODS

1. A botanical inventory was carried out on 55 C-AFS, both from smallholder farmers (n=33) and from the National Institute for Agronomic Studies and Research demonstration plots (INERA; n=22).
2. We measured associated perennials and cocoa trees diameter at breast height and height. Using surveys and bibliography, we also documented associated perennials succession guild, leaf-life span, farmer use and UICN status.
3. We then performed a Principal Component Analysis followed by a hierarchical ascending classification (Fig 1 & 2). We finally discriminated between the groups obtained using an ANCOVA using age of the C-AFS as a covariate (Tab 1).

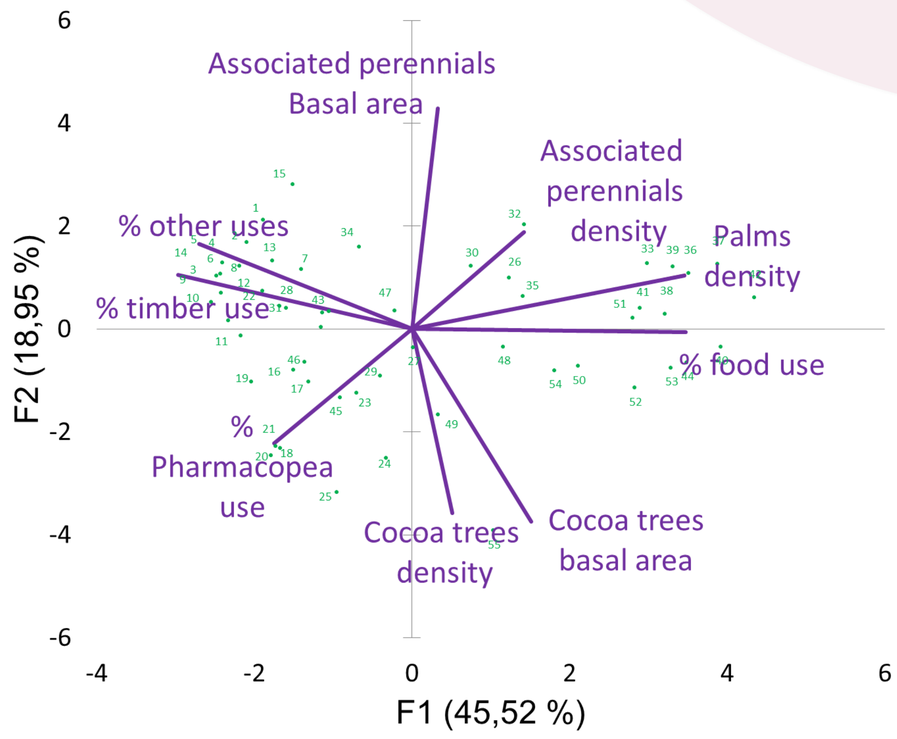

Figure 1: Characterization of cocoa agroforests by Principal Component Analysis (dots represent plots) in the Yangambi landscape

RESULTS

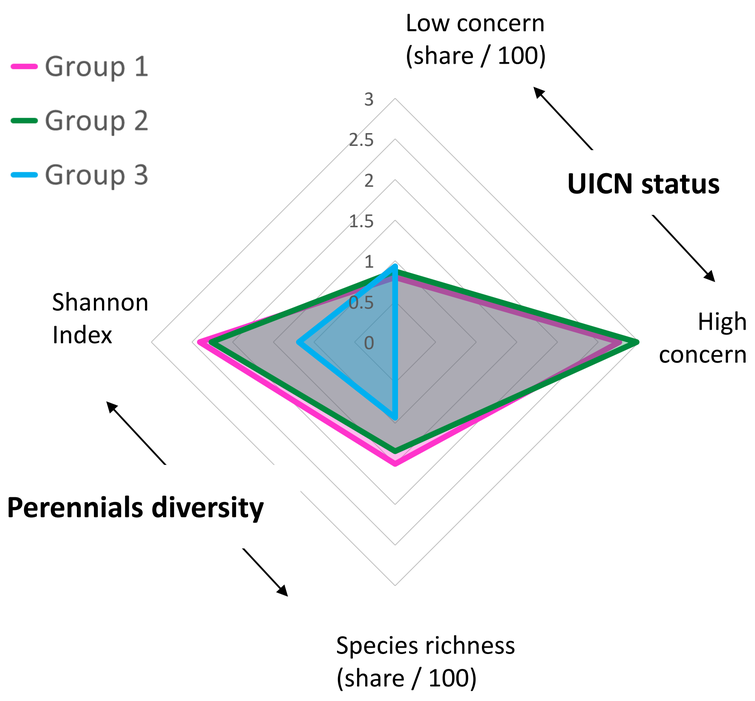

Figure 2:

(a) diversity and conservation concern status of associated perennials in the studied C-AFS

(b) Selection of characteristics of associated perennials in the studied C-AFS

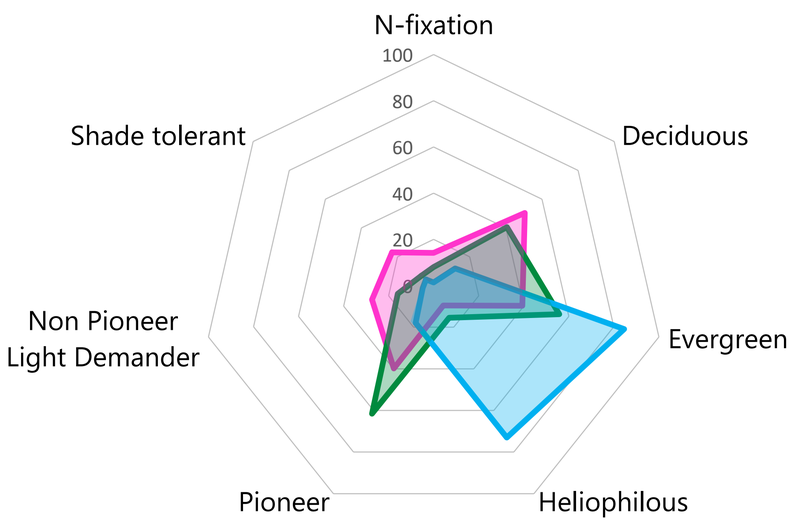

Table 1: Some structural characteristics of cocoa agroforests of the Yangambi landscape.

Variables		Group 1	Group 2	Group 3
Cocoa trees density (n.ha^{-1})		676.5 a	977.5 b	850.6 b
Mean DBH cocoa trees (cm)		9.0 a	10.7 b	9.5 a
Mean height cocoa trees (m)		3.4 a	3.9 b	3.8 ab
Associated trees density (n.ha^{-1})		129.0	109.1	143.3
Mean DBH associated perennials (cm)		43.2 b	35.1 a	38.0 ab
Mean height associated perennials (m)		21.3 b	16.6 a	17.7 ab
Associated palms density (n.ha^{-1})		6.29 a	8.31 a	99.22 b
Use of associated perenials (%)	Timber	32.2 c	19.4 b	5.7 a
	Food	8.4 a	16.5 a	73.7 b
	Pharmacopea	26.9 a	41.1 b	13.4 a
Species richness associated perennials		17.11 b	12.27 ab	7.24 a
Shannon diversity associated perennials		2.490 a	2.250 a	1.100 b

Different letters behind the means show significant differences

CONCLUSION

Our study highlights the **three main types of objectives given by** (or corresponding to the need of) **local farmers to C-AFS**: (**Group 1**) production of cocoa and timber – at the expenses of cocoa; (**Group 2**) production of cocoa and traditional/multiple use of their associated perennials; (**Group 3**) production of cocoa and food.

The composition and structure of C-AFS in the study area are determined also by the **history of the plot** and the proximity to mature forest : while keeping approximately 89 associated trees per hectare (excluding palms), **these C-AFS can't participate to species conservation at an interesting level**. This may be due to the selective logging undertaken before people install cocoa trees.

Yet, their diversity level is **worth mentioning** since they seem to both provide direct multiple services to the farmers cultivating them while probably supporting indirect forest-like ecosystem services **compared to very simple of full sun systems**.