

Dynamics of soil organic carbon pools following conversion of savannah to cocoa agroforestry systems in the Centre region of Cameroon

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Supplementary material

Table 1: Canopy cover (m^2 and % plot area) for each tree species in each cocoa agroforestry (cAFS) plot

Plot N°	<i>Albizia adianthifolia</i> (m^2)	<i>Canarium schweinfurthii</i> (m^2)	<i>Dacryodes edulis</i> (m^2)	<i>Milicia excelsa</i> (m^2)	<i>Ceiba pentandra</i> (m^2)	Other tree species (m^2)	Total tree species (m^2)	Unshaded area (m^2)	Plot area (m^2)
1	* 680 (14 %)	* 963 (20 %)	231 (5 %)	774 (16 %)	485 (10 %)	501 (10 %)	3,634 (75 %)	1,200 (25 %)	4,833
2		685 (29 %)	34 (1 %)		449 (19 %)	179 (7 %)	1,347 (56 %)	1,053 (44 %)	2,400
3	* 326 (11 %)		85 (3 %)		300 (10 %)	31 (1%)	741 (24 %)	2,355 (76 %)	3,096
4	* 227 (10 %)		152 (6 %)		465 (20 %)	74 (3 %)	917 (39 %)	1,424 (61 %)	2,341
5		103 (5 %)	73 (3 %)	* 231 (10 %)	310 (14 %)	922 (40 %)	1,638 (72 %)	644 (28 %)	2,282
6			117(4 %)	421 (14 %)	1,232 (41 %)	153 (5 %)	1,923 (64 %)	1,077 (36 %)	3,000
7			89 (9 %)	*170 (17 %)	250 (24 %)	219 (21 %)	727 (71 %)	298 (29 %)	1,025
8		481 (19 %)	34 (1 %)	167 (7 %)	611 (24 %)	103 (4 %)	1,397 (55 %)	1,153 (45 %)	2,550
All plots	1,233 (6 %)	2,232 (10 %)	816 (4 %)	1,762 (8 %)	4,100 (19 %)	2,181 (10 %)	12,325 (57 %)	9,203 (43 %)	21,528

Note: Values in brackets represent the percentage canopy cover of shade tree species in each plot; * means that two individual trees per shade tree species were selected in the plot.

Table 2: Validation metrics for the spectral prediction of carbon in soil fractions of the 0 – 10 cm layer

Soil particle size fractions	R ²	RMSE	RDP	RPIQ
C in 0 – 20 µm Fraction (g C kg ⁻¹ soil)	0.82	1.09	2.38	3.20
C in 20 – 50 µm Fraction (g C kg ⁻¹ soil)	0.94	0.18	3.95	5.54
C in 50 – 2000 µm Fraction (g C kg ⁻¹ soil)	0.75	2.65	1.78	2.58

RMSE = The Root Mean Squared Error, R² = Coefficient of determination, RPD = Residual prediction deviation, and RPIQ = The ratio of performance to inter quartile distance.

Table 3: Soil properties (0 – 10 cm) under unshaded areas and under shade trees in cocoa agroforestry systems (cAFS) of different ages

Treatment	Unshaded	Under <i>Albizia</i>	Under	Under <i>Ceiba</i>	Unshaded area	Under <i>Albizia</i>	Under	Under	Under	Under
	area	<i>Dacryodes</i>	<i>Dacryodes</i>				<i>Canarium</i>	<i>Dacryodes</i>	<i>Milicia</i>	<i>Ceiba</i>
20 years Old										
Clay g kg ⁻¹ soil	99±73 a	131±39 a	92±71 a	125±16 a	87±61 a	91±42 a	158±100 a	98±50 a	101±23 a	145±57 a
Clay + fine silt g kg ⁻¹ soil	196±139 a	207±44 a	191±21 a	196±19 a	189±44 a	214±16 a	238±101 a	164±52 a	166±35 a	226±78 a
Soil C (g C kg ⁻¹ soil)	16.7±3.7 ab	14.8±4.8 ab	16.5±3.9 ab	22.2±4.8 ab	14.6±5.6 ab	12.2±2.5 b	17.8±5 ab	16.9±7.5 ab	18.9±3.9 ab	24.3±6.3 a
Soil C / Clay + fine silt	0.9±0.1 ab	0.7±0.3 ab	0.9±0.3 ab	1.1±0.3 a	0.8±0.2 ab	0.6±0.2 b	0.8±0.3 ab	1±0.2 ab	1.1±0.2 a	1.1±0.3 a
Soil N (g N kg ⁻¹ soil)	1.3±0.4 ab	1.1±0.2 ab	1.2±0.2 ab	1.8±0.4 a	1.2±0.4 ab	1.1±0.2 b	1.4±0.4 ab	1.2±0.5 ab	1.5±0.3 a	2±0.5 a
C/N	12.8±0.8 ab	13±0.6 ab	13.8±0.9 a	12±0.8 ab	12.4±1.3 ab	10.9±0.2 b	12.7±0.7 ab	13.6±1.2 ab	12.3±0.9 ab	12.3±0.3 ab
pH H ₂ O	6.6±0.1 bc	6.1±0.2 cd	6.6±0.1 c	7.3±0.1 a	6.5±0.1 c	5.7±0.1 d	6.7±0.1 bc	6.6±0.1 bc	7.1±0.2 ab	7.2±0.1 a
Exch Ca ²⁺ (cmol kg ⁻¹ soil)	5.7±4.1 abc	3.5±0.9 bc	7.7±2.9 abc	11.8±2.7 a	9.9±4.3 ab	1.1±0.2 c	2.1±0.6 c	9.9±4.2 ab	11.5±3.7 a	9.5±7.4 ab

Note: Means separation was done by Neumann Keuls; data are presented as mean ± SD, values on each row followed by a different letter are not significantly different (p < 0.05).

Table 4: Soil $\delta^{13}\text{C}$, and soil carbon origin of the top 10 cm layer for all land-uses of different ages

Variables	Forest	Savannah	Annual cropland 5 years old	Cocoa monoculture 10 years old	Unshaded area	Under <i>Albizia</i>	Under <i>Dacryodes</i>	Under <i>Ceiba</i>	Unshaded area	Under <i>Albizia</i>	Under <i>Canarium</i>	Under <i>Dacryodes</i>	Under <i>Milicia</i>	Under <i>Ceiba</i>
$\delta^{13}\text{C}$ (‰)	-25.8±1.5 de	-16.9±1.7 a	-19.2±2.2 b	-22.9±0.6 c	-26.8±2.5 de	-24.6±1.4 cd	-26.3±0.8 de	-26.5±0.1 de	-26.6±0.3 de	-28.2±0.2 e	-26.8±0.1 de	-26.9±1 de	-27.1±0.4 de	-26.6±0.4 de
C-4 plants derived C (g C kg^{-1} soil)	2.4±1.9 bc	7.2±2.2 a	2.8±0.9 b	1.7±0.9 bc	1.4±0.5 bc	2.9±0.7 bc	1.8±1.2 bc	2.1±0.4 bc	1.3±0.8 bc	0.15±0.2 c	1.4±0.5 bc	1.5±1.9 bc	1.1±0.6 bc	2.1±0.9 bc
C-3 plants derived C (g C kg^{-1} soil)	13.9±5.2 bc	3.4±1.5 d	2.6±1.6 d	5.1±4.7 cd	15.3±4.1 ab	11.9±3.5 bc	14.7±2.7 ab	20.1±4.5 ab	13.3±5 ab	12.1±2.7 b	16.4±4.5 ab	15.4±5.8 ab	17.8±3.6 ab	22.2±5.8 a
Total C	16.3±5.8 bcde	10.6±3.1 cde	5.5±2.2 e	6.9±5.6 de	16.7±3.7 abc	14.8±4.8 abcde	16.5±3.9 abc	22.2±4.8 ab	14.6±5.6 abde	12.2±2.5 bcd	17.8±5 abcd	16.9±7.5 abc	18.9±3.9 abc	24.3±6.3 a

Note: Means separation was done by Neumann Keuls; data are presented as mean ± SD, values on each row followed by a different letter are not significantly different ($p < 0.05$).

Table 5: C/N values in litter and in soil particle size fractions in different land uses

Component	Savannah	Cocoa monoculture	Cocoa agroforestry system				
			In unshaded area	Under <i>Dacryodes</i>	Under <i>Milicia</i>	Under <i>Ceiba</i>	Under <i>Albizia</i>
Litter	70 a	41.30 b	41.30 b	39.11 b	29.31 c	29.27 c	18.17 d
F >50 µm (POC)	23.2±3 a	18.6±1 a	18.7±3 bc	20.8±2 ab	16.3±1 c	15.9±1c	15.7±1 c
F 20-50 µm	14.8± 0.7 a	12.9±0.7 b	12.1± 0.9 b	14.1± 0.6 a	12.6± 0.4 b	12.1±0.4 b	12.2±0.5 b
F 0-20 µm (MAOC)	9.95±0.9 ab	8.7± 0.5 b	9.3± 0.6 ab	10.4±0.9 a	9.7±0.7 ab	9.6±0.5 ab	9.1± 1.1 ab

Note: Means separation was done by Neumann Keuls; data are presented as mean ± SD, values on each row followed by a different letter are not significantly different ($p < 0.05$). Litter C/N are from Sauvadet et al (2020).