Supplementary Table 1 – Protocols for categories of coffee vegetation management, adapted from Moguel and Toledo (1999). Rustic and Traditional Polyculture/Coffee Garden systems were grouped into one category (Complex Coffee Agroforestry) for the purposes of our analyses due to limited details about shade tree species and agrochemical usage provided by the included manuscripts. Therefore, references to remnant forest trees maintained within the shade canopy allowed us to categorize the system as Complex Agroforestry, whereas Simple Agroforestry systems did not indicate that remnant forest trees were present.

Category from Moguel and Toledo (1999)	**New category used in this paper**	**System criteria**	**System description**
Rustic	Complex Coffee Agroforestry	Native shade present, introduced species and agrochemicals not applied.	Removes only the lower strata of the forest with original tree cover maintained. Minimal management, no agrochemical, typically low yields.
Traditional Polyculture/Coffee Garden	Complex Coffee Agroforestry	Native shade present, introduced species and agrochemicals are applied.	Coffee is introduced under the cover of the original forest, but other useful plant or tree species are also integrated and managed in a sophisticated system.
Commercial Polyculture	Simple Coffee Agroforestry	Remnant native forest trees not present. Other cash crops/products also grown along with the coffee.	Complete removal of the original forest canopy trees and the introduction of a set of shade trees appropriate for coffee cultivation. Trees providing crops like crops like fruit and timber also present. This system tends to use agrochemicals and have higher yields.
Shaded Monoculture	Shaded Monoculture	Remnant native forest trees not present. Canopy contains 1-2 species of specialized shade trees, not other cash crops.	Monoculture coffee plantation beneath a specialized shade canopy.
Unshaded Monoculture	Unshaded Monoculture	No shade.	No shade.

Supplementary Table 2 – Summary statistics (mean, median, SD, min, max, N) for carbon measurements across carbon stocks and system types. For all carbon stocks (except percent soil carbon, which is in percent (%) units), the unit is megagrams carbon per hectare (MgC ha^{-1}).

		Carbon (MgC ha^{-1})					
Carbon Stock	System Type	Mean	Median	SD	Min	Max	N
Coarse Woody Debris Carbon	Unshaded Coffee Monoculture	0.29	0.29	0.03	0.27	0.31	2
Coarse Woody Debris Carbon	Shaded Coffee Monoculture	1.13	0.97	0.62	0.50	2.19	6
Coarse Woody Debris Carbon	Simple Coffee Agroforestry	0.60	0.60	0.42	0.30	0.90	2
Coarse Woody Debris Carbon	Complex Coffee Agroforestry	3.96	3.21	3.96	0.30	9.12	4
Coarse Woody Debris Carbon	Forest	0.75	0.75	0.07	0.70	0.80	2
Soil Organic Carbon	Annual Crop Monoculture	56.75	68.65	20.74	32.80	68.80	3
Soil Organic Carbon	Unshaded Coffee Monoculture	68.75	51.78	21.97	50.99	98.70	7
Soil Organic Carbon	Shaded Coffee Monoculture	69.88	65.50	30.55	25.90	151.00	14
Soil Organic Carbon	Simple Coffee Agroforestry	68.78	57.56	23.83	49.63	139.00	19
Soil Organic Carbon	Complex Coffee Agroforestry	113.52	109.01	39.63	75.15	211.03	11
Soil Organic Carbon	Forest	99.46	77.60	75.93	29.00	229.31	5
Aboveground Carbon (Combined)	Annual Crop Monoculture	3.18	3.32	1.12	1.70	4.40	4
Aboveground Carbon (Combined)	Unshaded Coffee Monoculture	12.11	7.95	20.91	0.20	112.30	27
Aboveground Carbon (Combined)	Shaded Coffee Monoculture	25.84	21.90	20.49	1.22	114.00	55
Aboveground Carbon (Combined)	Simple Coffee Agroforestry	45.25	30.00	65.96	1.38	395.40	37

Supplementary Information

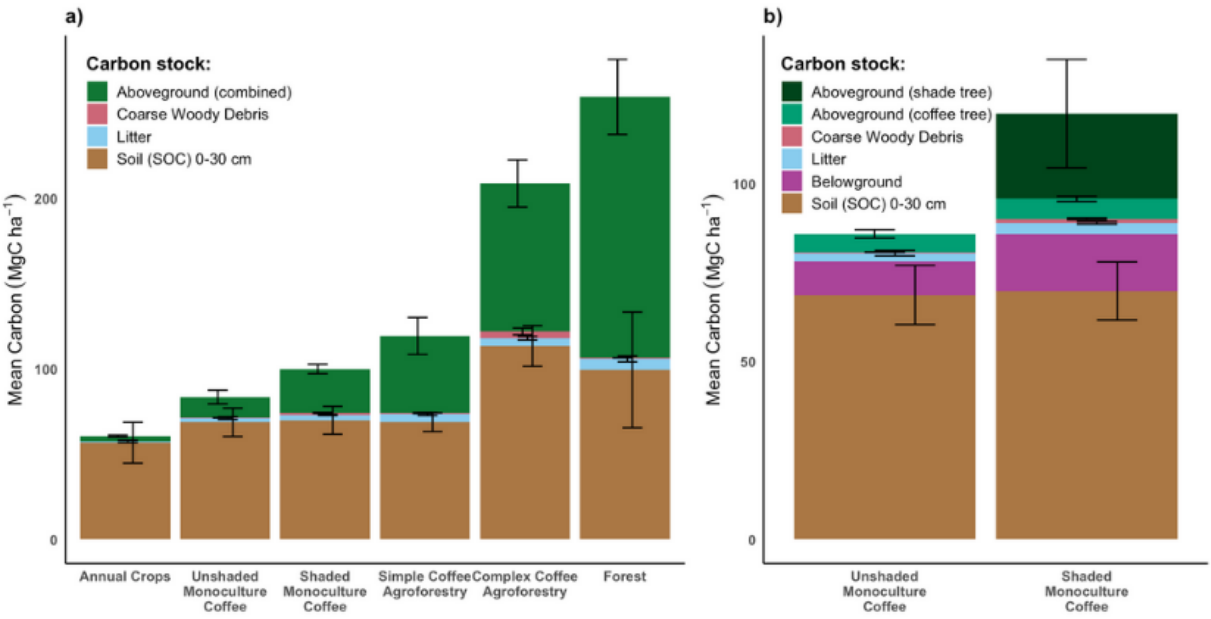
Carbon Stock	System Type	Carbon ($MgC\ ha^{-1}$) Mean	Median	SD	Min	Max	N
Aboveground Carbon (Combined)	Complex Coffee Agroforestry	86.83	68.32	63.29	25.50	255.45	21
Aboveground Carbon (Combined)	Forest	153.00	133.00	114.27	1.30	485.30	27
Litter Carbon	Annual Crop Monoculture	0.70	0.70	0.99	0.00	1.40	2
Litter Carbon	Unshaded Coffee Monoculture	2.40	1.50	2.54	0.63	9.65	11
Litter Carbon	Shaded Coffee Monoculture	3.19	3.27	2.02	0.10	8.50	34
Litter Carbon	Simple Coffee Agroforestry	4.73	4.50	2.95	0.26	9.60	13
Litter Carbon	Complex Coffee Agroforestry	4.57	3.20	4.38	1.31	19.29	17
Litter Carbon	Forest	6.44	5.00	5.92	0.69	19.30	12
Aboveground Carbon (Coffee Trees)	Unshaded Coffee Monoculture	5.15	4.44	3.35	0.20	11.30	8
Aboveground Carbon (Coffee Trees)	Shaded Coffee Monoculture	5.62	4.77	3.16	1.50	12.57	18
Aboveground Carbon (Coffee Trees)	Simple Coffee Agroforestry	2.24	1.60	2.38	0.50	6.40	5
Aboveground Carbon (Coffee Trees)	Complex Coffee Agroforestry	6.66	5.50	4.10	2.20	14.00	8
Aboveground Carbon (Shade Trees)	Unshaded Coffee Monoculture	0.00	0.00		0.00	0.00	1
Aboveground Carbon (Shade Trees)	Shaded Coffee Monoculture	23.96	8.40	34.07	0.40	81.82	5
Aboveground Carbon (Shade Trees)	Simple Coffee Agroforestry	8.84	8.92	5.67	2.39	14.90	6
Aboveground Carbon (Shade Trees)	Complex Coffee Agroforestry	24.70	34.10	17.41	0.30	41.70	7
		Percent (%)					

Supplementary Information

Carbon Stock	System Type	Carbon (MgC ha^{-1}) Mean	Median	SD	Min	Max	N
Soil Percent Carbon	Annual Crop Monoculture	1.22	1.22	0.03	1.20	1.24	2
Soil Percent Carbon	Unshaded Coffee Monoculture	2.23	2.17	1.06	0.45	5.54	43
Soil Percent Carbon	Shaded Coffee Monoculture	2.93	2.86	1.58	0.34	6.84	56
Soil Percent Carbon	Simple Coffee Agroforestry	2.74	2.33	1.50	0.92	6.51	19
Soil Percent Carbon	Complex Coffee Agroforestry	1.67	1.66	0.33	1.34	2.00	3
Soil Percent Carbon	Forest	5.04	4.27	3.42	2.16	16.09	15

12

13



Supplementary Figure 1 – Contribution of individual carbon pools (MgC ha^{-1}, SE whiskers) to total carbon held across six land management types spanning a vegetation complexity gradient common in coffee farming landscapes. Panel a) compares 4 carbon pools reported from all systems and includes both coffee and shade tree carbon in the "Aboveground" pool. Panel b) separates aboveground estimates for coffee and shade trees and includes belowground carbon for the two coffee systems that measured this pool. Sample size varies across pools and systems (Supplementary Table 2).

Supplementary Table 3 – Model-derived Hedges' g summary statistics for all paired comparisons across carbon stocks. In these Hedges' g calculations, the less complex system is treated as the reference among the following systems in order of complexity: annual crops (AC), unshaded coffee monoculture (UM), shaded coffee monoculture (SM), simple coffee agroforestry (SA), complex coffee agroforestry (CA), and forest (F, not treated as a reference system here). Output for categories where N < 2 were not calculated.

		Hedges' g			
Carbon Pool	**Comparison**	**Mean**	**Lower 95% CI**	**Upper 95% CI**	**N**
Aboveground	AC to UM	2.924	2.924	2.924	2
Aboveground	AC to SA	0.806	0.103	1.508	6
Aboveground	AC to CA	4.631	4.631	4.631	2
Aboveground	UM to SM	4.109	1.623	6.595	14
Aboveground	UM to SA	1.538	0.737	2.339	12
Aboveground	UM to CA	0.860	0.765	0.954	3
Aboveground	UM to F	3.503	0.198	6.807	7
Aboveground	SM to SA	2.708	-28.988	34.405	2
Aboveground	SM to CA	0.174	-0.128	0.477	2
Aboveground	SM to F	1.242	-0.055	2.539	13
Aboveground	SA to CA	0.933	0.215	1.650	9
Aboveground	SA to F	3.264	-2.309	8.837	14
Aboveground	CA to F	0.397	-0.054	0.848	11
Soil	AC to UM	1.226	-4.832	7.283	2
Soil	AC to SM	0.794	0.064	1.524	13
Soil	AC to SA	0.600	-1.005	2.205	14
Soil	AC to CA	0.242	0.063	0.421	10
Soil	UM to SM	0.209	-0.444	0.861	65
Soil	UM to SA	0.125	-0.079	0.330	16

Supplementary Information

		Hedges' g			
Carbon Pool	**Comparison**	**Mean**	**Lower 95% CI**	**Upper 95% CI**	**N**
Soil	UM to CA	1.368	0.570	2.165	4
Soil	UM to F	1.540	0.964	2.117	43
Soil	SM to SA	1.837	-7.119	10.793	13
Soil	SM to CA	-0.182	-0.577	0.212	12
Soil	SM to F	0.794	0.029	1.558	33
Soil	SA to CA	0.198	-0.094	0.490	13
Soil	SA to F	0.296	-0.471	1.064	23
Soil	CA to F	0.145	-0.138	0.428	10
Litter	UM to SM	1.587	-0.512	3.687	4
Litter	SM to SA	-1.809	-7.762	4.144	3
Litter	SM to CA	-0.026	-0.553	0.501	2
Litter	SM to F	0.699	-2.117	3.515	11
Litter	SA to CA	3.910	-32.519	40.340	2
Litter	SA to F	1.564	-0.404	3.532	6
Litter	CA to F	0.026	-0.036	0.088	6

Supplementary Table 4– Mixed effects meta-regression results for Hedges g' values comparing all coffee monocultures (shaded and unshaded) to all coffee agroforestry systems (simple and complex). The meta-regression tested the Hedges' g statistic against the difference in tree diversity and the difference in tree density (per ha) between the two compared systems, treating study ID as a random effect. The results displayed here are for the full dataset with data on aboveground carbon and soil carbon metrics together. The sample sizes are relatively small (compared to the full dataset) because they only include paired comparisons that also had reliable diversity and density information reported.

	Hedges' g – Combined Dataset (Aboveground + Soil)		
Predictors	*Estimates*	*CI*	*p*
(intercept)	0.1634	-0.7466 – 1.0733	0.715
Tree diversity difference	0.0421	-0.0427 – 0.1269	0.317
Tree density difference	0.0018	0.0003 – 0.0032	**0.018**
Observations	27		
logLik	-30.0193		
Deviance	60.0386		
AIC	68.0386		
BIC	73.2219		
AICc	69.8567		
Sigma^2	Estim: 0.7888 Sqrt: 0.8881		
QE	50.8382, p-val = 0.0036, df = 27		
k	30		
Method	REML		

Supplementary Table 5 – Mixed effects meta-regression results for Hedges g' values comparing all coffee monocultures (shaded and unshaded) to all coffee agroforestry systems (simple and complex). The meta-regression tested the Hedges' g statistic against the difference in tree diversity and the difference in tree density (per ha) between the two compared systems, treating study ID as a random effect. The results displayed here are for two models: aboveground carbon data only and soil carbon metric data only. The sample sizes are relatively small compared to the full dataset because they only include paired comparisons that also had reliable diversity and density information reported.

	Hedges' g – Aboveground Carbon			**Hedges' g – Soil Carbon Metrics**		
Predictors	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*
(intercept)	0.69	-0.86 – 2.24	0.346	0.05	-1.20 – 1.30	0.932
Tree diversity difference	0.06	-0.07 – 0.19	0.301	-0.01	-0.15 – 0.13	0.918
Tree density difference	0.002	-0.001 – 0.004	0.191	0.002	0.001 – 0.003	**0.010**
Observations	10			14		
logLik	-14.2916			-11.4067		
Deviance	28.5832			22.8135		
AIC	36.5832			30.8135		
BIC	37.7936			33.3697		
AICc	44.5832			35.2579		
Sigma^2	Estim: 1.5403 Sqrt: 1.2411			Estim: 0.8474 Sqrt: 0.9205		
QE	27.2304, p-val = 0.0024, df = 10			8.6485, p-val = 0.8529, df = 14		
k	13			17		
Method	REML			REML		

Supplementary Table 6 – Linear mixed effects model for aboveground carbon data. Fixed effects were system type, study region, and the first three principal components derived from a principal components analysis of bioclimatic variables (Fick and Hijmans 2017): elevation, annual precipitation, annual maximum temperature, and annual minimum temperature, and annual mean temperature. Study ID was treated as a random effect. Significant p values ($p < 0.05$) are in bold.

	Aboveground Carbon		
Predictors	*Estimates*	*95% CI*	*p*
(Intercept)	-35.89	-141.77 – 69.99	0.503
Unshaded Coffee Monoculture	82.53	-7.31 – 172.38	0.071
Shaded Coffee Monoculture	103.22	13.76 – 192.68	**0.024**
Simple Coffee Agroforestry	101.82	11.94 – 191.70	**0.027**
Complex Coffee Agroforestry	142.84	50.43 – 235.25	**0.003**
Forest	203.50	114.37 – 292.62	**<0.001**
Region: Asia	15.88	-66.27 – 98.03	0.702
Region: Latin America	-44.40	-109.97 – 21.16	0.182
PC1	-1.35	-14.03 – 11.32	0.832
PC2	1.95	-14.44 – 18.33	0.814
PC3	7.67	-32.97 – 48.30	0.709
Random Effects			
σ^2	1660.75		
τ_{00}	653.21 $_{\text{study.id}}$		
ICC	0.28		
N	15 $_{\text{study.id}}$		
Observations	107		
Marginal R^2 / Conditional R^2	0.471 / 0.620		

Supplementary Table 7– Linear mixed effects models for soil organic carbon (0-30 cm depth) and litter carbon. Fixed effects were system type, study region, and the first three principal components derived from a principal components analysis of bioclimatic variables (Fick and Hijmans 2017): elevation, annual precipitation, annual maximum temperature, and annual minimum temperature, and annual mean temperature. Study ID was treated as a random effect. Significant p values ($p < 0.05$) are in bold.

	Soil Organic Carbon			**Litter Carbon**		
Predictors	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*
(Intercept)	98.10	-54.87 – 251.08	0.188	1.72	-8.31 – 11.74	0.732
Unshaded Coffee Monoculture	2.67	-104.40 – 109.74	0.958	0.88	-7.10 – 8.87	0.825
Shaded Coffee Monoculture	9.00	-81.63 – 99.63	0.832	1.95	-5.59 – 9.48	0.605
Simple Coffee Agroforestry	11.18	-97.82 – 120.17	0.827	2.49	-5.66 – 10.63	0.542
Complex Coffee Agroforestry	58.59	-59.04 – 176.22	0.299	5.23	-3.48 – 13.95	0.233
Forest	55.10	-51.09 – 161.30	0.280	6.48	-1.52 – 14.48	0.110
Region: Latin America	7.22	-98.95 – 113.40	0.885	-0.35	-6.73 – 6.04	0.913
PC1	-30.37	-61.41 – 0.66	0.054	-0.52	-2.04 – 0.99	0.493
PC2	-63.75	-125.16 – -2.34	**0.043**	0.04	-1.66 – 1.75	0.959
PC3	-71.22	-246.28 – 103.84	0.393	-3.28	-7.70 – 1.13	0.141
Random Effects						
σ^2	1461.30			12.12		
τ_{00}	166.02 $_{study.id}$			2.99 $_{study.id}$		
ICC	0.10			0.20		
N	15 $_{study.id}$			15 $_{study.id}$		
Observations	24			57		
Marginal R^2 / Conditional R^2	0.500 / 0.551			0.272 / 0.416		