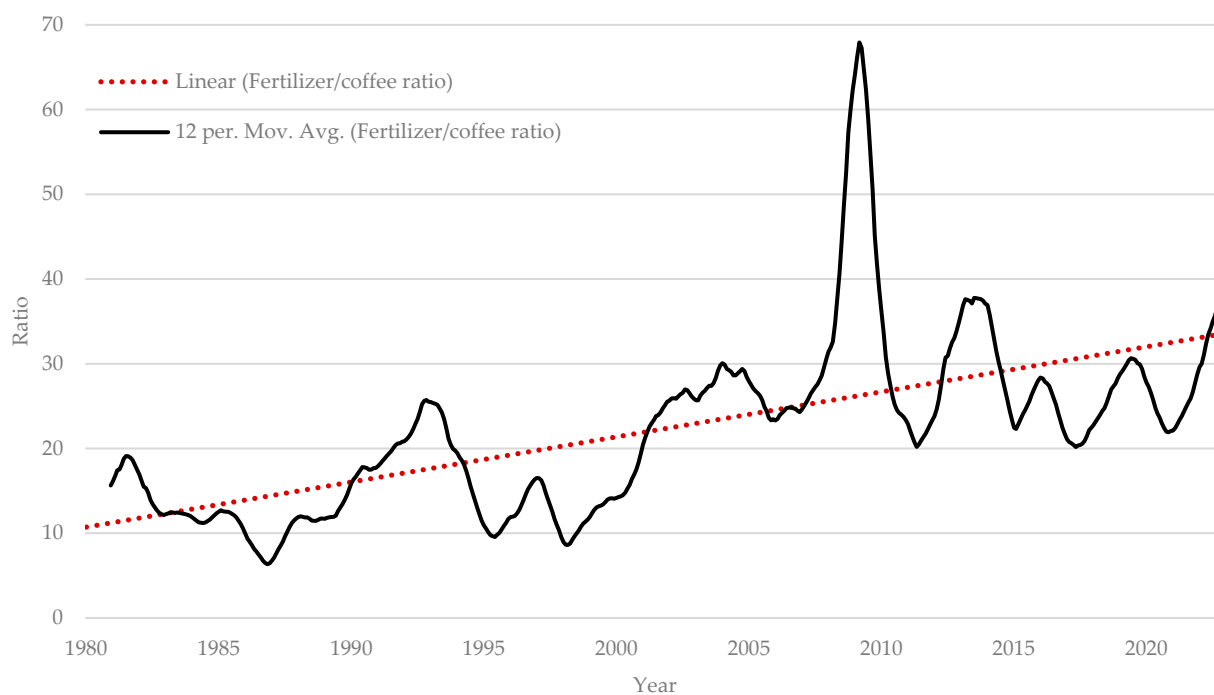


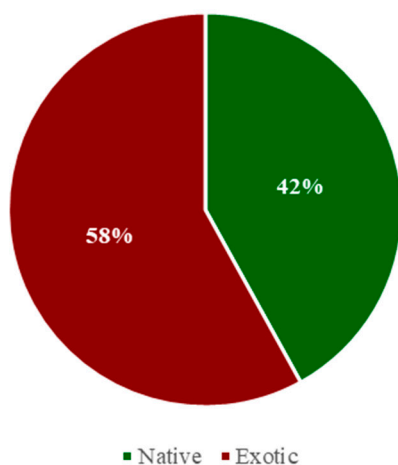
Supplementary materials



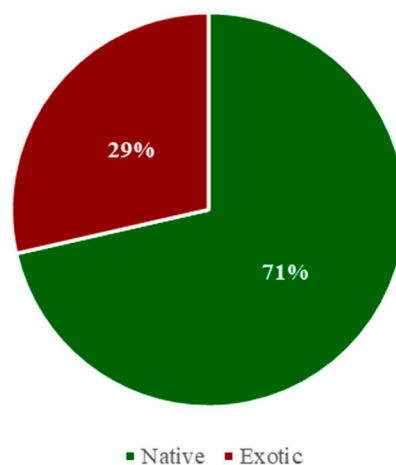
Supplementary Figure S1: ^a 12 month moving average ratio of World Bank fertilizer index to nominal arabica coffee price in USD from 1/1980 to 12/2022.

^a Author calculation from World Bank Commodity Price Data (The Pink Sheet); plotted annual averages from monthly data; Indices based on nominal USD

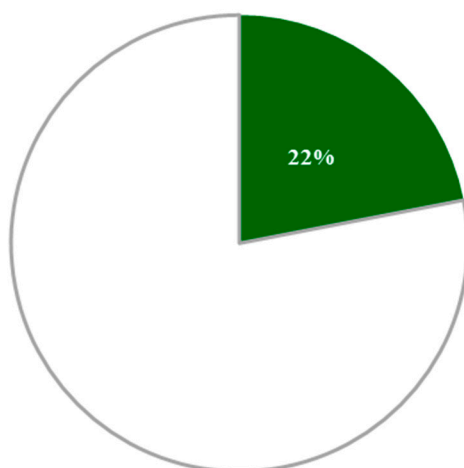
Uganda Tree Species Type



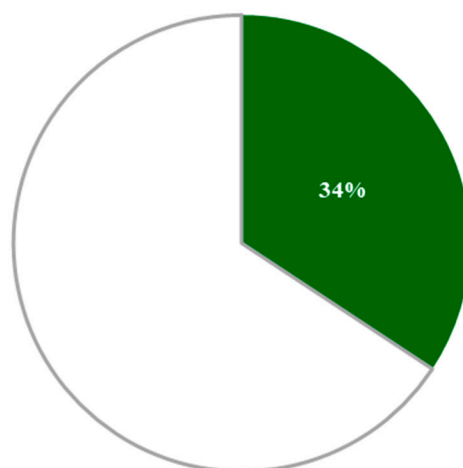
Colombia Tree Species Type



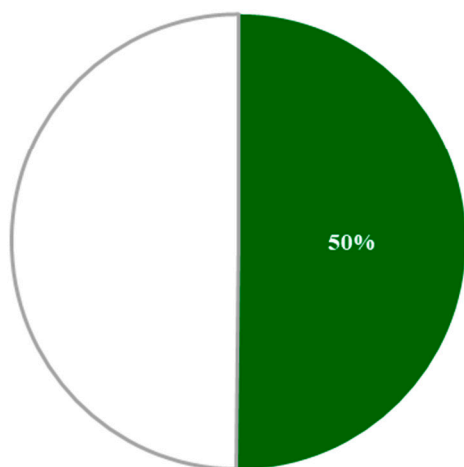
Uganda Nitrogen Fixing



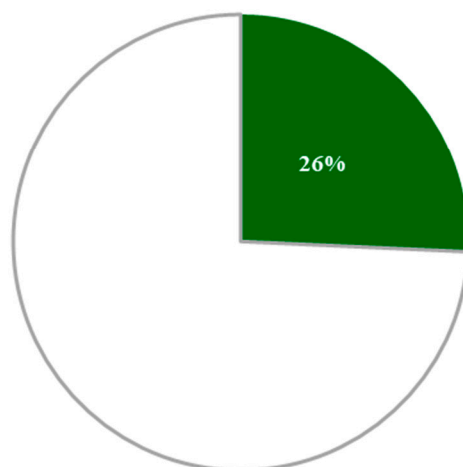
Colombia Nitrogen Fixing



Uganda Fruit Trees



Colombia Fruit Trees



Supplementary Figure S2: Colombia and Uganda tree type frequency shares, based on frequency of unique species presence within the respective category on individual coffee farms, data from smallholder farmer surveys

Supplementary Table S1: January 1980 to December 2022 changes*

Fertilizer index price	348%
Arabica coffee price	97%
Robusta coffee price	38%
Fertilizer vs. Arabica ratio	3.6
Fertilizer vs. Robusta ratio	9.2

*Author calculation from World Bank Commodity Price Data (The Pink Sheet); plotted annual averages from monthly data; Indices based on nominal USD

Supplementary Table S2: Average brutality index in Colombian coffee growing departments weighted by coffee production share of national total

Department	Brutality Index (AVG)	% coffee production	Weighted Brutality Index
Antioquia	0.0169	14.18%	0.002401
Boyacá	0.0020	1.22%	0.000025
Caldas	0.0034	8.69%	0.000297
Caquetá	0.0805	0.40%	0.000325
Casanare	0.0103	0.31%	0.000032
Cauca	0.0607	9.06%	0.005502
Cesar	0.0086	2.77%	0.000238
Cundinamarca	0.0018	4.79%	0.000086
Huila	0.0160	13.83%	0.002211
La Guajira	0.0055	0.59%	0.000032
Magdalena	0.0037	2.11%	0.000077
Meta	0.0283	0.33%	0.000095
Nariño	0.0392	3.67%	0.001440
Norte De Santander	0.0580	3.23%	0.001871
Quindío	0.0145	3.70%	0.000538
Risaralda	0.0152	5.81%	0.000882
Santander	0.0033	5.20%	0.000171
Tolima	0.0167	12.19%	0.002041
Valle Del Cauca	0.0162	7.90%	0.001283
		100%	0.01955

Source: Author's calculations based on National Coffee-growers' Federation of Colombia 2021 (SICA - Gerencia Técnica FNC) and Lara-Rodríguez 2022

Supplementary Table S3: Weighted average brutality index in sample municipalities (Colombia)

Location	Brutality Index	Frequency	Weighted brutality Index
La Plata, Huila	0.0099	4	0.00439
Paicol, Huila	0.0020	2	0.00044
Ataco, Tolima	0.0521	1	0.00579
Planadas, Tolima	0.0614	2	0.01365
		Sample brutality^a	0.02427
		Sample vs. national brutality^b	24%

^a Average brutality index weighted by the frequency in the sample

^b Difference in brutality index of sample versus national average weighted by coffee production

Source: author's calculations based on Lara-Rodríguez 2022

Supplementary Table S4: Synthesis of survey responses of Ugandan smallholder coffee farmers prepared by SFCC Uganda, titled "Marketing Constraints for Agroforestry Coffee in Uganda"

CONSTRAINTS	DESCRIPTION
-------------	-------------

Lack of income alternatives to meet farmers' immediate local needs	<p>Majority of the coffee farmers are rarely guided by experts on financial diversifications to meet their immediate local needs. This makes coffee the sole provider of the financial support to the farming communities. This result into mono cropping of coffee for the interest of quantity but compromising quality and the environment.</p> <p>To overcome this constraint, farmers will need capacity building sessions in income diversification through coffee agroforestry and in establishment and management of farmers' Cooperatives.</p>
The topography of the coffee farming communities and the low level of agroforestry skills.	<p>Given the landscapes of the various coffee producing communities being mountainous, flat, valleys and some are located in the Lake Victoria crescent, these ecosystems differ greatly in terms of agroforestry establishment and management. Coffee Farmers in Uganda are not always knowledgeable about their ecosystems even though they are desperate to produce under agroforestry.</p> <p>To overcome this constraint, capacity building about agroforestry in respective ecosystems coupled with an exchange visit will be required by our different communities.</p>
The missing farmers' formal structures (organizations) and the ignorance about the bureaucracy behind establishing one.	<p>Farmers groups are not as strong and not as sustainable as cooperatives. Small groups and individual farmers tend not to bulk their harvest at the point of selling. This leads them to very high cost of production, exploitative intermediaries and poor access to market information.</p> <p>To overcome this constraint, farmers required capacity building in establishment and management of farmers' cooperative societies and financial literacy.</p>
Weak land tenure rights and limited access to finances to secure ownership.	<p>The land tenure rights are still weak for most of the coffee farming communities in Uganda. This makes it a challenging endeavor for such farmers to establish sustainable systems such as agroforestry.</p> <p>To solve this constraint, collaborations with other stakeholders including government authorities is being established.</p>
Farmers' distrust of buyers and vise versa to convince each other to establish and promote agroforestry coffee.	<p>Since agroforestry coffee has never been promoted by both farmers and buyers in Uganda, it is very difficult for buys to offer affair price for coffee produced in an agroforestry system and on the other hand farmers do not feel comfortable to give their extra energy to produce coffee sustainable to be solve to the same buyers who will not appreciate it.</p> <p>To solve this constraint, through SFFC, we have started establishing PGS amongst coffee communities to ensure a holistic coffee quality approach and we will organize a coffee festival to bring farmers and traders together with the aim of building trust.</p>
Insufficient labor to help at the form	<p>Youth have continually forgone coffee farming and are highly engaged in low earning day-to-day jobs. This has increased rural-urban migration and has reduced the working force in the farming communities.</p> <p>To solve this constraint, we will equip the Youth with agroecological farming skills to encourage them to join leadership positions in the PGS committees to ensure continuity.</p>

Source: Slow Food Coffee Coalition, prepared by John Wanyu, Slow Food Uganda, on 13 October 2022

Supplementary Table S5: Survey questions asked to Colombian smallholder farmers

	Spanish question (asked)	English question (translated)
1	¿Conoces el concepto de la agroforestería?	<i>Are you familiar with the concept of agroforestry?</i>
2	¿La agroforestería es algo valioso o favorable, ambientalmente, y/o económicamente para usted?	<i>Is agroforestry something valuable or favorable for you?</i>
3	¿Cuáles son las ventajas y desventajas de la agroforestería en el café?	<i>What are the advantages and disadvantages of agroforestry in coffee?</i>
4	¿Practica agroforestería? ¿Por qué sí o no? ¿Le gustaría cambiar sus prácticas de agroforestería?	<i>Do you practice agroforestry? Why do or don't you? Would you like to change your agroforestry systems?</i>
5	¿Cuáles especies tienen y por qué?	<i>Which tree species do you have and why?</i>
6	¿Por qué hay tanto café a libre exposición?	<i>Why is there so much unshaded monoculture coffee?</i>
7	¿Cuál es la percepción de los vecinos de la agroforestería?	<i>How do your neighbors view agroforestry coffee?</i>
8	¿Cuáles son las fuentes de información de prácticas y tecnologías agrícolas y ambientales más confiables? ¿Cuáles son las menos confiables?	<i>Which are the most trustworthy sources of information about agricultural practices and technologies?</i>
9	¿Es miembro de un grupo u organización de caficultores?	<i>Are you a member of a farmers' group or organization?</i>
10	¿Su finca tiene alguna certificación?	<i>Does your farm have any certifications? (understood as voluntary sustainability certifications)</i>
11	¿Cuánto tiempo lleva cultivando café?	<i>For how long have you been growing coffee?</i>
12	¿Cuántos años tiene?	<i>How many years old are you?</i>
13	¿Tiene alguna formación o entrenamiento en temas agrícolas?	<i>Have you received any (formal) agricultural training?</i>

Supplementary Table S6: Frequency of unique tree species presence on sampled coffee farms in Colombia

Scientific name(s)	Native	Nitrogen fixing	Edible fruit producing	Frequency
<i>Erythrina poeppigiana</i>				7
<i>Cordia alliodora</i>				4
<i>Inga ingoides</i>				3
<i>Juglans neotrópica</i> ; <i>Cedrela odorata</i> ; <i>Cedrela montana</i>				2
<i>Tabebuia rosea</i>				2
<i>Cassia grandes</i>				2
<i>Mangifera indica</i>				2
<i>Citrus</i> × <i>sinensis</i>				2
Lauraceae				2
<i>Albizia carbonaria</i>				1
<i>Ladenbergia oblongifolia</i>				1
<i>Handroanthus chrysanthus</i> ; <i>Tabebuia chrysantha</i>				1
<i>Zanthoxylum rhoifolium</i>				1
<i>Guadua angustifolia</i>				1
<i>Eucalyptus</i>				1
N/A				1
<i>Citrus limon</i>				1
<i>Platanus acerifolia</i>				1

Supplementary Table S7: Share of unique tree species presence on sampled coffee farms in Uganda

Scientific name	Native	Nitrogen fixing	Edible fruit producing	Presence
Lauraceae				49%
Moraceae				49%
Mangifera indica				38%
Artocarpus heterophyllus				38%
Albizia coriaria				28%
Maesopsis eminii				21%
Psidium guajava				18%
Grevillea				14%
Cordia Africana				12%
Calliandra calothyrsus				7%
Citrus × sinensis				3%
Carica papaya				4%
Canarium schweinfurthii				3%
Ricinus communis				3%
Annona muricata				3%
Milicia excelsa				3%
Antiaris toxicaria				3%
Markhamia lutea				3%
Albizia zygia				3%
Eucalyptus				3%

Supplementary material S1: About SFCC agroforestry program

Slow Food is grassroots nonprofit organization based in Italy with chapters around the world, committed to a philosophy of “good, clean and fair” food. The Slow Food Coffee Coalition (SFCC) is a subsidiary organization involved in training and education and facilitates the Participatory Guarantee System (PGS) in which diverse stakeholders along specific supply chains take a collaborative approach to designing their own quality and sustainability standards and operating practices. The SFCC is involved in facilitating training programs as well as PGS in Malawi and Uganda and agroforestry has emerged as a key component of participating producer cooperatives’ efforts.