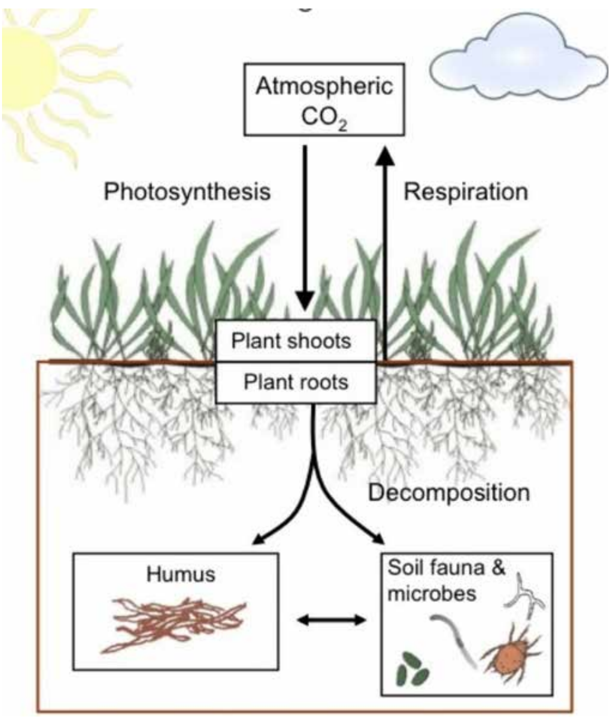
"Always Growing"

SUSTAINABLE DEVELOPMENT

February 2023

SOIL CARBON **SEQUESTRATION**

"Soil carbon sequestration is a process in which CO2 is removed from the atmosphere and stored in the soil carbon pool. This process is primarily mediated by plants through photosynthesis, with carbon stored in the form of Soil organic carbon (SOC).... SOC is a vital component of soil with important effects on the functioning of terrestrial ecosystems. Storage of SOC results from interactions among the dynamic ecological processes of photosynthesis, decomposition, and soil respiration." Ontl & Schulte (2012)



2012 Nature Education Knowledge

Figure: Carbon balance within the soil (brown box) is controlled by carbon inputs from photosynthesis and carbon losses by respiration. Decomposition of roots and root products by soil fauna and microbes produces humus, a long-lived store of SOC.

According to **Unispice's Organizational Carbon Footprint Quantification Report from June 2020 to May 2021** prepared by Green Development Environmental Consulting company, soil is an important carbon store, its capacity varies depending on the geomorphological characteristics of the area and the mineral composition of the soil, as well as other factors such as the forest composition or the type of land use, climate variables such as humidity and temperature, as well as possible conditions such as erosion.

For Unispice, soil sequestration by rotating crops has an important role in the carbon cycle. Soil and crop management can improve time of carbon resistance and storage in soil. For this reason, the FAO recommends increasing organic matter of soils using organic fertilizers, rotating crops, increased biomass due to productivity, fertilization and irrigation.

METHODOLOGY

In order to estimate carbon sequestration in the soil, Green Development used the methodological guide of the Center for Environmental Studies and Biodiversity (CEAB, as per its acronym in Spanish) of Universidad del Valle de Guatemala (UVG, as per its acronym in Spanish). This guide contains the procedures for estimating the carbon content in forests and agroforestry systems in Guatemala and has a section for calculating carbon stored in soils. The number of samples and the sampling methodology was developed following the guidelines of the CEAB-UVG team; once processed, the samples were analyzed with their laboratory equipment, from which the carbon content was determined.

For all farms considered for the carbon estimation during the period from June 2020 to May 2021, one percent of the total carbon sequestered to date was taken into account considering the carbon permanence of 100 years[1].

RESULTS

The following table shows the results of the total carbon content in the soil of each of the Farms:

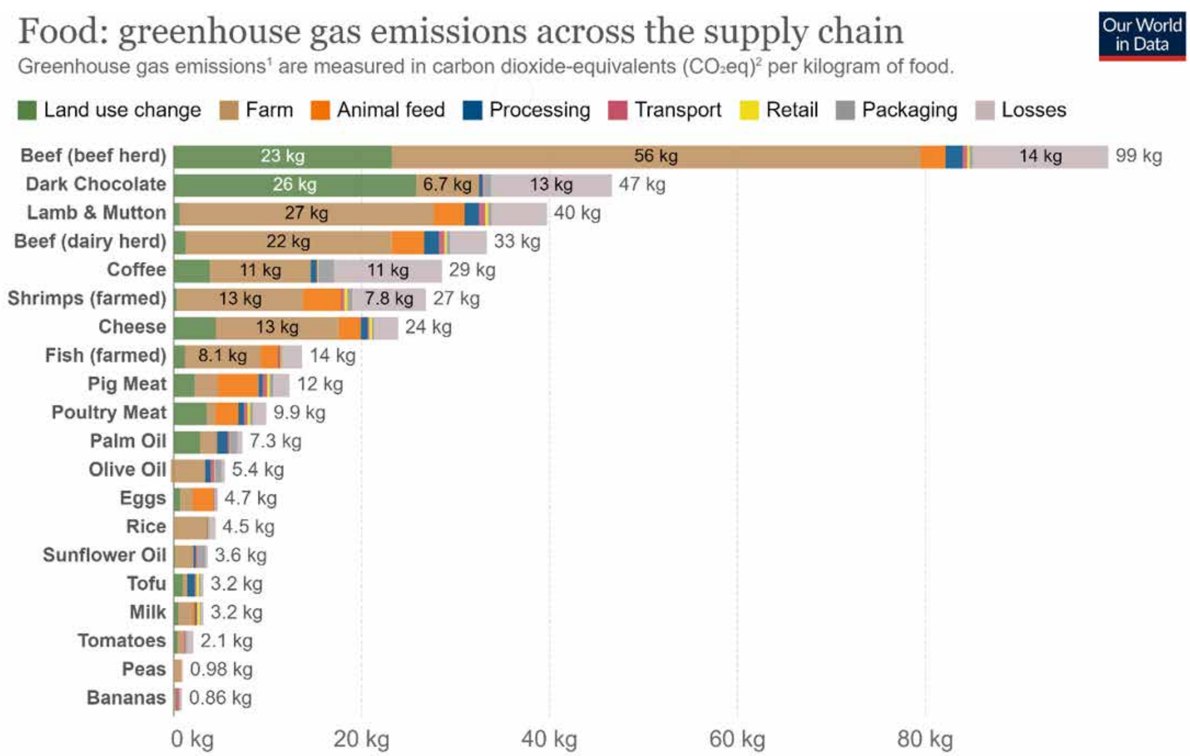
FARM	Sample	Storage (Ton C)	Storage (Ton CO2e)	Total storage per Farm (Ton CO2e)	Total/100 years (Ton CO2e)
Andares	Crop	661.41	2,425.16	2,429.61	24.30
	Plant waste deposit	1.21	4.45		
San Nicolás	Crop	970.95	3,560.13	3,560.13	35.60
Peña Blanca	Crop	454.28	1,665.70	1,665.70	16.66
San Rafael	Crop	912.69	3,346.53	3,346.53	33.47
San Jacinto	Old plant waste deposit	0.46	1.70	2,761.02	27.61
	Crop	752.54	2759.32		
	Total	3,753.54	13,762.99	13,762.99	137.63

SOURCE: Table 32 of the Quantification Report elaborated by Green Development

[1] The Global Warming Potential (GWP) is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO2). The time period usually used for GWPs is 100 years. Tomado de: EPA US Environmental Protection Agency, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials.

As an operating unit, the group of Farms recorded a total emission of **1,151.42 tons of CO2e** during the period; the resulting balance, after subtracting the carbon sequestration values, gives 1,013.79 tons CO2e, that is, a **12%** reduction. The same is seen in the values of unitary emissions from Farms, which dropped from 0.16 kg CO2e / kg of harvested product to **0.14 kg CO2e / kg.**

When comparing the information provided by **Our World in Data** (2020) on greenhouse gas emissions in the food supply chain and considering only the Land Use and Tillage phases, Unispice's unit balance is below the vegetables and vegetables listed (see table below the illustration).



Source: Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science.
OurWorldInData.org/environmental-impacts-of-food • CC BY

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1. **Greenhouse gas emissions**: A greenhouse gas (GHG) is a gas that causes the atmosphere to warm by absorbing and emitting radiant energy. Greenhouse gases absorb radiation that is radiated by Earth, preventing this heat from escaping to space. Carbon dioxide (CO_2) is the most well-known greenhouse gas, but there are others including methane, nitrous oxide, and in fact, water vapor. Human-made emissions of greenhouse gases from fossil fuels, industry, and agriculture are the leading cause of global climate change. Greenhouse gas emissions measure the total amount of all greenhouse gases that are emitted. These are often quantified in carbon dioxide-equivalents (CO2eq) which take account of the amount of warming that each molecule of different gases creates.

2. **Carbon dioxide-equivalents (CO_2eq)**: Carbon dioxide is the most important greenhouse gas, but not the only one. To capture all greenhouse gas emissions, researchers express them in 'carbon dioxide-equivalents' (CO_2eq). This takes all greenhouse gases into account, not just CO_2. To express all greenhouse gases in carbon dioxide-equivalents (CO_2eq), each one is weighted by its global warming potential (GWP) value. GWP measures the amount of warming a gas creates compared to CO_2. CO_2 is given a GWP value of one. If a gas had a GWP of 10 then one kilogram of that gas would generate ten times the warming effect as one kilogram of CO_2. Carbon dioxide-equivalents are calculated for each gas by multiplying the mass of emissions of a specific greenhouse gas by its GWP factor. This warming can be stated over different timescales. To calculate CO_2eq over 100 years, we'd multiply each gas by its GWP over a 100-year timescale (GWP100). Total greenhouse gas emissions – measured in CO_2eq – are then calculated by summing each gas' CO_2eq value.

Food	Land use Change	Farm	TOTAL FARMING
	kgCO₂e per kg	kgCO₂e per kg	kgCO₂e per kg • 2018
Cassava	0.59 kg	0.22 kg	0.81
Coffee	3.82 kg	10.75 kg	14.57
Groundnuts	0.49 kg	1.58 kg	2.07
Maize	0.48 kg	0.72 kg	1.20
Oatmeal	0.00 kg	1.87 kg	1.87
Onions & Leeks	0.00 kg	0.21 kg	0.21
Other Vegetables	0.00 kg	0.18 kg	0.18
Peas	0.00 kg	0.72 kg	0.72
Potatoes	0.00 kg	0.19 kg	0.19
Rice	-0.02 kg	3.55 kg	3.53
Root Vegetables	0.01 kg	0.15 kg	0.16
Tomatoes	0.37 kg	0.71 kg	1.08
Wheat & Rye	0.10 kg	0.82 kg	0.92

SOURCE: Information taken from https://ourworldindata.org/food-choice-vs-eating-local data base table.

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