CARBON FOR CROPS

Assessing Impacts of Regenerative Organic Agriculture

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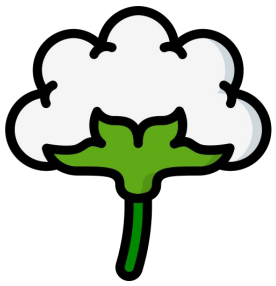
BACKGROUND

Conventional agriculture is a massive contributor to greenhouse gas emissions, declines in soil health, and erosion of arable soil. These impacts will only worsen as the global population grows and the effects of climate change becomes more severe.

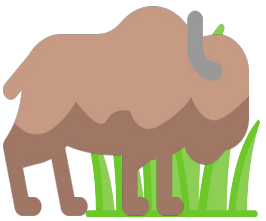
Regenerative organic agriculture is proposed as an alternative to conventional agriculture, with practices that aim **to improve soil health and reduce greenhouse gas emissions by allowing crops to sequester more carbon in the soil.** Some organizations, such as Patagonia Inc., aim to pair regenerative practices with existing organic standards. This type of system would use organic standards to keep synthetic inputs and GMOs out of the soil while promoting soil health with regenerative practices.

Patagonia is interested in pursuing regenerative organic agriculture in the production of crops they purchase. They hope to reduce their carbon footprint through regenerative agriculture and want to quantify the carbon sequestration potential of regenerative organic agriculture in their supply chain. The analysis was conducted for the following crops in Patagonia's fiber and food production:

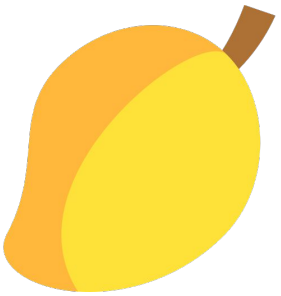


COTTON

KERNZA WHEAT



PERENNIAL GRASS



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OBJECTIVES

1

Model soil carbon sequestration and GHG emissions of four crops under organic and regenerative management over multiple global locations.

2

Determine which regenerative practices had the greatest impact on soil carbon sequestration and greenhouse gas emissions.

3

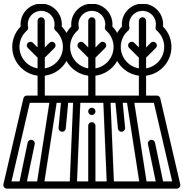
Recommend Patagonia which practices have the largest carbon sequestration and the lowest greenhouse gas emissions.

APPROACH

The team used the University of New Hampshire's DNDC soil model to simulate soil carbon and GHG emissions between organic and regenerative management for the four crops. This model required data inputs on:

Climate: For domestic sites, this data came from NOAA, while data for international sites was obtained from online resources.

Soil properties: This data for all crops and locations assessed came from ISRIC's SoilGrids, a meta analysis on global soil properties and carbon stock.

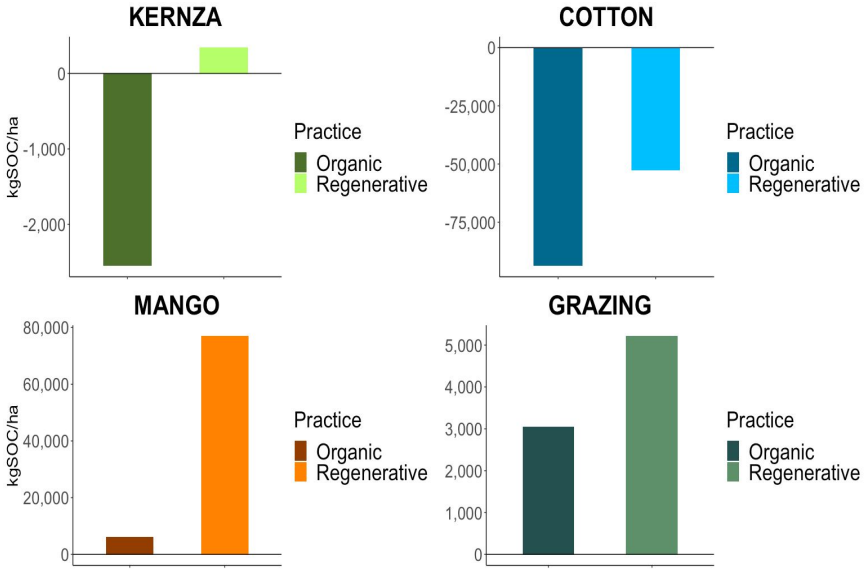


Crop management practices: This involved data on crop type, crop rotations practiced, tillage use, fertilizer use, irrigation and flooding, and the use of grazing.

Using this data, the DNDC model simulated soil carbon and nitrogen dynamics, as well as the emissions of trace gases, for each crop and location under a **20 year time period.**

RESULTS

1 Soil Organic Carbon

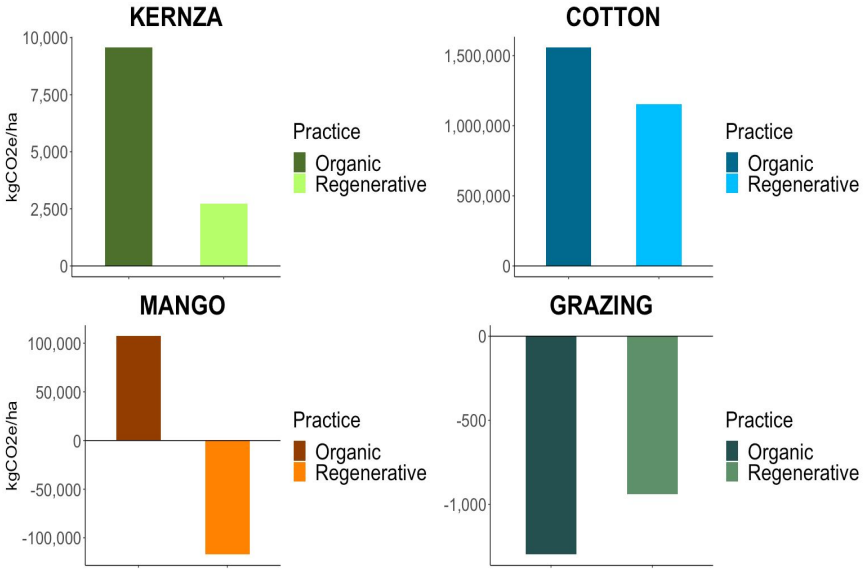


Total changes in soil organic carbon under regenerative and organic management after 20 years. **It can be seen that for all crops analyzed regenerative practices lead to more carbon stored in the soil after 20 years.** All perennial crops (i.e. mango trees, grasslands, Kernza wheat) sequestered carbon. The annual crop (cotton) lost carbon, although it lost less carbon under regenerative management.

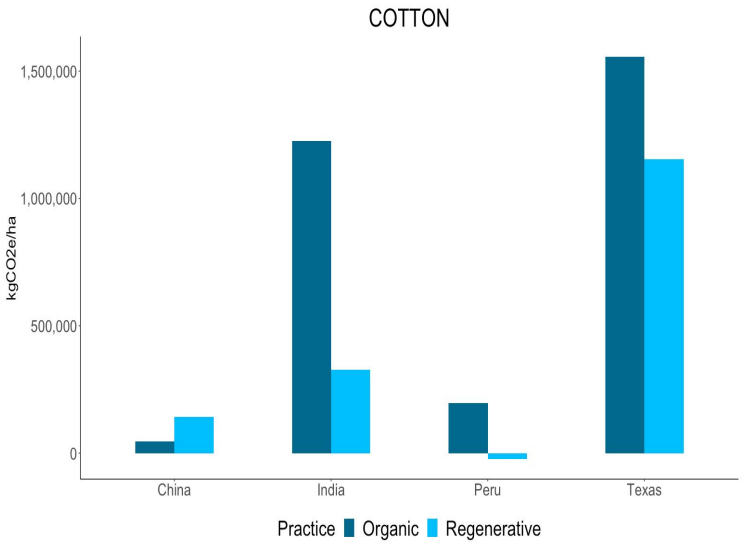
When total GHG emissions are taken into account, emissions are reduced in all crops except for grazing on perennial grasslands.

Some regenerative practices (such as compost use) can sequester carbon, but emit other greenhouse gases like nitrous oxide.

2 Total GHG Emissions



3 Impact of Location on GHG Emissions



Greenhouse gas emissions in cotton production in four locations. Regenerative management had lower emissions in all locations except China.
Regeneratives will not always produce lower emissions than organic. Practices will behave differently depending on climate and soil type.

KEY FINDINGS

- Regenerative organic agriculture builds soil organic carbon.
- Effects of regenerative agriculture on net greenhouse gas emissions are variable.
- The same practices will behave differently with variability in outcomes when implemented in different climate and soil properties.

RECOMMENDATIONS

Based on our results, we recommend Patagonia to **utilize perennial cover and fiber crops**. Unlike annual crops, perennials grow deep root systems that allow them to sequester more carbon and maintain soil structure over time.

Additionally, Patagonia should **pair regenerative practices that optimize carbon sequestration and GHG reduction**, such as combining compost application and drip irrigation.

Yields should be closely monitored to understand the impact of regenerative agriculture. While no yield drop was detected, such a decrease could increase greenhouse gas emissions due to land clearing for additional cropping area.

ACKNOWLEDGEMENTS

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