

FROM CARBON EMITTER TO CARBON SINK

~ Measuring the Carbon Sequestration Potential of Agricultural Soils in the Hudson Valley



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Abstract

The practice of mechanized agriculture has caused significant depletions in the soil's organic matter constant as well as emissions of CO₂ into the atmosphere. The adoption of alternative farming practices, such as conservation tillage and rotational grazing, have the potential to sequester carbon in agricultural soils. Analysis using Geographic Information Systems and the agricultural carbon sequestration model *Comet-VR* shows that with better practices Hudson Valley farms could *sequester* up to 700,000 tons of CO₂ or 200,000 tons of C per year. These "carbon sequestration friendly" practices not only help to mitigate climate change, but also improve the soil's quality, thereby helping farmers adapt to decreased productivity caused by climate change.

The Soil's Carbon Carrying Capacity is an important component of the carbon cycle – the soil holds approx. 1,500 Pg C in organic form (Wigley 2000). Changes in land use practices cause significant amounts of carbon to be either sequestered or emitted as soils reach a new equilibrium carbon constant (Stevenson 1986).

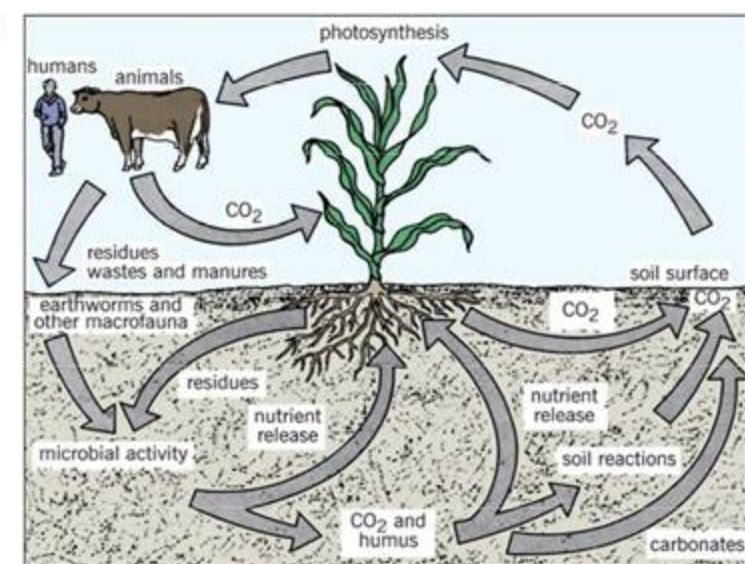


Figure 1. The carbon cycle in the soil (schematic). (Dubbin, 2001)

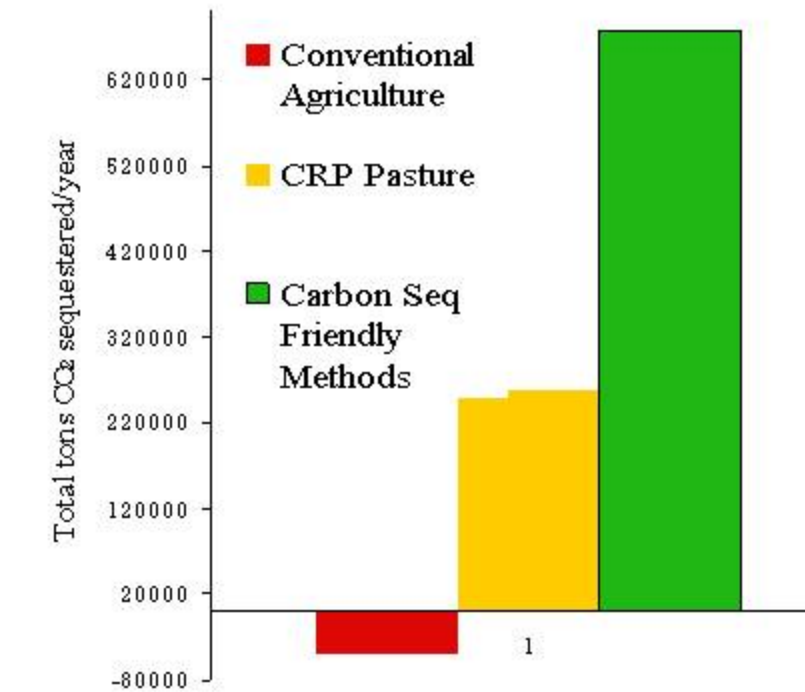
The Carbon Sequestration Potential of Agricultural Soils in the Hudson Valley was calculated using the *Comet-VR* tool, a simplified CENTURY soil carbon flux model. The rates of carbon sequestration for Hudson Valley farms were calculated for three future scenarios

- 1) Continuation of conventional agriculture practices.
- 2) Conversion of agricultural land to a grass/legume Conservation Reserve Program (CRP).
- 3) Carbon sequestration friendly management techniques, such as *no-tillage* and *management intensive grazing*.

Methods

1) **Comet-VR** generated rates of carbon sequestration per county based upon a *factorial matrix* - the input factors reflect the most common agricultural scenarios of each county

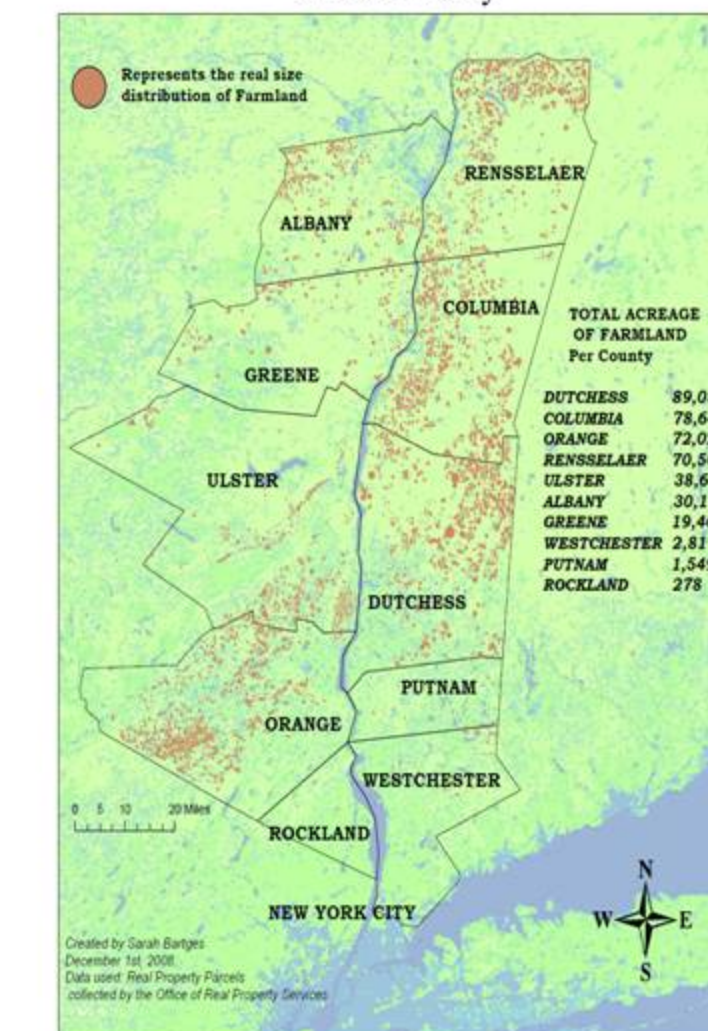
Total tons of CO₂ sequestered or emitted on HV farms for three future scenarios



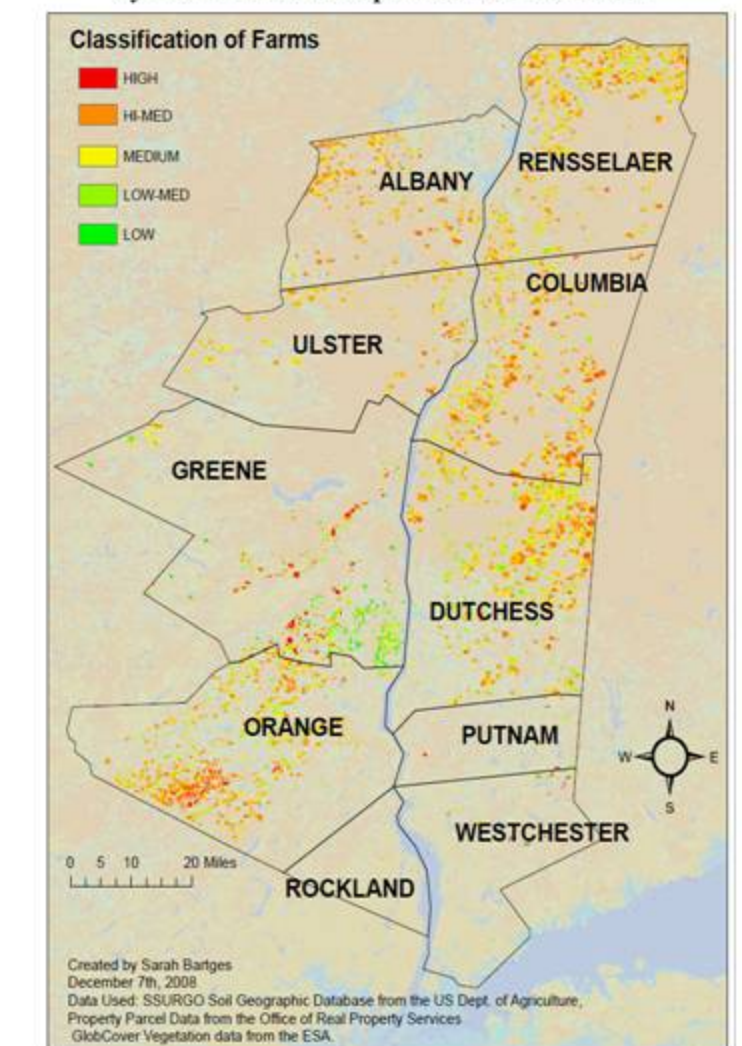
Results

2) A **Geographic Information System (GIS)** was used to analyze agricultural diversity in the Hudson Valley. In addition, farms were ranked on their ability to sequester carbon based on four criteria - **farm size, farm type, soil type, and vegetation**

Distribution of Acres of Farmland in the Hudson Valley



Ranking Hudson Valley Farms by Soil Carbon Sequestration Potential



Discussion: Factors Affecting Carbon Sequestration

- **Soil** - Soil textures significantly affect rates of carbon sequestration, with greater percentages of silt and clay resulting in higher rates.
- **Moisture** - The higher the moisture content of the soil the greater the soil's ability to store organic matter
- **Land Use History** - Past cultivation practices are more influential in determining rates of carbon sequestration than are current practices (Post & Kwon, 2000).

References

- Wigley, T.M.L., Schimel, D.S. *The Carbon Cycle*, Cambridge University Press, (2000).
- Stevenson, F.J. *Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulfur Micronutrients*. John Wiley & Sons, Inc. (1986).
- Post, W.M and Kwon, K.C, *Soil carbon sequestration and land-use change: processes and Potential Global Change Biology* 6, 317-327 (2000).
- Uri, Noel D. *Conservation Tillage in US Agriculture*. Food Products Press. (2000)

Conclusions and Implications

- **Hudson Valley farms can provide ~\$1 million in carbon credit.** Under the best scenario a market based on conserv. tillage and rotational grazing would consist of 620,000 tons CO₂ = **\$1,023,000** (based on CCX value of \$1.65 per ton CO₂).
- **Farmers will benefit from switching to carbon-friendly practices.** The conversion to conservation tillage and grazing management could increase yield and productivity (Uri 2000), as well as being beneficial for the environment.
- **A Hudson Valley Carbon Credit Program needs to include avoided as well as sequestered carbon. To create a viable program, Farmers should additionally be compensated for avoided carbon emissions and for the public service of increasing organic matter in the soil and protecting animal and plant biodiversity.**