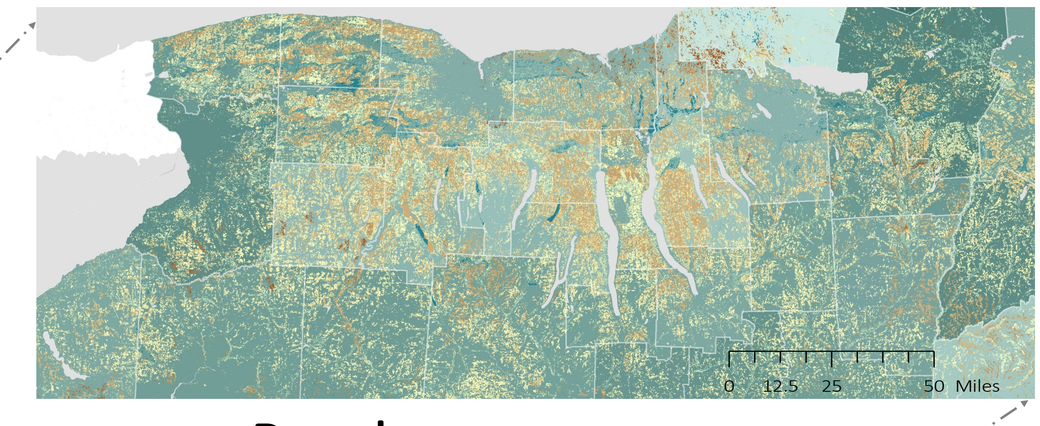
Soil Health, Conservation, and U.S. Agriculture Policy:

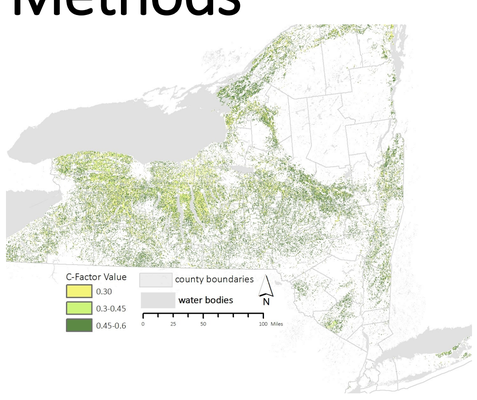
Identifying soil quality and conservation agriculture adoption in New York

Introduction

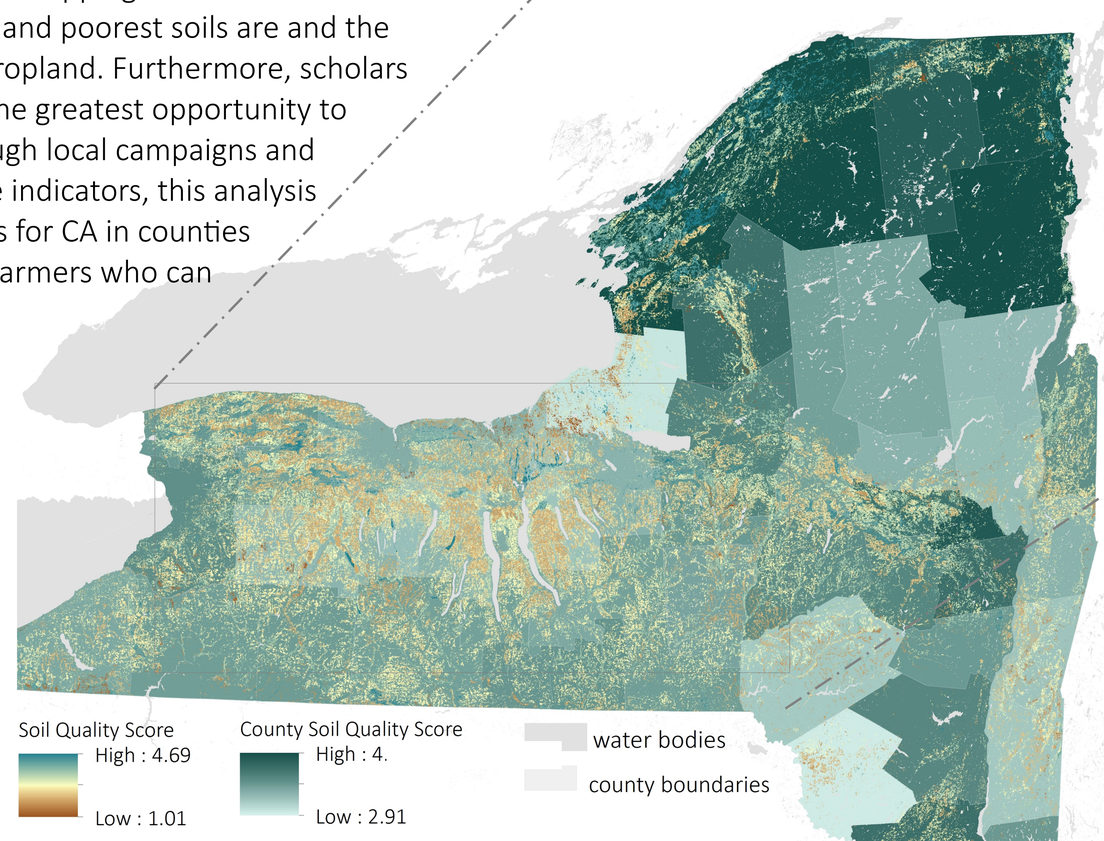
Soil health has been regarded as the panacea for achieving global environmental conservation. Improving the soil quality is understood to be a strategy to achieve agricultural sustainability, ecosystem management, and sequester carbon. However, those conclusions have yet to make a significant impact in the U.S., where most of agricultural land remains under conventional practices, which degrade soil through overuse, mismanagement, and require significant inputs to sustain productivity. Healthy soils ensure greater soil structure, fertility, soil organic carbon, and water holding capacity.[1] These improvements allow for increased agricultural yield, enhancements in resilience against erosion, pests, and loss in agricultural yields.[2] This analysis evaluates soil in New York identifying soil most susceptible to degradation, agricultural land management, and regions enrolled in federal conservation agriculture (CA) programs. Mapping these indicators allow for a detailed analysis of where the greatest and poorest soils are and the relationship between soil quality and cropland. Furthermore, scholars such as Liz Carlisle (2016) have found the greatest opportunity to Encourage farmers to adopt CA is through local campaigns and community lead initiatives.[3] With these indicators, this analysis can identify the suitability of campaigns for CA in counties which have vulnerable soils, active CA farmers who can influence their neighbors.

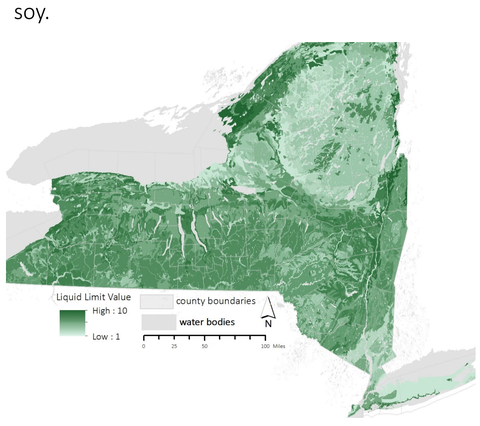


Methods

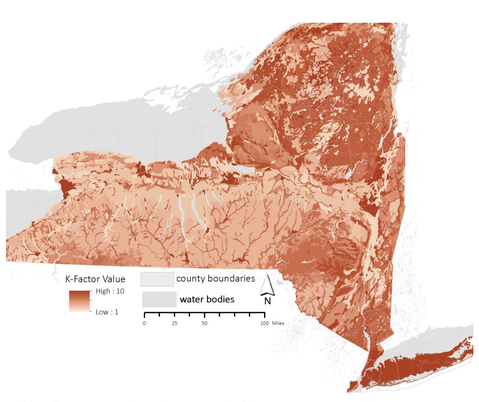


*2015 Cropland: In 2015, the average cropland acres were predominantly small grains, corn, and soy.

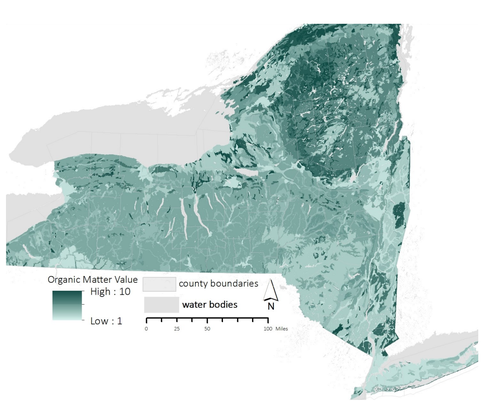




*Liquid Limit: Water holding capacity of soil. The greater the liquid limit percentage better the porosity of the soil and the better the soil quality.



*K –Factor: A soil erodibility value which describes the susceptibility of the soil type to erosion.



*Percentage of Soil Organic Matter by Weight

Part A

Informed by the Revised Universal Soil Loss Equation (RUSLE) principles to identify vulnerable soils, this analysis identify soils at risk of erosion and degradation and employs the following parameters:

Soil Parameter	Unit	Score Range
Slope (S)	Percent	1 to 10 (high S = low score)
Organic Matter (OM)	Percent OM by Weight	1 to 10 (high OM= high score)
Liquid Limit (LL)	Percent Moisture by Weight	1 to 10 (high LL = high score)
K- Factor (K)	Soil Erodibility Factor	1 to 10 (high K= low score)

This analysis assigns scores to each of the parameters, assigning a high score to a parameter which would increase the overall quality of a soil such as the percentage of organic matter or percent of water holding capacity (LL), and a low score to parameters which could increase the erodibility or nutrient loss such as percent slope or K-Factor.

*Soil Attribute Score = S*OM*LL*K*

In addition to scoring the soils across the state, this analysis identifies the current cropland acres and assigns a score based on the residue coverage of the crop type. This coverage management factor (C-Factor) whereby higher is correlated with increased soil protection.

C-Factors: Small Grains = 0.6, Soy = 0.55, Corn = 0.3

This analysis produces a final score joining the C-Factor and the Soil Attribute Score to identify areas with both poor soil attributes and minimal crop cover management.

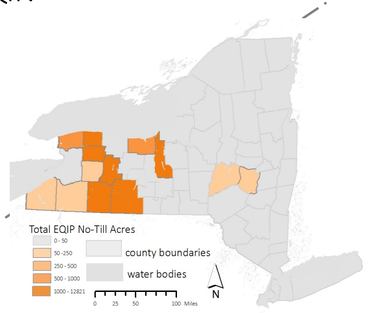
*Soil Quality Score = Soil Attribute Score * C-Factor*

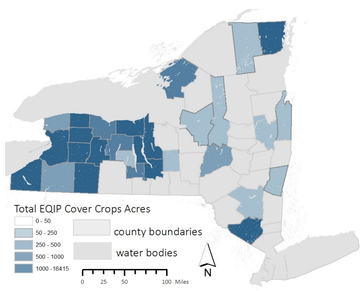
Part B

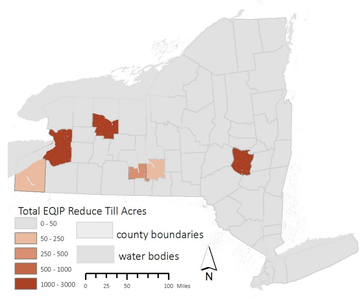
County level analysis of federal conservation program enrollment. This analysis illustrates which counties have the most cropland under Environmental Quality Incentives Program (EQIP). The analysis focuses on four specific conservation agriculture practices proven to build soil.

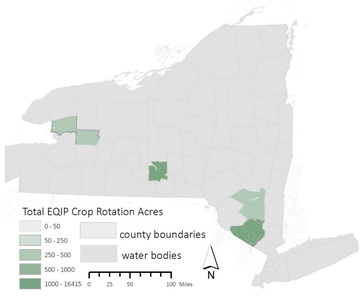
Results

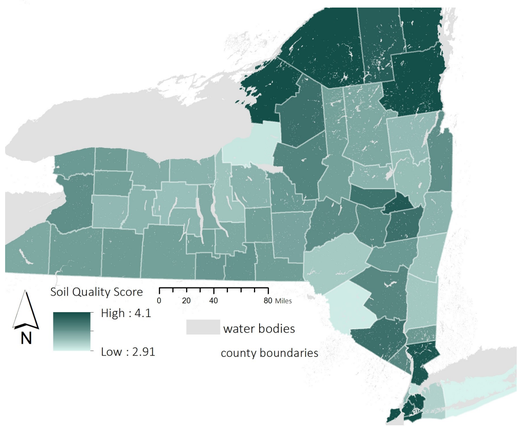
The agricultural practices which regenerate soils and qualify for EQIP funding include: crop rotation, cover crops, reduce till, and no till. The figures below identify the acreage of each conservation practice funded through EQIP.











These figures illustrate a valuable visual of the soil and the cropping type across NY. Whereby in regions such as western-NY it appears that many counties which primarily grow corn (C-Factor of 0.3) have a relatively low soil scores. Additionally, these NY counties, also have some of the highest rates of EQIP application acreage. These western -NY counties include Livingston, Tompkin, Orleans, Orange, Schoharie, and Erie. Given the map results and EQIP assessment the greatest opportunity to begin influencing farmers to adopt CA could start in those regions. These counties should receive targeted campaigning and support to encourage a rapid adoption of CA.

Conclusion & Limitations

Several assumptions were made to compute the Soil Attribute Score. Although developed in part from the RUSLE equation this analysis incorporates variables such as OM and LL which are not factors in RUSLE. Additionally, RUSLE is typically used field-level measurements allow for extremely precise soil erosion values. This level of detail was omitted to allow for this large scale state-wide analysis.

The Cropland Data layer used has been found to have some measurement errors, which may have altered the accuracy of the C-Factor analysis. For a more accurate analysis the data could have been cleaned, however given the scale of this analysis a few minor errors should not have significantly altered the data.

Sources:

Cropland Data Layer. US Department of Agriculture. 2015.

US Department of Agriculture.-Natural Resource Conservation Service, EQIP Obligations, 2012-2017. Data was provided by NRCS data statistical research support.

Soils data for the Conterminous United States (STATSGO) Derived from the Natural Resource Conservation Service

HU12. Water Bodies. US Geological Survey. 2016.

1: Clair, S. B. S., & Lynch, J. P. (2010). The opening of Pandora's Box: climate change impacts on soil fertility and crop nutrition in developing countries. Plant and Soil, 335(1-2), 101-115.; Islam, R., & Reeder, R. (2014). No-till and conservation agriculture in the United States: an example from the David Brandt farm, Carroll, Ohio. International Soil and Water Conservation Research, 2(1), 97-107.; Lal, R (2004). Soil carbon sequestration impacts on global climate change and food security. Science 304: 1623–1627.; Lal, R. (2008). Carbon sequestration. Philosophical Transactions of the Royal Society of London B: Biological Sciences, 363(1492), 815-830.; West, T. O., & Post, W. M. (2002). Soil organic carbon sequestration rates by tillage and crop rotation. Soil Science Society of America Journal, 66(6), 1930-1946.

2: slam et al., 2014; West & Post 2002; Lal 2004; Clair & Lynch 2010; Lal 2008; Banwart, S., Black, H., Cai, Z., Gicheru, P., Joosten, H., Victoria, R., & Vargas, R. (2014). Benefits of soil carbon: report on the outcomes of an international scientific committee on problems of the environment rapid assessment workshop. Carbon Management, 5(2), 185-192.

3: Carlisle, Liz (2016) Factors influencing farmer adoption of soil health practices in the United States: a narrative review, Agroecology and Sustainable Food Systems, 40:6, 583-613, DOI: 10.1080/21683565.2016.1156596

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