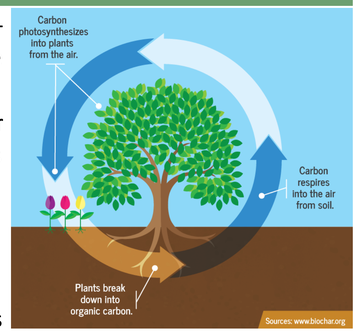
U.S. Potential for No-Till Regenerative Farming

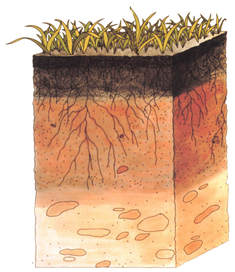
Suitability analysis for implementation of no-till farming practices in the United States

Regenerative Agriculture and Tilling



The global food system accounts for 19-29% of total anthropogenic greenhouse gas emissions.[1] As population continues to rise, the agricultural sector must increase output while reducing its carbon footprint. Plants naturally store carbon in soil through the process of photosynthesis and a symbiotic relationship with soil microbes. Therefore, croplands, which encompass 3.6 billion acres globally[2], have significant potential to sequester carbon. However, current industrial agriculture practices, including tillage, have depleted the carbon content of soils.

Tilling, the practice of turning over the top layer of soil by mechanical agitation, has been used in agriculture for centuries. The practice has many initial benefits such soil aeration, soil loosening, mixing of nutrients, and reducing weeds. However, recent understanding of organic matter and soil microbial communities has made it apparent that tillage actually has negative impacts on soil health and carbon sequestration over the long term. Tilling destroys soil structure, kills soil microbes, and releases carbon into the atmosphere. In addition, the loss of soil structure increases erosion and nutrient runoff, contributing to environmental contamination and loss of fertile farmland.



Studies have shown that no-till or reduced-till practices sequester carbon into the soil as well as increase resiliency by improving moisture and nutrient retention and reducing erosion.

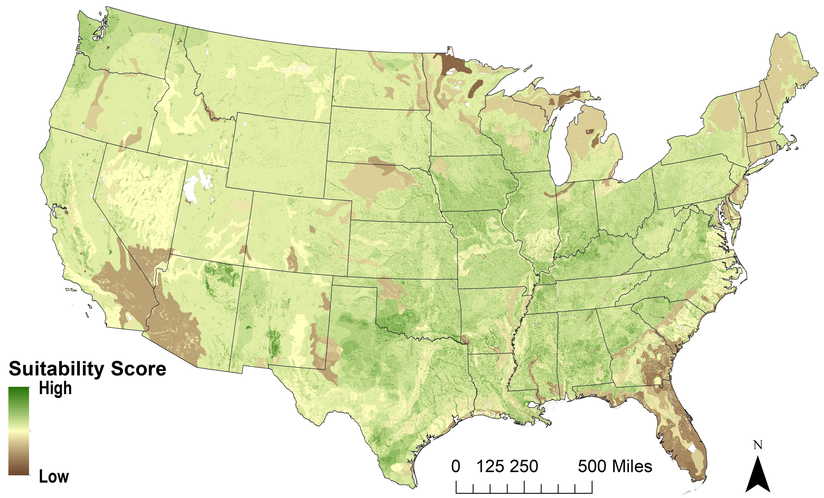
Methods

Suitability analysis was performed to determine optimal areas to target for adaptation of no-till farming methods in the contiguous United States. The analysis was based on 6 criteria (table 1) determined through a literature review[3,4] and included factors which increase the success of no-till farming and factors which increase the need for no-till farming. Spatial data was obtained from the sources listed in table 1.

Datasets were projected, converted to raster (if needed), resampled (to 1000m resolution), and clipped to the study area. Each criteria was then reclassified to a scale from 0 to 6, with 6 representing the highest suitability. Reclassified raster layers were then combined using raster calculator to obtain a suitability score consisting of the added values.

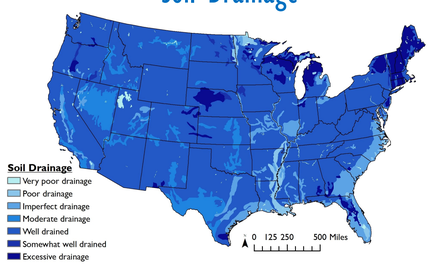
Next, identification of highly suitable regions for no-till farming was performed at a county level. Zonal statistics was used to add mean suitability score to county polygons. Global and Local Moran's I was used on the county level data to assess clustering of highly suitable land.

Suitability Analysis

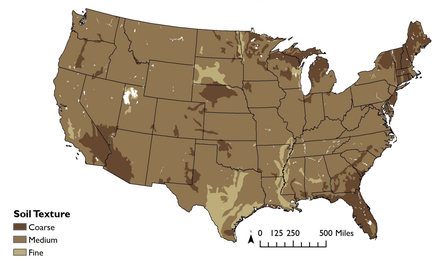


Criteria		High Suitability	Low Suitability	Data source
Improved success	Soil Drainage	Well drained soil	Poorly drained soil	Harmonized World Soil Database, 2012
	Soil Texture	Light to medium texture	Course texture soil	Harmonized World Soil Database, 2012
Increased need	Erosion	High erosion of topsoil	Low erosion of topsoil	ESRI, gSSURGO, NRCS, 2019
	Flooding	High flooding frequency	Low flooding frequency	ESRI, gSSURGO, NRCS, 2017
	Drought	High drought intensity	Low drought intensity	United States Drought Monitor, 2019

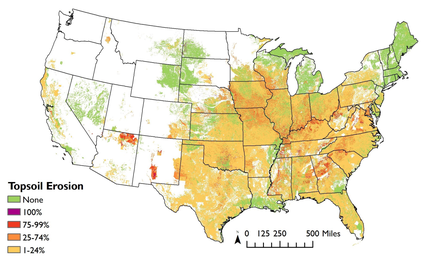
Soil Drainage



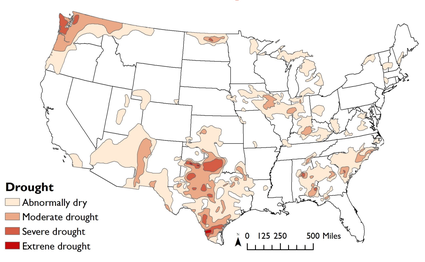
Soil Texture



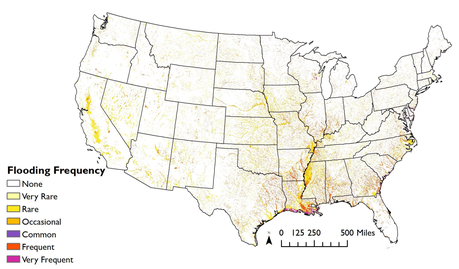
Erosion



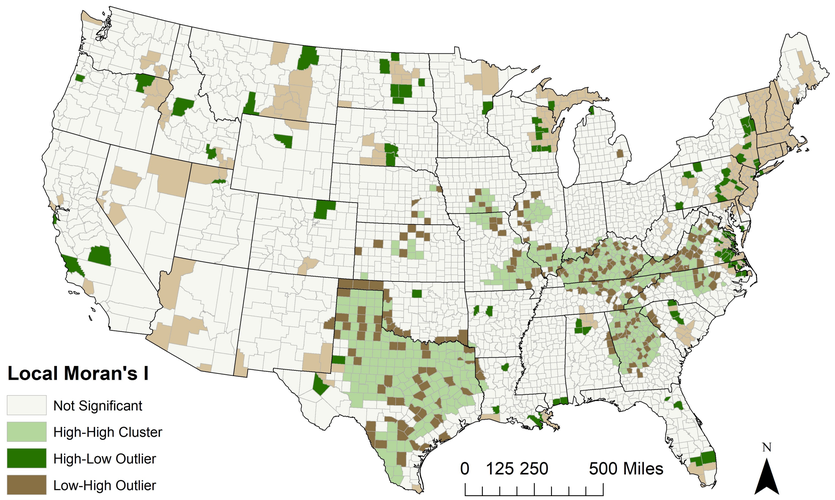
Drought



Flooding



Local Moran's I



Results and Conclusions

This suitability analysis shows a large area of the U.S. is suitable and would benefit from no-till agricultural practices, especially in the central and southeast regions. Moran's I spatial autocorrelation indicates clustering, with a Moran's Index of 0.167. Local Moran's I illustrates areas of high-high clusters in Texas and the central eastern region.

This analysis indicate areas of opportunity to focus on a transition to no-till agriculture techniques. These results could be used to identify high priority areas for regenerative agriculture grant funding, education, and outreach.

A limitation of this analysis is the use of only 6 criteria, and future analysis could incorporate a wider analysis. Furthermore, this analysis does not take into consideration weighted importance of each criteria. These additional parameters could easily be added into the current analysis after additional literature review.

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Projection: Contiguous USA Albers Equal-Area Conic

Data Sources: Harmonized World Soil Database v1.2, ESRI, ggSSURGO, Natural Resources Conservation Service (NRCS), United States Drought Monitor

1. Vermeulen, S.J., B.M. Campbell, and J.S. Ingram, *Climate change and food systems.* Annual review of environment and resources, 2012. **37**.
2. Batjes, N., *A world dataset of derived soil properties by FAO–UNESCO soil unit for global modelling.* Soil use and management, 1997. **13**(1): p. 9-16.
3. Vilček, J., et al., Identifying Soils for Reduced Tillage and No-Till Farming Using GIS. Polish Journal of Environmental Studies, 2019. 28(4).
4. Busari, Mutiu Abolanle, et al., Conservation tillage impacts on soil, crop and the environment. International Soil and Water Conservation Research 3.2, 2015: 119-129.