



## Introduction

Agriculture, a cornerstone of the U.S. economy and the livelihood of millions, takes a severe negative toll on the planet. Fertilizers and pesticides used on crops drain into our watersheds, massive amounts of methane are produced by beef and dairy operations, and the transportation of harvested food across the globe emits many more tons of other greenhouse gases (GHGs). Rather than give up livestock farming or attempt to convert the globe into self-sufficient regional food systems to cut down on transportation, changing the ways in which farmers farm can similarly address emission and pollution issues. Conversion to sustainable farming methods can be effective in cutting GHGs and will maintain the lifeblood of the United States, preserving and creating many jobs in the agriculture sector.

There are many ways to measure sustainability in agriculture. This project is not a comprehensive overview of all sustainable methods. Its focus and analysis concerns soil till methods, fertilizer use, renewable energy on farms and percent of USDA certified organic farms in each state in 2012 and 2017. Visualizing changes in the percent of farms involved in each of these practices over this five year period will serve as a simple indication of each state's trend towards or away from increasingly sustainable practices.

## Research Questions:

1. Within each state, has there been a noticeable change in the percent of farms designated as certified-organic or that practice no-till?
2. Which type of renewable energy is most common in each state? Is renewable energy use increasing?
3. How does use of chemical fertilizers vs. manure vs. organic fertilizer compare across states?
4. Overall, has New England increased adoption of sustainable practices or indicators between 2012 and 2017?

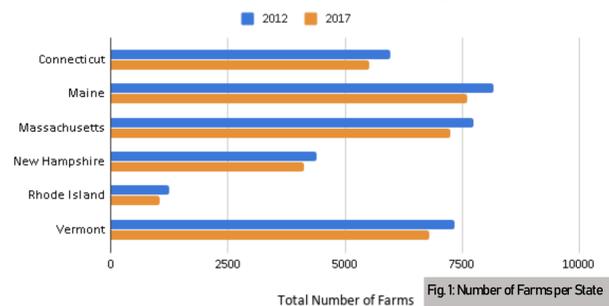
## Methods:

First, relevant data were extracted and imported into spreadsheet format from each state's Tables 1, 46, 47, and 50 from the National Agriculture Statistics Survey (NASS) 2017 Census. All data were collected in the unit of number of farms. In order to compare participation in various agriculture practices across different states, these numbers had to be normalized. For each state, all 'number of farms' values were divided by the total number of farms (from 2012 and 2017 respectively) and converted into a percent of total farms in that state. Within the spreadsheet, percent of total farm values were organized by theme (Organic, Soil Till, Renewable Energy and Fertilizer Use) and each state's 2012 values were placed alongside their 2017 values so that the visualization would include them side by side. This allows viewers visual ease when looking for the changes in each state over the five year period.

Stacked bar charts were used to display information on soil till, fertilizer use and renewable energy. This format allowed for comparison of multiple types of till practices/fertilizers/renewable methods and side-by-side comparisons of individual state data by year. Change in total number of farms, change in percent of farms with USDA Organic certification and percent of farms with solar energy producing systems were visualized as simple bar charts.

## Number of Farms

Change in Total Number of Farms in New England by State

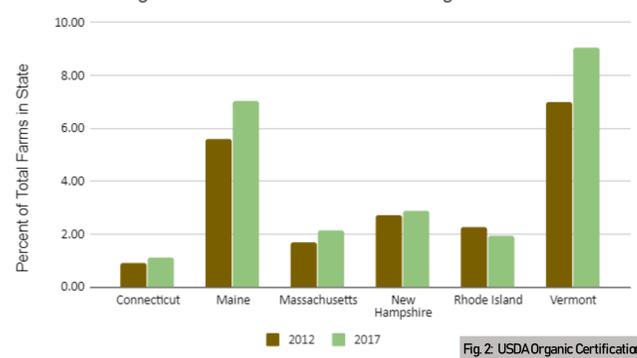


In each state, the number of farms decreased between 2012 and 2017.

Data from Table 1 of NASS 2017 Census.

## Certified Organic

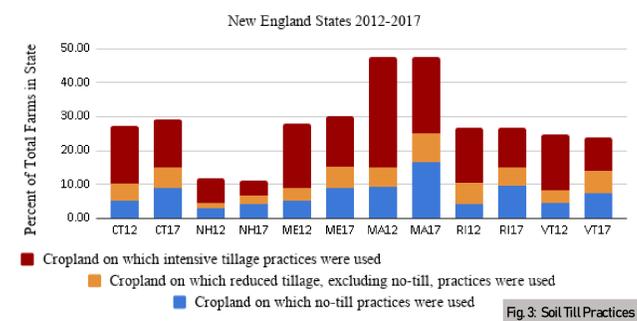
Percent Change in Number of USDA National Organic Certified Farms



USDA Organic farms must comply to a variety of farming standards which dictate the ways in which livestock and crops are raised. Prohibited practices include use of synthetic fertilizers and pesticides, GMO seed, and use of antibiotics or hormones in livestock. Data from Table 51 of NASS 2017 Census.

## Soil Till

Percent Change in Farms Practicing No Till, Reduced Till and Intensive Till

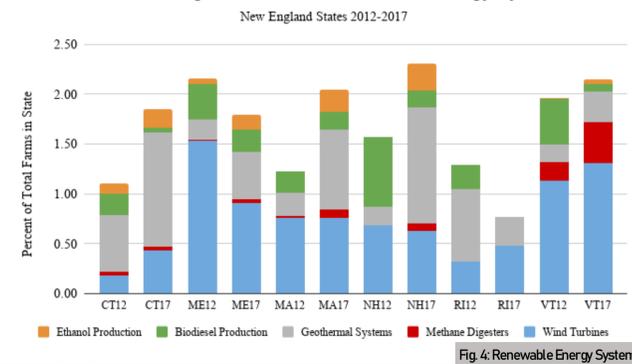


Farmers who till their soil do so because it facilitates easy seed planting, incorporates animal manure and surface crop residue into the soil, and aerates and warms the soil.

However, intense till practices leave the topsoil bare and more likely to be eroded by wind and water, can displace and kill the healthy microbes needed for healthy soil biology and ruin the structure of the soil, leaving it less able to absorb and filter water and nutrients. Maintaining soil health is vitally important for farmers and for the success of the world's agriculture as a whole. Data from Table 47 of the NASS 2017 Agriculture Census

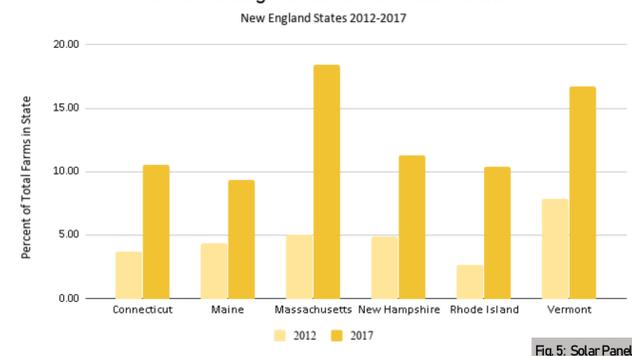
## Renewable Energy

Percent Change in Farms with Renewable Energy Systems



Ethanol and biodiesel production can be debated as questionably sustainable due to the amount of cropland that must be dedicated to growing non-food corn or soy to fuel their industry. However, for the scope and purpose of this project, a farm which employs any of these renewable methods is considered to be acting sustainably.

Percent Change in Farms with Solar Panels

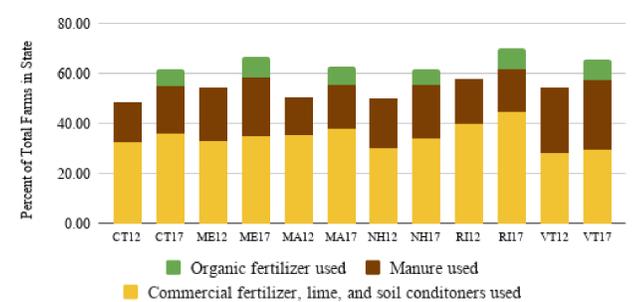


Solar panels were the most common renewable energy system found on farms. They were extracted into their own bar chart so as to not distort the rest of the renewable energy data results.

Data from Table 49 of NASS 2017 Census

## Fertilizer Use

Use of Commercial, Manure, and Organic Fertilizer 2012-2017



As soil health depletes and demand for increased crop yields continues to rise, fertilizer has become a vital tool for farmers. However, over-use of chemical fertilizers contributes to nitrate-rich runoff into our waterways which poisons ecosystems and contaminates our drinking water.

There are no 2012 data available for farms which used organic fertilizer.

Data from Table 46 of NASS 2017 Survey

## Results

**Certified Organic** With the exception of RI, all New England (NE) states had higher percentages of organic farms from 2012 to 2017. However, organic farms still make up a small amount of total farms in each of these states. With less than 10% of total farms in state, VT is home to the greatest number of organic farms in New England.

**Soil till** The data show that overall, intensive till is the most common till practice in NE, but from 2012-2017, all states see an increase in % of farms whose cropland are not tilled and a decrease of intense till across the board. With the exception of RI, all states also see an increase in percent of farms with reduced till practices. Although the percent of farms with reduced till in 2012 is not directly proportional to the growth seen in 2017 in the no-till sector, each sector grew from 2012-2017. It is possible that farms practicing reduced till are in transition to no-till, thus in future censuses, percent of farms with no-till can reasonably be expected to increase.

**Renewable Energy** Solar panels on farms are the most common type of renewable energy, and there are steep increases in adoption over the observation period for all NE states. Geothermal systems also saw growth in adoption across all states. However, wind energy systems saw decreases in Maine, Massachusetts and New Hampshire over the same period. Aside from solar, however, the percent of states with any of these renewable systems are minute.

**Fertilizer** The question on farms' use of organic fertilizer was a new addition to the 2017 census. This could indicate that a shift in the importance or prevalence of organic practices is occurring. While there is no way to compare growth in organic fertilizers used, it is likely that the numbers in 2012 were even smaller than they are in 2017. Chemical fertilizers remain the most common option. 30% or more of farms in all NE states except VT use chemical fertilizers.

## Discussion

The findings of this project are not sufficient to complete a conclusive analysis on the status of sustainable agriculture in New England. In order to keep the scope of the project manageable, only four of the many aspects sustainable agricultural practices were examined. Additionally, it should be noted that the data on renewable systems and fertilizer use may have double-counted farms because it is possible for one farm to have more than one type of renewable energy system on its land, and similarly, use more than one type of fertilizer.

Despite these limitations, the data show a general increase in percent of total farms for all New England states for almost every sector of sustainability. (Rhode Island had a reduced proportion of organic farms and some states decreased use of various types of renewables over the five year period). While the general finding that sustainability measures are increasing overall is encouraging, it should be recognized that the increases still represent very small percentages of total farms in each state. If we expect to address climate change issues with changes to our agriculture systems, more farms in every state must step up to the plate for a greater collective impact to be felt.

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ENM70: Environmental Data Analysis and Visualization

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Data Sources: 2017 National Agriculture Statistics Survey (NASS) Census of Agriculture (Tables 1, 46, 47, 50 & 51) [nass.usda.gov](http://nass.usda.gov)  
Images: [prjimage.net](http://prjimage.net), [maxpixel.net](http://maxpixel.net), [pxhere.com](http://pxhere.com), [needpix.com](http://needpix.com)