

Climate Change and Agriculture in New York's Genesee-Finger Lakes Region

Agriculture and associated industries (e.g., food purveyors and craft beverage producers) are major economic sectors in the Genesee-Finger Lakes Region, contributing \$1 billion¹ in revenue and about 19,000 permanent jobs.² Approximately 21% of New York State's farmland is in the Region, and the main agricultural outputs include dairy, produce, and commodity crops. The Region is a leader in agricultural innovation; for example, five popular varieties of apple — the Cortland, Empire, Jonagold, Macoun, and Northern Spy — were perfected at the New York State Agricultural Experiment Station in Geneva.³ This abundance of natural and human capital positions the Region to lead the transition to a net-zero economy as required by the State's Climate Leadership and Community Protection Act (CLCPA).

Industrialized agricultural production is an appreciable source of greenhouse gas emissions, as is the larger food system when considering the energy involved from farm to fork. The agricultural sector also faces a range of climate impacts that can undermine yields, posing significant financial risk to farmers and rural economies.

The agricultural sector thus has an important role to play in the transition to a climate-friendly future and can directly benefit from such a transition. Farmers

can reduce greenhouse gas emissions through on-site energy reductions and soil health improvements. Enhanced soil health can sequester additional carbon from the atmosphere, while improving soil fertility, maximizing yield, and mitigating the risks of climate change.⁴ Developing a local, sustainable food system, therefore, can help meet the State's climate goals, generate local economic development, and ensure that residents have access to affordable, healthy food.

However, farmers face several barriers to implementing more climate-friendly practices, such as high upfront costs. Policy shifts are necessary to enact the broader, systems-level change needed to reduce agriculture's climate impacts and maximize carbon sequestration potential, as envisioned in the CLCPA.

Climate change impacts on the agricultural sector

Climate change impacts the Region's agricultural sector through shifts in temperature and precipitation; the increased frequency of flooding, droughts and other climate extremes; and the rise in pests and weeds. Such impacts can directly destroy crops, lead to delays in planting and harvesting, which can reduce yield, and reduce animal outputs that underpin the Region's livestock and dairy industries.⁵ The increasing unpredictability associated with climate change makes it difficult to make decisions about costly investments and about when to plant and harvest. See Figure 2, p. 2.

Agricultural impacts on climate change and the environment

Agricultural production is a significant contributor to climate change and can have other negative impacts that undermine the long-term sustainability of the farming sector. Agriculture accounts for 10% of total greenhouse gas emissions in the U.S., an increase of 10% since 1990.⁶ Energy-intensive inputs, such as

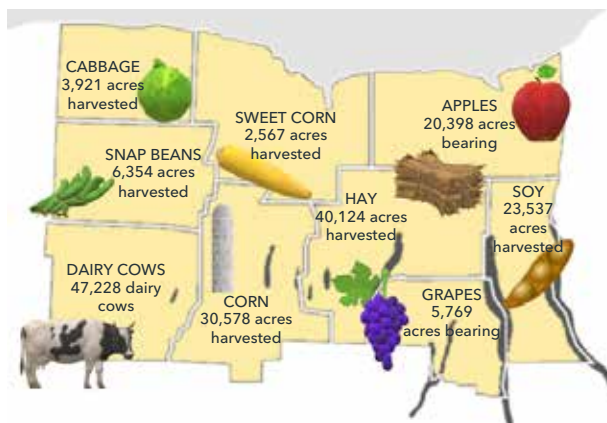


FIGURE 1. Major Agricultural Products by County

Source: (2017 Census) <https://quickstats.nass.usda.gov/>

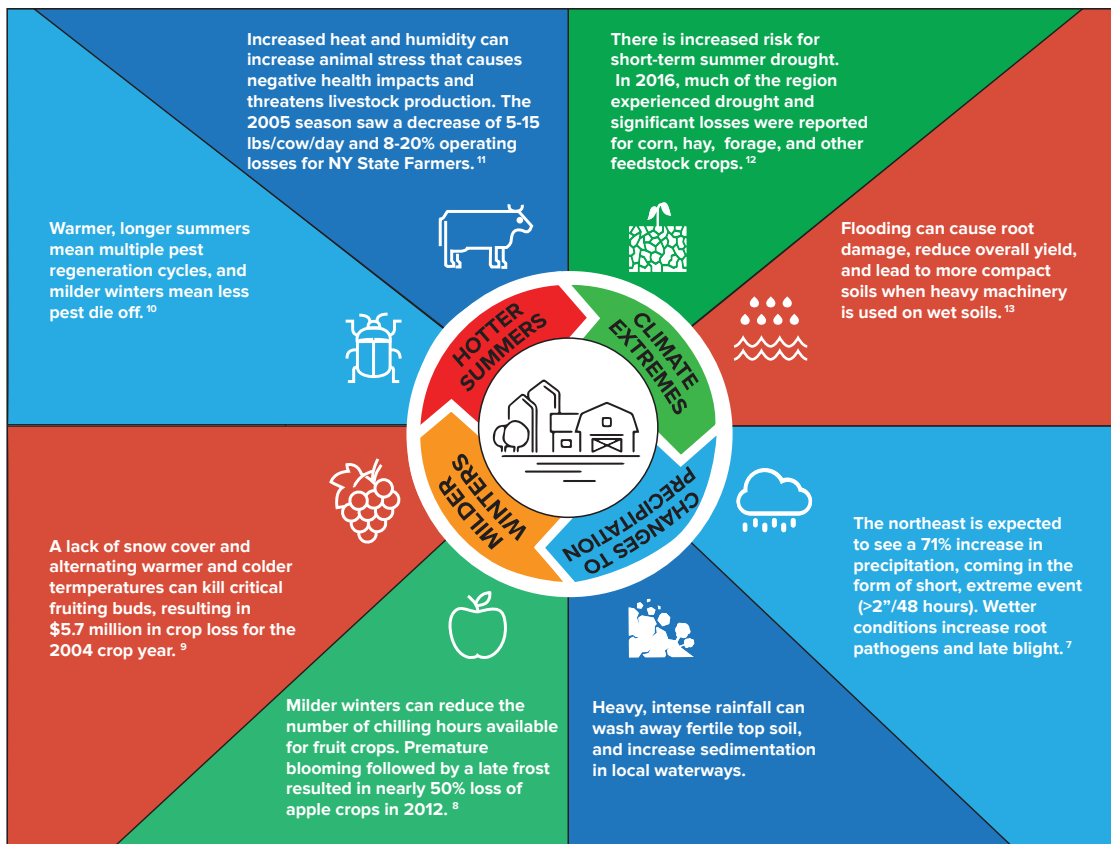


FIGURE 2. Local Climate Change Impacts on Agriculture

Climate change and farmworker health

Farmworkers play an essential role in the vitality of the Region’s local food system. The National Center for Farmworker Health estimates that there are approximately 16,000 migrant farmworkers in the Region, but this is likely an underestimate, given the difficulties in counting seasonal agricultural workers.¹⁴ Farmworkers labor long hours during the hottest parts of the year and are already susceptible to heat-related illness and dangerous pesticide exposure. The extreme temperatures and unpredictability associated with climate change will exacerbate the health, labor, and environmental risks associated with farm work. Local organizations, such as Rural Migrant Ministries and Worker Justice Center, are working to improve farm working conditions, but everyone can advocate for farmworker rights to a safe workplace that helps ameliorate climate change and supports our local food system.



fertilizer, contribute significantly to climate change, as does the operation of farm equipment and buildings. Across the food supply chain, energy inputs from the packaging, transportation, and storage of foodstuffs also contribute to climate change, with energy costs contributing significantly to overall food costs.

Industrial production that involves monocropping of soy, corn, and wheat is the most energy intensive. These crops require significant amounts of synthetic fertilizer and pesticides, which require fossil fuels for development.¹⁵ Industrialized meat and dairy operations also contribute significantly to climate change. Livestock, particularly ruminants like cows, produce methane emissions as part of their digestive process, known as enteric fermentation; this contributed over 25% to the nation’s agricultural greenhouse gas emissions in 2018. Manure management contributed another 12% to agricultural emissions in the form of methane and nitrous oxide.¹⁶ Raising cows on pasture reduces the amount of methane generated, especially if the pasture is fertilized with compost instead of synthetic fertilizers. Pasture-raised cows also reduce

Healthy Soil. Healthy Planet.

Good soil health, based on higher soil organic matter (about 58% carbon), is the foundation of productive farming and is essential for carbon sequestration (See Figure 3). According to a recent survey of New York farmers, 60% of those who incorporated reduced tillage or cover cropping saw better resilience to droughts and flooding.¹⁷ Research by American Farmland Trust shows that New York farmers who implemented soil health practices increased carbon sequestration and earned an average return on their investment of \$41/acre per year.¹⁸

PLANT WINTER COVER CROPS

Sequesters more CO₂ via photosynthesis
Reduces soil erosion during heavy rain wind
Crop roots can loosen compact soils and help feed beneficial organisms

REDUCE TILLAGE

Helps reduce soil compaction
Reduces rate of organic matter decay
Improves soil structure



ROTATE CROPS

Disrupts pest cycles
Adds organic matter
Remediates degraded soils

ADD COMPOST, MANURE, OR BIOCHAR

Improves soil structure
Improves water retention
Promotes beneficial soil organisms

FIGURE 3. Soil Health Improvement Strategies

the need for feed and the associated carbon dioxide, methane, and nitrous oxide emissions.¹⁹

Environmental issues, such as nutrient run-off, should also be considered when evaluating agricultural sustainability. Excessive or improper fertilizer application, coupled with heavy rains, can lead to nitrogen and phosphorus leaching into nearby waterways, resulting in harmful algae blooms; these HABs contaminate drinking water and are toxic to fish, livestock, and pets. Since 2017, HABs have been found in all 11 of the Finger Lakes, threatening drinking water and recreational resources.²⁰ Increasing water temperatures associated with climate change worsen this problem. Farmers can help address this issue by eliminating or reducing nitrogen-based fertilizers, implementing manure management systems, and improving soil health. In 2019, the Region's Soil and Conservation Districts received over \$2 million to address HABs, largely through agricultural improvement projects.²¹

Climate action: potential opportunities for the agricultural sector

New York's climate legislation requires a net-zero economy by 2050 through 85% reductions in greenhouse gas emissions and an additional 15% achieved through carbon sequestration, achieved by our natural and working lands. Though accomplishing this goal will require substantial long- and short-term investment in switching to climate-friendly agricultural practices, research has demonstrated promising environmental and economic benefits for farmers and local communities.²²

Below are just a few examples of on-site practices, policy mechanisms, consumer advocacy, and behavioral changes that can hasten the agricultural sector's transition to a sustainable future.

On-site emissions reductions

- **Implement soil health practices**, such as cover cropping, reduced tillage, nutrient management, tree and shrub establishment, and buffer strips. These practices sequester carbon, improve overall soil and water quality, and maximize soil fertility and yield.
- **Adopt on-site energy efficiency measures**, such as high efficiency lighting design, ventilation system upgrades, and variable speed drives that improve the efficiency and comfort of agricultural workspaces.
- **Install solar panels or wind turbines** to power on-site buildings and operations, as well as generate electricity that can be added to the grid.
- **Convert to certified organic practices** and eliminate the use of synthetic nitrogen fertilizers, and toxic synthetic pesticides, including herbicides.

Policy mechanisms

- **Increase support for soil health programming** to further soil health research and development and to facilitate technical and financial assistance for farmers looking to adopt these practices.
- **Develop a soil health label**, similar to the organic label, that builds the reputation of farmers utilizing soil health practices and signals to consumers the importance of soil health in producing healthy, nutritious, and sustainable food products.

- **Provide payments to farmers for ecosystem services**, such as carbon sequestration, building healthy soil, clean water provision, and pollinator services.
- **Eliminate outdated agricultural incentives** that promote large-scale monocrop production that is vulnerable to climate change, and modify crop insurance programs to provide protection for farmers investing in climate-friendly production.

Consumer advocacy and behavior

- **Advocate for state and federal agricultural policies that promote soil health and climate-friendly agricultural production.**
- **Advocate for farmworker protections**, including safe, stable, and sustainable housing for farmworkers and the implementation of NY State's Farm Laborers Fair Practices Act.
- **Buy direct from farmers** at farmers' markets, on-farm markets, or through a community supported agriculture (CSA) program. Buying direct maintains food dollars in the local community.
- **Consider the carbon footprint of your food choices.** Eating local, seasonal, organic, and lower on the food chain can reduce the carbon footprint of your diet.
- **Reduce food waste.** In the U.S., food waste creates as much greenhouse gas emissions as 37 million cars.²³ Food waste squanders the resources necessary to produce food and rotting food in landfills creates methane emissions, a potent greenhouse gas.

ENDNOTES

- 1 Finger Lakes Land Trust: *Lakes, Farms, and Forests, Forever*. <https://www.flit.org/lakes-farms-and-forests-forever/>
- 2 Greater Rochester Chamber of Commerce. "Agriculture is a Crown Jewel for the Finger Lakes Regional Economy." <https://greaterrochesterchamber.com/agriculture-is-a-crown-jewel-for-the-finger-lakes-regional-economy>
- 3 Edible Finger Lakes, January 2015. "New York Agriculture by the Numbers." <https://ediblefingerlakes.com/2015/01/26/new-york-agriculture-by-the-numbers/>
- 4 New York Soil Health. Soil Health and Greenhouse Gas Emissions. <https://blogs.cornell.edu/soilhealthinitiative/soil-health/soil-health-greenhouse-gases/#.YGofkKhKjPB>
- 5 Cornell Cooperative Extension. 2014. "Climate Change Facts: Farming Success in an Uncertain Climate." http://climatesmartfarming.org/wp-content/uploads/2015/09/CornellClimateChange_Farming-Success-in-an-Uncertain-Climate-Dec2014_FINAL.pdf
- 6 United States Department of Agriculture, Economic Research Service. <https://www.ers.usda.gov/topics/natural-resources-environment/climate-change/>
- 7 Cornell Climate Smart Farming. "How is Climate Change Affecting Your Farm?" <http://climatesmartfarming.org/changing-climate/>

- 8 Wolfe, D., DeGaetano, A.T., Peck, G.M., et al. "Unique challenges and opportunities for northeastern US crop production in a changing climate." *Climatic Change* 146, 231-245 (2018). <https://doi.org/10.1007/s10584-017-2109-7>.
- 9 Ibid.
- 10 Ibid.
- 11 Cornell Cooperative Extension. 2014. "Climate Change Facts: Farming Success in an Uncertain Climate." http://climatesmartfarming.org/wp-content/uploads/2015/09/CornellClimateChange_Farming-Success-in-an-Uncertain-Climate-Dec2014_FINAL.pdf
- 12 Donnegan, B. July 2016. "Three New Drought Areas You May Not Have Heard About." <https://weather.com/climate-weather/drought/news/drought-northeast-southeast-plains-mid-summer-2016>
- 13 Cornell Climate Smart Farming. "How is Climate Change Affecting Your Farm?" <http://climatesmartfarming.org/changing-climate/>
- 14 The National Center for Farmworker Health, Inc. "Migratory and Seasonal Farmworker Population Estimates." <http://www.ncfh.org/number-of-ag-workers.html>
- 15 Hitaj, C. and Suttles, S. 2016. "Trends in U.S. Agriculture's Consumption and Production of Energy: Renewable Power, Shale Energy, and Cellulosic Biomass." United States Department of Agriculture: Economic Information Bulletin Number 159. https://www.ers.usda.gov/webdocs/publications/74658/60128_eib159.pdf?v=0
- 16 United States Environmental Protection Agency. Greenhouse Gas Emissions, Land Use and Forestry. <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#land-use-and-forestry>
- 17 New York Soil Health. 2019. *Soil Health Road Map*. https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/6/7573/files/2019/02/NYSH_roadmap_2019feb15_web-23n3qcx.pdf
- 18 American Farmland Trust. "Soil Health Case Studies Findings." <https://farmland.org/soil-health-case-studies-findings/>
- 19 Benbrook, C. 2009. "Shades of Green: Quantifying the Benefits of Organic Dairy Production." https://www.greenbiz.com/sites/default/files/document/Shades_of_Green_03302009_final.pdf
- 20 Finger Lakes Land Trust. "Protecting Water Quality in the Finger Lakes Region." <https://www.flit.org/finger-lakes-water-quality-landprotection#:~:text=The%20Finger%20Lakes%20Land%20Trust,and%20our%20Regional%20Conservation%20Agenda.&text=You%20can%20help%20us%20save%20more%20land%20and%20keep%20our%20water%20clean.>
- 21 Day, L. 2019. Finger Lakes Daily News. "Finger Lakes Water and Conservation Districts Share in \$16.2 Million in Funding." <https://www.fingerlakesdailynews.com/2019/11/19/296055/>
- 22 Bodell, J., Brandt, B., Bruner, E, et al. 2019. Soil Health Case Studies. <https://farmlandinfo.org/publications/soil-health-case-studies/>
- 23 World Wildlife Foundation. "Fight Climate Change by Preventing Food Waste." <https://www.worldwildlife.org/stories/fight-climate-change-by-preventing-food-waste>

For more information

APR 2021

Visit us at
sei.org and climategfl.org

SEI Stockholm
Environment
Institute


Climate Solutions
Accelerator