

A Call for Innovation: New York's Agrifood System

Cornell
AgriTech

New York State Agricultural
Experiment Station

Center of Excellence
for Food and Agriculture



Grow-NY

Table of Contents

- 3** Acknowledgements
- 4** About the Project
- 5** Calling All Entrepreneurs
- 6** What You Need to Know About NY's AgriFood System
- 12** Capital Investment Trends in NY
- 16** AgriFood Innovation Trends to Benefit NY
- 22** What NY Farmers are Saying
- 55** What Others in NY's AgriFood Industry Are Saying
- 58** Methodology and Limitations
- 62** Citations



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About the Project

This report is the result of collaboration between the Center of Excellence for Food and Agriculture (COE) and the Center for Regional Economic Advancement (CREA) at Cornell University.

The COE launched in September 2018 with a mission to grow New York's food, beverage, and agriculture economy by serving as a hub for NY businesses to connect with the expertise and resources they need to innovate, grow, and thrive. The following year, New York state invested \$15 million over three years to establish the Grow-NY Food and Agriculture Competition, which awards \$3 million a year to startups that demonstrate they can execute bold plans to grow jobs, connect with local industry partners, and contribute to the upstate NY economy.

CREA was charged with running the Grow-NY Food and Agriculture Competition, now entering its third year. These two programs share the goal of growing an enduring food and agriculture innovation cluster in central and upstate NY.



Leaders of both programs saw an opportunity for target beneficiaries and other stakeholders in the region to play a role in informing the competition of business and investment opportunities. Inspired by the highly influential Y Combinator series "Requests for Startups," which articulates descriptions of the startups that Y Combinator leaders wished entrepreneurs might explore, we proposed to produce a report on the most pressing problems and needs facing the agricultural community in Grow-NY today with the hope and intent of inspiring future innovation, commercialization, and entrepreneurial activity.

Despite the resiliency food and agricultural players have demonstrated in continuing to supply food and other necessities during the ongoing crisis, COVID-19 has nonetheless revealed our food system's fault lines. There is an even greater urgency to understanding the common pain points in the region's agriculture, processing, and distribution sectors.

With a track record of attracting, bolstering, and showcasing agrifood innovation, COE and the Grow-NY program are uniquely positioned to identify and analyze the themes drawn from first-hand reports made by primary sectors in the region's agrifood community, with actionable outcomes.

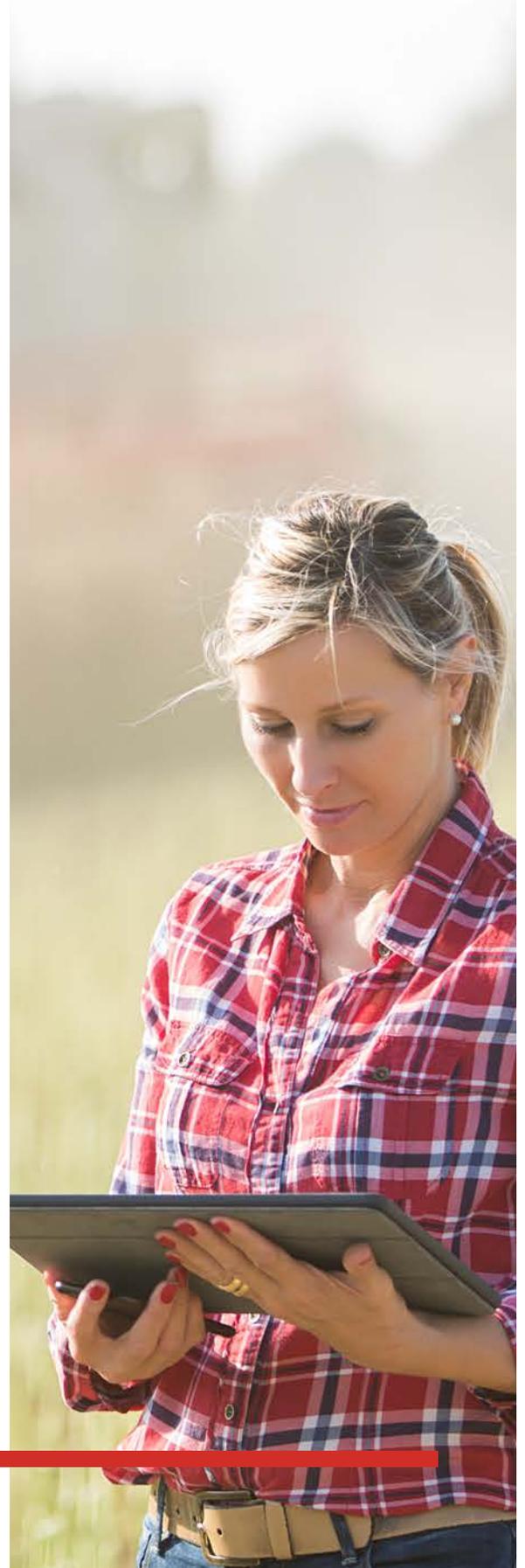
We hope this report will foster regionalization and diversity in our agricultural sector by offering evidence-based recommendations and guidance to aspiring inventors, innovators, and startup founders, as well as investors looking for investment opportunities in the agriculture, processing, and distribution space.

Calling All Entrepreneurs

Technology and innovation have exploded in the food and agriculture sectors in recent decades, and for good reason. Experts at the [United Nations estimate the world](#) will need to double its food production by 2050 in order to meet the growing global population's needs. U.S. farms are among the [most productive in the world](#), and investment in agriculture innovation, historically an afterthought by the private sector and venture capitalists, is beginning to boom. The USDA launched its [Agriculture Innovation Agenda](#) in early 2020 to stimulate increased research and development in agriculture by the private and public sectors, especially in the areas of food waste, climate change mitigation, water quality, and renewable energy. The USDA's goal is to increase the nation's agricultural production by 40% while cutting the environmental footprint of its agriculture in half by 2050.

In New York state, we plan to be part of the solution. But what do NY farmers say needs to happen to increase their productivity and cut their environmental impacts? Technology to improve farming is proliferating: drone pollinators, remote sensing, laser scarecrows, vertical farming — these are all innovations that populate the entrepreneurial space in agriculture. But here in NY, farmers and food manufacturers say they face one overarching and existential crisis: their economic survival.

This report offers you a first step in understanding NY, its farmers, and the larger food system. It is not a list of product ideas to work on, but rather a first step in understanding the agricultural ecosystem of this unique state. Working on an idea in this report is not a requirement for application to the [Grow-NY Food and Agriculture Competition](#), and working on an idea discussed here will not necessarily give you an advantage. Instead, use this report to learn about NY and those who work to grow and make food in NY communities.





What You Need to Know About NY's Agrifood System

New York is the dominant agricultural state in the Northeast and typically ranks within the top five in the United States for production of apples, milk, cottage cheese, sour cream, yogurt, maple syrup, grapes, wine, and several other commodities.

Select New York Agricultural Products Ranked Within the Top 5 Nationwide, 2017

	U.S. Rank	Share of U.S. Production
Cottage Cheese	1	26.7%
Sour Cream	1	19.5%
Yogurt	1	15.8%
Maple Syrup	2	17.8%
Cabbage	2	14.7%
Apples	2	11.4%
Snap Beans	2	11.3%
Milk	3	6.9%
Italian Cheese	3	6.5%
Grapes	3	2.5%
Calves	4	11.8%
Corn for silage	4	6.9%
All other cheese	4	6.8%
Tart Cherries	5	3.1%

SOURCE: U.S. DEPARTMENT OF AGRICULTURE THROUGH THE OFFICE OF THE NEW YORK STATE COMPTROLLER, A PROFILE OF AGRICULTURE IN NEW YORK STATE (2019).

As of 2017, there were 33,438 farms in NY, and 57,865 farmers operating them (up to four per farm). About 23% of NY's land area is currently farmland, or 6.86 million acres, of which two-thirds is dedicated to crops, 21% to woodlands, and the rest to pastureland and conservation, according to the Office of the New York State Comptroller. The U.S. Department of Agriculture (USDA) reported that 62% of agricultural producers identified as male and 38% as female.



The NY farming community is overwhelmingly white: 57,155 of 57,865 farm producers in the state are white, meaning just 2% identify as members of an ethnic or racial minority group. Of these, 606 farm producers identified as Hispanic or Latino, and 139 identified as Black. The agricultural community is not representative of NY's population. NY is home to nearly 20 million people, 55% of whom identify as white alone (not Hispanic or Latino), 17.6% as Black, 19.2% as Hispanic or Latino, and 9% as Asian.

Most farms are small, meaning they sell less than \$10,000 in agricultural goods or are less than 10 acres in size, but farms are consolidating every year. Following a national trend, very small farms in NY and very large farms (those making \$1 million or more) are growing in number, while midsize farms are declining.

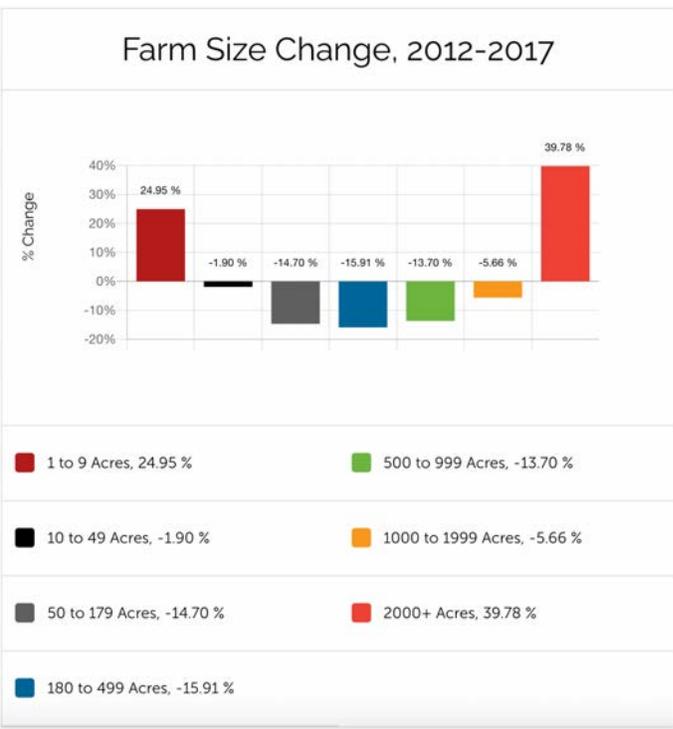


CREA analysis of the USDA National Agricultural Statistics Service 2017 Agricultural Census.

<h1 style="margin: 0;">23%</h1> <p style="margin: 0;">of land in New York is farmland</p>	<h1 style="margin: 0;">33.4K</h1> <p style="margin: 0;">farms in New York State</p>	<h1 style="margin: 0;">62%</h1> <p style="margin: 0;">of agricultural producers identify as male</p>	<h1 style="margin: 0;">98%</h1> <p style="margin: 0;">identify as white</p>
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NY is also a national leader in organic farming and sales, and in selling agricultural products direct to consumer. In 2019, NY ranked third in the nation for number of farms with organic operations — a total of 1,321 farms — a 25% increase over 2016. NY also ranked seventh in organic sales with \$298 million in 2019, behind California, Washington, Pennsylvania, Oregon, Texas, and North Carolina. In 2017, 17% of NY farmers sold direct to consumer, in contrast with just 6.4% nationally. The pandemic also caused a significant increase in direct-to-consumer sales as farmers sought alternative sales channels when some wholesale accounts were shut down due to state-mandated closures of restaurants and other establishments. NY is also the fourth most populous state, after California, Texas, and Florida, and is home to the largest city in the U.S., New York City. The state's farms also supply the densely populated East Coast, with Boston, New York City, and Philadelphia all in close proximity.



CREA analysis of the USDA National Agricultural Statistics Service 2017 Agricultural Census.

#3

NY's rank nationwide for number of farms with organic operations

#4

most populous state in the U.S.

#7

in organic sales with \$298 million in 2019



Employment in Food & Agriculture-Related Industries

More broadly, food, agriculture, and related industries make up 9.7% of NY's employment, with 1.25 million people employed in agrifood-related jobs in the state. Agrifood-related industries include on-farm jobs; fishing; forestry; food, beverage, and tobacco manufacturing; wood product manufacturing; textile and leather manufacturing; food wholesale and distribution; food and beverage stores; and food service, eating, and drinking places. (1)

The bulk of employment is concentrated in "downstream" agrifood-related industries, namely food and beverage stores in addition to food service, eating, and drinking places. "Upstream" industries in this report include farming, fishing, food manufacturing, and support industries.

On-farm employment and agricultural support account for approximately 5% of agrifood jobs, or an estimated 67,563 jobs in 2019. But it's important to note this number is likely an undercount. On-farm employment is difficult to estimate given the transient nature of seasonal and migrant labor, as well as differing definitions of on-farm employment. Most farms are still family-owned, and so this number likely does not capture all who are self-employed, those who are hired labor on farms.

This estimate is based on the number of people who reported they were "operators" on farms in NY to the USDA in 2017, and the number of people who reported they were engaged in agricultural support activities in 2019 to the Bureau of Economic Assistance (BEA). See this resource from the USDA for a discussion of farm labor in the U.S.

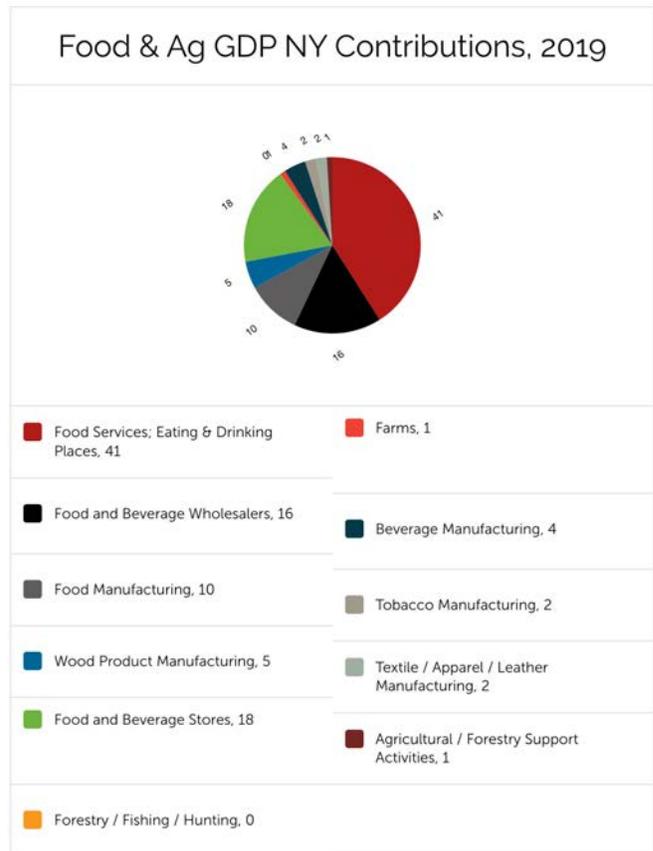
Food, beverage, and tobacco manufacturing employed 74,971 people (6% of agrifood jobs), and wholesale for food, beverage and raw farm product employed 72,317 people (6%). Food service employed the greatest number of people in agrifood in the state — 59% of agrifood jobs (735,640 jobs) in 2019, although the Bureau of Labor Statistics shows that employment in the leisure and hospitality sectors was still down more than 60% at the end of 2020 in NY, meaning employment in the food service industry has shrunk dramatically from the 2019 numbers due to COVID-19.

Downstream industries — food and beverage stores, and food service — dominate agrifood employment. Those industries account for 77% of agrifood employment.

A closer look at the upstream categories only shows that food and beverage wholesaling and manufacturing are dominant. Upstream employment categories tend to provide better-paying, more stable jobs (excepting seasonal and migrant farm worker jobs) than downstream employment in food service and food and beverage stores. This is discussed in more detail below.

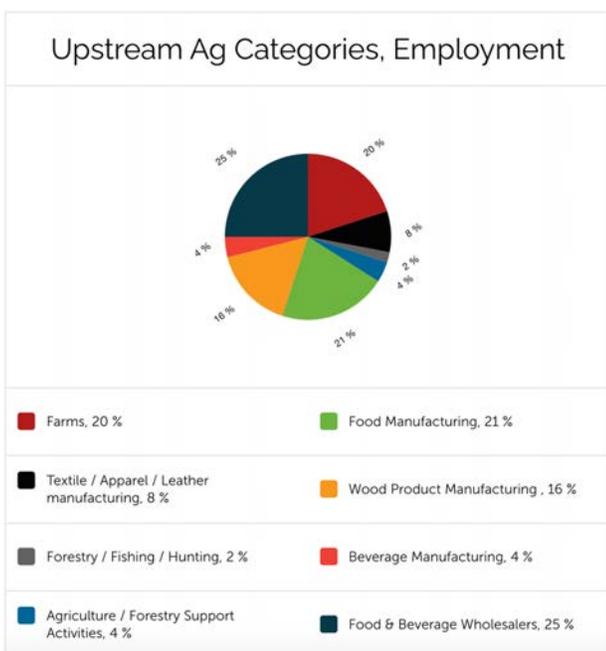
The USDA Economic Research Service [found that](#) in 2019, the agrifood and related industries contributed \$1.109 trillion dollars to the U.S. gross domestic product (GDP), a 5.2% share.

NY's agrifood industry contributed at least \$73 billion to the state's GDP, a total of 4.3% of the state's \$1.7 trillion dollar economy. Of course, the value of agriculture to the state goes beyond direct revenue or employment statistics. For example, a [recent analysis](#) of the value of the NY grape and wine industry, which included multipliers such as regional tourism and supporting industries, estimated that the total economic impact of the wine industry alone was more than 70,000 jobs and \$6.65 billion in 2019.



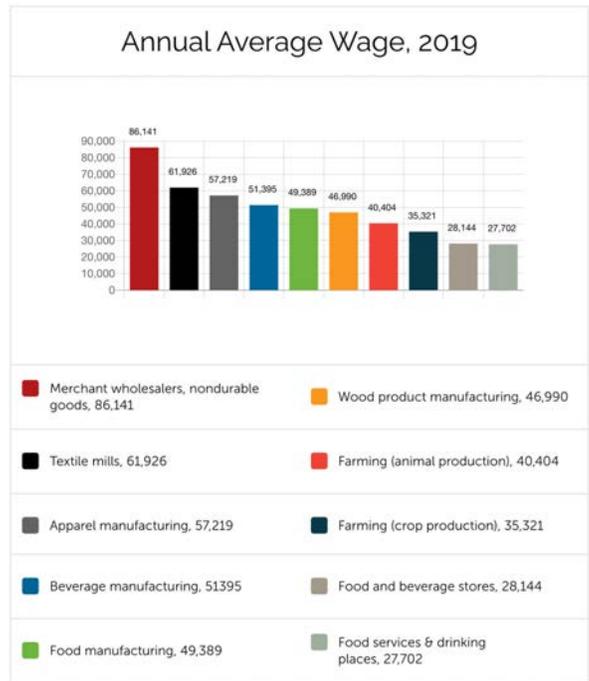
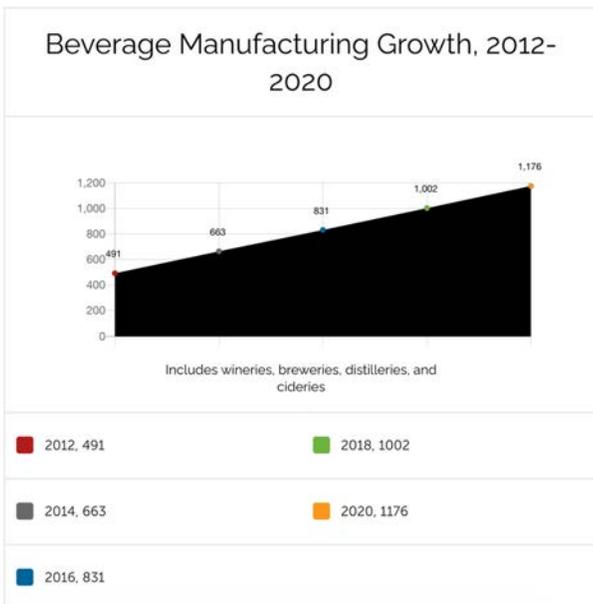
Once again, downstream industries — in this case food services — dominate GDP contributions in the state (\$30.3 billion). Food and beverage stores are second with \$13.3 billion dollars. Of the upstream agricultural industry categories, food and beverage wholesaling is the largest sector (nearly \$12 billion).

Although upstream categories are dwarfed by the size of downstream industries in terms of employment and GDP contributions, they tend to offer more stable jobs, particularly in food distribution and manufacturing. The NYS DOL reports the average annual wage in food service was \$27,702 in 2019, and \$28,144 for food and beverage store workers. Workers at food and beverage manufacturing plants made between \$49,389 and \$51,395 in 2019 on average, and textile manufacturing employees made \$61,926. Merchant wholesalers for nondurable goods (including food) made on average \$86,141 in 2019.



NY ranks second in the U.S. behind California for food and beverage manufacturing, with an estimated 2,946 plants operating in the state, according to the NYS DOL. Food manufacturing in the state is heavily concentrated downstate. More than 40% of food manufacturing facilities (e.g., bakeries, animal slaughtering and processing, dairy product manufacturing, and seafood product manufacturing) are located in New York City. Bakeries and tortilla manufacturers employ the highest number of people in food manufacturing (more than 22,000 people across 1,389 establishments), with dairy product manufacturing being the next largest manufacturing sector in the state (10,767 workers at 143 plants). However, the average bakery is much smaller than the average dairy plant. Bakeries in the state average 16 employees, while dairy plants average 75 people or more, suggesting output per dairy plant is much higher.

Beverage manufacturing is also a major employer in the state, even more so now that the craft beverage sector has boomed over the past decade. The number of craft beverage manufacturers, between wine, beer, cider, and craft distilling, has grown 141% since 2012, with the largest gains going to craft brewing (373% increase in breweries from 2012 to 2020).



Food and agriculture remain critical pillars to much of NY's economy, particularly in rural areas. While the rural economy of the state has diversified over the past three decades, food and agriculture are significant sources of employment and help to drive the culture and community of many rural areas in the state, especially in the areas of upstate NY, including western NY, central NY, the Finger Lakes, Southern Tier, and North Country. As the agricultural anchor of the Northeast, NY and its agrifood industries are well placed to lead innovation in the region. New and better solutions to 1) raise up food and agriculture as pillars of the rural economies in the state, 2) bolster the industry's role in reducing greenhouse emissions, and 3) shore up the regional food supply are all major goals for NY in the coming decades and are important in making strides to improve the lives and livelihoods of those living and working in the state.



Capital Investment Trends in NY

Indoor farming leads the way.

New York City (NYC) has become the epicenter of urban agriculture over the past five years, especially for companies pioneering controlled environment agriculture (CEA) methods like soilless systems (e.g., hydroponics, aeroponics, and aquaponics). (2) Over the past decade, investors have channeled hundreds of millions of dollars to companies championing CEA in urban settings, companies like Bowery Farming, backed by Google Ventures (now called GV), and Square Roots, founded by Kimbal Musk (brother of Elon Musk).

According to PitchBook Data, venture capitalists invested \$1.42 billion in agriculture-related startups in NY from 2012-2020. Of that, at least \$400 million went to controlled-environment agriculture startups with headquarters in New York City or the surrounding metropolitan area. The largest investments went to Bowery Farming, BrightFarms, Gotham Greens, Square Roots, CEA Fresh Farms, and the upstate NY-based Clearwater Organic Farms, based on data from market intelligence database CB Insights. All of the companies received at least \$10 million in private investment. All of the listed companies are developing and operating novel farming methods indoors using greenhouses and hydroponics. Most are growing lettuces, arugula, herbs, tomatoes, cucumbers, and microgreens.

Bowery Farming is headquartered in New Jersey but has raised at least \$167 million in NY in fundraising efforts led by big names like GV, General Catalyst, and GGV Capital. Bowery Farming raised \$140 million of their capital in 2018 and 2019 alone. CB Insights reports that Gotham Greens also raised \$87 million in a single round in December 2020.

Similarly, BrightFarms, an indoor farming company headquartered in Irvington, NY, grows and supplies local, non-GMO, pesticide-free, and fresh salad greens to supermarkets in computer-controlled hydroponic greenhouses, according to the company's website. BrightFarms raised a total of \$110 million in NY as of 2018. Square Roots and Gotham Greens, another NYC-based indoor farming company, also raised significant capital in 2018 and 2019. Square Roots received \$19 million in a single deal in 2019 according to CB Insights.

Another NYC-based indoor farm, Upward Farms (formerly known as Edenworks), supplies microgreens, salad greens, and seafood to restaurants and markets in the city. Upward Farms received \$5 million in 2018 from Founder.org, a group of Silicon Valley venture capitalists providing early-stage funding.



A recent report from PitchBook shows that 2020 was again a banner year for CEA investment, reaching \$929 million invested across 41 deals in the U.S., double the deal value of 2019. In NY, CEA Fresh Farms received \$14 million in 2020 through a venture capital deal, and Upward Farms received an additional \$15 million in 2020 to expand operations. One of the most recent high-profile projects in NY is Green Empire Farms, which began building its 60-acre indoor growing facility in August 2019 in Madison County (in central NY). Mastronardi Produce — a multinational grower and distributor headquartered in Canada that markets produce under nationally recognized brands like SUNSET, Campari, and Angel Sweet — owns Green Empire Farms. While Green Empire Farms did not receive venture capital backing, Mastronardi Produce's investment in indoor farming underscores the interest and growth of the space in NY.

Despite continued enthusiasm for indoor farming, the space is not without its critics. CEA claims to be the solution to growing more food with less space, fewer inputs, and fewer environmental impacts. However, methods and skeptics say that indoor and vertical farming has significantly higher startup costs and higher energy demands, and is still susceptible to disease and pest pressure despite proponents' claims to the contrary. A 2019 study by Cornell University researchers found that CEA farms in NYC did indeed have significantly higher yields for lettuces, anywhere from 150 to 900 tons per acre compared to 18 tons per acre with traditional, outdoor, soil-based farming of greens. [The study](#) reported mixed results on environmental sustainability based on studying seven CEA farms in NYC and suggested that CEA makes the "most sense in regions with favorable climates where less supplemental heat and light is needed. Beyond that, the environmental advantages begin to shrink."

Some conventional farmers in NY also questioned CEA's applications outside of an urban setting. Farmers in western and central NY pointed to the high startup costs of indoor farming, whether soil-based or soilless, as an insurmountable barrier to establishing or growing existing indoor farming operations for the average farmer — those not backed by deep reserves of capital. Many farmers who were interviewed had greenhouses or high tunnels on their properties but ran them as traditional, soil-based operations to grow seedlings before transferring them to outdoor plots.

While CEA holds the potential to bring farming to urban spaces and enable a year-round growing season for certain kinds of produce in NY, many conventional farmers in NY will require convincing to adopt CEA, or indoor growing on a large-scale in general, because of the high level of capital required and the questions being raised about CEA's ability to save labor and costs in the long-run while boosting productivity.



From 2010 through the first quarter of 2021, there were at least 860 deals in the agriculture, food and beverage sectors recorded by CBInsights.

Upstream vs. Downstream: What are Agrifood Categories?

We use AgFunder's categorization system to discuss investment trends in the agrifood industry. Venture capital fund AgFunder uses the broad categories "downstream" and "upstream" to identify companies working at various points along the complex supply chain, from farm to consumer. Upstream categories, which AgFunder also refers to as "farm tech" in a 2020 report, includes companies working on solutions that will largely benefit farms and farmers, such as agricultural biotechnology, farm robotics, and farm management software. AgFunder added a new upstream category in 2020 called "farm-to-consumer e-grocery: online platforms for farmers to market and deliver their produce direct to consumers." Given the uptick in direct-to-consumer sales for NY farmers, this is an important category for investment in NY.

Investment in food and beverage eclipses investment in agriculture.

While investment in upstream ventures like agricultural biotechnology, farm management tools, robotics, cellular agriculture, and novel farming has grown significantly over the past decade, investors continue to focus mainly on consumer-packaged goods and food delivery services.

From 2010 through the first quarter of 2021, there were at least 860 deals in the agriculture and food and beverage sectors recorded by CB Insights. Very few of those deals went to companies developing new technologies and approaches to agriculture — just 89 deals over 10 years to 38 companies. The rest of the deals went to food and beverage companies producing consumer-packaged goods such as yogurt, cheese, sports drinks, and alcoholic beverages.

The number of investment deals going to the food and beverage sectors has climbed steadily over the past decade. The amount of investment dollars, on the other hand, has been much more volatile (though, on average, the amount of investment has also risen over the past decade).

In 2014, investment in the food and beverage sector skyrocketed from \$20.6 million to well over a billion dollars in one year. However, that drastic shift is in part due to a single \$750 million investment made in Greek yogurt manufacturer Chobani by TGP Capital.

But even without the Chobani deal, 2014 still would have been a banner year for food and beverage investment, totaling over \$500 million. All Star Market, Bevyz Global, and Avion Spirits were also big winners that year, receiving more than \$100 million each in investment. Investors began flocking to food and beverage companies and startups beginning in 2013, and 21 agrifood investment funds were launched in 2014.

Globally, investment in downstream food technologies such as restaurant marketplaces and online grocery platforms declined for the first time in three-year period during 2019, according to AgFunder. Investment in upstream agrifood companies lagged far behind investment in downstream technologies such as online grocery platforms, cloud retail infrastructure, and restaurant marketplaces.

Those three categories alone accounted for nearly half of all investment in 2019. The largest category for upstream investment was midstream technologies for food safety and traceability, logistics, and transport — all technologies that NY farmers, distributors, and retailers said would improve their operations.

At the seed stage, however, it's a different story. Upstream companies attracted more deals and more money in 2019 (609 companies raised \$563 million in 2019 around the world). AgFunder compiled a list of the top 15 seed deals, which included early-stage investment for smart sensors, cannabis technology, cellular ingredients, robotics, autonomous vehicles, and on-farm logistics. Early data on 2020 deals showed even greater growth in upstream categories, with upstream agriculture companies attracting more venture capital investment than downstream categories for the first time ever.

Agrifood Innovation Trends to Benefit New York

This section describes a few innovation trends important for bolstering the food and agriculture industries in New York that will help farmers adopt relevant technology and services that will enable them produce and sell excellent quality food while reducing costs and environmental impacts.

Farm Robotics and Automation

Farmers in New York state need solutions to their labor problems. Lack of affordable labor is threatening the economic viability of farms in the state, particularly dairy farms and some specialty crop farms that require significantly more labor to harvest their crops.

Despite the urgent need, there has been relatively little investment in farm robotics. In 2019, AgFunder reported that robotics saw a 46% drop in funding from 2018, and just 1% of all investment in the “agrifood technology” space went to farm robotics, reflecting what AgFunder referred to as a continued “skepticism over farm robotics efficacy and durability” by investors.

It's true that robotics and automated harvesting are still some distance away from widespread, practical applicability for most specialty crops, but potential positive impacts of effective and affordable robotics are substantial.

The Grow-NY Food and Agriculture Competition 2021 is open.

Go to the [competition website](#) to learn more. Past winners have included companies working in farm robotics, agricultural biotechnology, food safety technology, consumer packaged goods, and more. Each year seven contestants have been awarded seed funding.

Grow-NY has garnered more than **460 applications** from businesses originating in **32 unique states** and **37 other countries** over the last two years.

The farm robotics category is large, including technology-enabled mechanical harvesters, drones, and autonomous robots. Companies like Harvest CROO, Naio Technologies, and American Robotics are developing robots that can autonomously weed, hoe, and provide harvest assistance, as well as scan fields and rows for pests, diseases, and other problems.

NY farmers said solutions to boost harvest efficiency, pest and disease identification, and other field management data were on the top of their priority lists. However, the biggest barriers to adoption of new technology on NY farms are the high costs of the equipment, marginal profitability on most farms, and access to adequate information about new technologies. Even if the robotics technologies were more advanced, there would still likely be slow adoption rates across NY if the dairy industry is any indicator. The limits on farmer access to education about new technologies, wariness of the reliability and cost effectiveness of new technology, and limits to available financing options — especially for new farmers — all result in robotics and mechanization being peripheral to most NY farmers' operations.



Robots in Action

A team of Cornell University researchers are developing robots to prune apple trees, and optimize apple crop yields. [Read more about the project here.](#) Dropcopter, a 2019 Grow-NY winner, manufactures autonomous drone pollinators to spray pollen on areas of fields and orchards that may not benefit from natural pollinators. [Read more about Dropcopter and the other 2019 Grow-NY winners here.](#)

Supporting Local Supply Chains

Although consumer demand for local and sustainably raised food has never been higher, New York state distributors and food retailers said that managing a transparent supply chain is a constant challenge because of the complex nature of that supply chain. NY farmers and distributors would welcome startups focusing on end-to-end logistics for small to midsize farms, transportation, cold-chain technology, and traceability tools. Farmers and distributors who transport perishable fruits, vegetables, and other products also pointed to reducing food waste in transit as a priority.

Part of supporting a local supply chain is also making it easier for farmers to keep their produce fresh, reduce waste, improve food safety, and get it to where it needs to go. It's also useful for the farmer to know that their product will be accurately and transparently labelled — as organic, sustainably grown, or locally grown — rather than mixed with imports.



Opportunities in Reducing Food Waste

Companies are reducing food waste with better packaging, preservation technology, and the promotion of grocery store rejects. The 2020 Grow-NY Food and Agriculture Competition winners, [SoFresh](#) and [Purespace](#), both work to extend the shelf life of stored foods. SoFresh manufactures packaging material that emits an organic vapor extending the shelf life of bread. Purespace is technology that gets rid of ethylene gas, airborne mold, and viruses in food storage spaces, thereby extending the shelf life of produce and improving food safety. In 2019, [Imperfect Foods](#) was the top e-grocery investment deal made worldwide at \$30 million. The online grocer sells grocery store rejects that might look imperfect but are perfectly safe and healthy to eat, reducing food waste and getting more fresh food to directly to consumers.

Direct Marketing Platforms

The pandemic has provided an opportunity for more New York state farmers to sell directly to their consumers. Yes, direct-to-consumer selling brings better profit margins for farmers, but it also brings new challenges — such as managing customer relationships, keeping track of inventory, reaching customers, and filling orders. Few farmers reported creating their own e-commerce platform and relied mostly on word-of-mouth advertising to increase their CSA sign-ups. E-commerce platforms that help farmers sell more easily to customers online, streamline their marketing operations, and help connect farmers and buyers in their region would address these challenges. E-commerce for farmers and buyers looking to shop local is a new category. But in light of the supply chain disruptions in 2020 because of the pandemic and renewed customer interest in shopping local, this appears to be an area with potential.



Novel Crop Protection

Farmers ranked disease and pest pressure as a top concern and are always looking for new ways to protect their crops and boost productivity. Crop protection technologies and techniques that effectively identify and control pests and diseases in farmers' fields while reducing environmental impacts are a high priority for New York state farmers. Most farmers expressed dissatisfaction with current methods of control through traditional pesticide spraying, which they said was expensive and harmful at times, both to the environment and human health. Organic sprays were also inadequate, they said. Organic and conventional farmers were skeptical of organic fungicides like liquid copper, which they said contributes to heavy metal build-up in the soil. That being said, the biopesticides market is already at \$2.2 billion and projected to grow 5% every year between 2020 and 2026. Some analysts predict growth in the biopesticides market in North America as a result of increased consumer demand for organic produce.

Farmers in NY said improved data collection and ability to identify pests and diseases early would help minimize spraying and improve efficiency in pesticide application. Certainly, technologies geared towards improved identification and decision-making around pest, disease, and weed pressure are of interest, but farmers also said they are interested in novel approaches to protecting crops, including seed gene editing to strengthen resilience against certain pests and diseases. In the agricultural biotechnology space, more companies are focused on developing new crop protection technology. For example, a company called GreenLight Biosciences, located in the Finger Lakes region of NY, received \$50 million in 2019 to fund growth of its work in applying RNA technology to eliminate pests and disease. The first application they developed, pending regulatory approval, was an RNA product targeting the Colorado potato beetle.

Cornell AgriTech in Geneva, NY, has also produced critical research advancing alternatives to better control pests, disease, and weeds on farms. For example, researchers at Cornell AgriTech, Rensselaer Polytechnic Institute's Lighting Research Center, the University of Florida, and the National Agricultural University of Norway have recently developed autonomous vehicles to fight powdery mildew infections in grape vineyards on the East Coast of the U.S. The vehicles are fitted with ultraviolet (UV) lamps, which are then used at night to kill powdery mildew.

Biomaterials: Innovative Applications for Hemp

2018 was a banner year for hemp in New York state. But cannabidiol (CBD) growers and manufacturers got all the glory — and the investment. A glut of supply resulted in NY farmers questioning hemp's prospects, but hemp grown for food, fiber, and industrial applications still has potential, with the right research and investment.

Startups working on alternative applications for hemp as a biomaterial and biofuel hold significant interest, as well as sustainable bioproducts made from hemp or other agricultural crops, and potential industrial and consumer applications for hemp — such as biopolymers, nanocellulose, nutraceuticals, food and beverage, textiles, paper, building materials, and animal nutrition. NY's climate is suited to hemp production, and with investment in processing and manufacturing capabilities, the state could be home to new innovation in hemp.



Sparkling Maple Water

The 2020 Grow-NY Food and Agriculture Competition finalist, Asarasi, is bottling plant-sourced sparkling water, sourced mainly from the maple industry. Read more about the organic water brand on the [Grow-NY website](#).

New Product Development

Two of New York's key agricultural products are falling out of consumer favor: milk and maple syrup. As consumers become more health and environment conscious, they are turning away from dairy in favor of plant-based dairy alternatives, and eschewing sugar — natural or otherwise. Both the milk and maple syrup industries in NY are key agricultural pillars in the state and are capable of increasing production — if there's a market for their product. NY has already made strides to invest in new product development through an innovation competition. The competition is designed to boost interest from entrepreneurs and investors in new dairy products for consumers that will result in increased dairy sales in NY. The Cornell Maple Program has also pointed to new product development for maple syrup as key to growing the market and providing opportunities for maple syrup producers across the state. The program has begun to experiment with products such as maple soda and maple wine, and [some private companies](#) have begun bottling a significant waste byproduct of the industry called "tree water" — the water produced from sap during the syrup-making process. Table grapes also present an opportunity for new product development as consumer interest in products such as grape juice dwindles.

Tackle Climate Change

Farmers are on the front lines of climate change, and they don't have the tools they need to cope with growing climate challenges. They need early warning systems to more accurately predict things like frost, heavy rain, hail, and other destructive weather events that threaten the health of their crops. Farmers have said they need more support in making decisions around long-term capital investments to improve their effectiveness in fighting climate change. Farmers in New York state are also interested in crop varieties, including genetically engineered seeds that have increased tolerance to climate change in NY — namely crops that are resilient to temperature swings and drought.

Not only do farmers need tools to adapt to climate change, but they need tools to help them mitigate it, too. The NY Department of Environmental Conservation says the state's agriculture is responsible for 4% of greenhouse gas emissions — particularly methane emissions from livestock and manure management. While 15% of emissions from the agricultural sector come from manure, soil emissions account for about 30%.



Invest in Diverse, Young Farmers

New York's farms need to attract more diversity. The industry is overwhelmingly white and male — although women have made strides towards equity in the past decade. The 2017 Census of Agriculture showed that 37% of farmers in NY were women, and 9,300 or 16% had primary responsibility for their farm operations. As NY farmers approach retirement, it is critical that the resources to make agriculture more inclusive and attractive are available to people of all ages, races, sexual orientations, and national origins and that they focus on how to bring more young people, especially young Black, indigenous, and other people of color, into agriculture and provide them with the resources and mentorship necessary to get into agriculture.

Support Rural Economies

Research has shown that small to midsize farms are good for their communities by offering employment, keeping money in the local economy, and increasing food security.

Agriculture and related industries — such as agricultural suppliers, service providers, warehousing, transport, retail, restaurants, and tourism — continue to be pillars of New York state's rural economy, especially in the Finger Lakes, central NY, and western NY, and to some extent, the Southern Tier and Hudson Valley. Food and agriculture will continue to be critical to NY's rural economy, including as a major source of employment. We are interested in funding startups with innovative models around supporting agrifood economies in rural areas.



What NY Farmers Are Saying

Labor is Costly, But So Are Robots

The future is robotics, say most people. But there are steep barriers to overcome before robotic planting, managing, and harvesting is ubiquitous in farming. For the foreseeable future, manual labor will continue to be critical to getting food onto U.S. tables. That being said, labor is becoming more expensive every year. Innovators and entrepreneurs interested in New York's agricultural industry may investigate new solutions to help bring labor costs down for NY farmers while protecting the state's valuable agricultural workers.

High Costs of Labor

All of the farmers interviewed cited the cost of hired labor as one of their most pressing concerns, followed closely by complying with labor regulations set out by New York state. Also a top concern for farmers in the state is access to labor, although slightly less pressing than the rising cost of labor. (5)

Effective January 1, 2020, NY established a mandatory overtime threshold of 60 hours, and effective December 31, 2020, it raised the minimum wage to \$12.50 per hour for all state workers (except for New York City and Long Island, which raised the minimum wage to \$15.00 per hour).

At the same time, NY's governor appointed a three-person Farm Laborers Wage Board to determine whether the overtime threshold should be lowered to 40 hours a week — following California, which not only passed a law guaranteeing overtime pay for farm workers in 2016 but also implemented a plan to reduce the hourly threshold by five hours every year until it hits 40 hours on January 1, 2022. The Farm Laborers Wage Board recommended on December 31, 2020, to delay lowering the overtime threshold until at least November, given the extraordinary circumstances facing farmers during the ongoing pandemic.

In 2017, there were about 55,636 hired farmworkers in NY, according to the USDA Census of Agriculture. (6) However, only 8,963 farms or 26.8% reported hiring labor in 2017, and that number has decreased over time. In 2002, NY farms employed 67,886 workers, or 22% more workers than today. Hired labor is increasingly concentrated on larger farms. In 2017, 61% of the state's hired farmworkers were employed on farms that hired 10 or more workers — a total of 1,268 farms. Each of these farms employed an average of 26 workers. Of the farmers at operations large and small, most had at least one part-time, paid, hired worker. (7)

Nationwide, the cost of hired farm labor has outstripped the rise in other production costs for farmers. The cost of hired labor increased by 17% between 2012 and 2017 and made up about 10% of all production expenses in agriculture. In NY, the costs of hired labor increased 11% over the same time period and now make up 18% of NY farmers' production expenses, significantly higher than the nationwide average. The cost of labor has steadily increased over the past two decades while total employment in agriculture has decreased. The number of hired agricultural workers across the nation has decreased by nearly 26% since 2002. In NY, the hired agricultural workforce declined 22% over the same period, and farmers spent just over \$800 million on hired labor in 2017. The only cost that exceeded hired labor was the cost of feed purchased that year, a cost that decreased from 2012 but still represented the highest cost for farmers in NY (\$850 million). (8)

This largely reflects the agricultural makeup of the state. NY's most important agricultural products are milk and dairy, as well as a variety of specialty crops including apples, cabbage, and other fruits and vegetables (see table). The USDA's Agricultural Resources Management Survey found that certain types of farms rely more on farm labor than others. The two types of farms that rely most heavily on hired labor are dairy farms and specialty crop farms. (9) In 2018, the survey found that hired farm labor accounted for 13% of production expenses in agriculture (up slightly from the 2017 USDA Census of Agriculture estimate of 10%). But specialty crop farms — which produce fruits, vegetables, and nursery crops — had the highest share of labor costs to total cash expenses at 39%. In NY, 21.7% of all farm sales fell under the category of specialty crops. NY is also a national leader in organic sales and direct-to-consumer sales; both categories tend to rely heavily on specialty crops. The share of labor costs to total cash expenses for specialty crop farms was more than three times higher than the average for all farms.

Dairy farms had the second highest share of labor costs with 14% of farm expenses going to cover the cost of hired labor. The USDA average is based on labor costs and farming operations in all states. In NY, those cost shares are likely to be higher based on the higher average cost of labor compared to other states and the national average. Further, milk is a dominant agricultural commodity in NY. In 2017, 47.1% of all farm sales were milk, and 4,648 of NY's farms were primarily dairy farms. The majority of dairy farms in NY had at least 20 milking cows in 2017.

17%

increase in hired labor cost between 2012 and 2017, nationwide

\$800M

spent by NY farmers on hired labor in 2017

39%

share of labor costs to total cash expenses for specialty crop farms nationwide

Given that 68.8% of all farm sales in NY are fluid milk, fruits, vegetables, or nursery crops — categories that are the most labor intensive — it is not surprising that labor costs make up a larger portion of production costs for farmers in NY. In contrast, cash crops like corn for silage, wheat, soybeans, and alfalfa do not require the same level of manual labor given the efficiency of mechanical harvesters for those crops. Hired farm labor costs are only 5% of production expenses for farms primarily producing field/cash crops.

Finally, the meat packing industry — largely small to medium-size slaughtering and meat processing facilities in NY — also reported labor costs as a significant issue. Some of the processing facilities interviewed for this report also owned farmland and raised livestock. Meat packers in particular reported NY's workers' compensation insurance costs as a serious financial burden. A [2019 report](#) titled "The State of the USDA Inspected Red Meat Harvest and Processing Industry in New York and New England," surveyed all 62 of the meat processing facilities located in NY and New England. Sixty-two percent of the respondents said that workers' compensation "places a constraint on their business." Butchering and slaughtering is considered a high-risk job and requires a workers' compensation pay rate of approximately \$21 per \$100 of total payroll.

Availability of Labor

Farmers reported labor availability as a top concern less often than the high cost of labor. Farmers that reported finding and hiring labor as an issue were usually farther away from urban centers (for example, Hudson Valley farmers said they had little difficulty finding labor because of their proximity to population centers). However, growing labor scarcity in general has driven increased interest and use of the H-2A program. In fact, hiring through the H-2A program in New York state has increased more than 80% since 2014. In 2020, NY farmers hired [8,482 workers through the H-2A program](#).

However, the H-2A program has important limitations. The program only provides workers on a seasonal or temporary basis, meaning an H-2A worker can only work annually if it's on a seasonal basis, as with harvest. Many farmers said they bring back the same H-2A workers every year, but they work only during harvest months. Dairy farmers expressed frustration that they had no access to H-2A workers. Dairy farming requires labor year-round for milking and animal care, and so dairy farmers generally do not apply for H-2A labor. Farmers also said H-2A labor is more expensive relative to hiring local labor given they are required to pay a higher wage to workers and provide them with housing at no cost.

What is the H-2A program?

H-2A allows agricultural employers to hire foreign workers to the U.S. on temporary work visas to meet higher labor demands during the agricultural growing season, especially harvest. The employer must demonstrate that there are not enough U.S. workers available to fill their needs, and that H-2A workers will not suppress wages and working conditions for U.S. workers. Farmers must apply with the Department of Labor to request H-2A workers and meet certain conditions, including providing housing and other benefits for H-2A workers.

Despite its limitations, many farmers said the higher costs of H-2A labor is offset by the reliable pool of labor it provides, especially as hiring undocumented immigrant labor has become riskier in recent years. Although it is estimated that up to half of all hired farm labor is undocumented nationwide, farmers in NY said they have become more risk-averse when it comes to hiring undocumented workers and prefer to pay higher costs in exchange for peace of mind.

Finally, livestock farmers and meat processors say finding skilled workers to slaughter and cut meat is a top challenge. The same 2019 report found that 74% of meat packers in NY and New England said, “lack of access to qualified workers is the biggest constraint to the industry. 52% stated they want trained employees or employees with some knife work but can easily be retrained to meet the plant’s needs. It is important that plants find labor that is willing to work, shows up to work, believes in the industry, and understands that they are part of the national food system.”

Barriers to Adopting Robotics and Mechanization

As the costs of human labor continue to rise across the country for agricultural work, robotics and mechanization have become an option for replacing farmworkers. Mechanization in agriculture has already increased agricultural efficiency and crop yields exponentially over the past century and a half, allowing for fewer and fewer people to be engaged in agriculture and for more food to be grown with fewer inputs. However, effectiveness, affordability, and access to mechanization and new technology — like robotic harvesting and milking for farmers — has room to grow. Of the farmers interviewed who focused on specialty crops and dairy, very few had adopted new technology to bring down labor costs, citing the high capital costs required to invest in new technology like robotic milkers and custom harvesters.

Dairy

New York dairy farmers interviewed said the capital investment required to buy and maintain robotic milkers, as well as to retrofit barns for installation, was often cost prohibitive. They also expressed uncertainty about their ability to service the robotic milking system, keep the systems up-to-date, and have the equipment professionally maintained when needed. Some studies have also pointed to other hurdles in adopting robotic milking systems, including a decline in milk quality and changes to barn design and herd management practices.

Dairy farmers in NY, including farmers with very large operations, remain skeptical about the value-add of robotic milking systems, even as they cite labor availability and labor costs as their most urgent farming challenges. A large dairy farmer in western NY with a herd of more than 5,000 milk cows has yet to install a robotic milking system despite concerns about rising labor costs. “Things like robotics are great,” he said (name withheld at owner’s request). “But you have to have someone to fix your robot when they are not working. That creates a challenge. There isn’t a broad base of people here who can service [the robots].”



Jamie Baker, a 57-year-old dairy farmer in Brooktondale, NY, (in the Southern Tier) milks 300 cows and employs four full-time staff and a few part-timers. Baker also cited labor as his most pressing issue but when asked about robotic milking he said, "I would have robots in a second if it weren't for debt." Baker said he was doubtful that any cost savings would outweigh the high cost of installing a robotic milking system.

Automatic or robotic milking systems have been commercially available since the 1990s in Europe, and dairy farmers in Wisconsin began adopting robotic milking in 2000. Researchers at the University of Minnesota estimated in 2019 that more than 35,000 robotic milking systems were operational on dairy farms around the world. Doug Reinemann, associate dean for University of Wisconsin-Extension and Outreach, [told Agri-View](#) in 2019 that he predicts more than half of the dairy industry would switch to robotic milking systems in the coming decades if the current rate of adoption continues. "It's coming fast. We're reaching a tipping point," he said.

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Things like robotics are great. But you have to have someone to fix your robot when they are not working. That creates a challenge. There isn't a broad base of people here who can service [the robots].

DAIRY FARMER IN WESTERN NY WITH A HERD OF MORE THAN 5,000 MILK COWS

The two major suppliers of robotic milking systems in the U.S. are currently Lely and DeLaval. Whitney Davis, the capital sales director for Finger Lakes Dairy Services (FLDS), said he supplies Lely robots to dairy farms in NY and that Lely dealers represent 80% of the market share in NY. Sam Steinberg, a robotics sales specialist for DeLaval Corporate said that DeLaval represents 40% of the milking robot market share globally and that the two companies (DeLaval and Lely) were the top manufacturers for robotic milking systems in the U.S. Davis reported that FLDS has installed 180 robots on 45 dairy farms in NY. He estimates that between FLDS and two other Lely dealers in the state, there are 250 Lely robots operating on 60 farms in NY. Steinberg reported that DeLaval has 60 robots installed on 15 NY dairy farms.

Davis added that he had seen a "lull" in adoption due to low milk prices and especially the onset of the COVID-19 pandemic. However, he expects sales and installations to pick up in 2021, as greater education of the benefits of robotic milking systems grows.

Steinberg agreed that with rising labor costs in NY in particular, he expected to see more farms adopting robotics over time. Although he doesn't think robots are necessarily a panacea for dairy's labor problems, he said smaller, family-run farms without hired labor might adopt robots as a lifestyle choice. Even though they may not increase revenue or profits, they are able to reduce the manual labor required to milk in a conventional parlor. Larger farms that can directly replace labor with robots will save on labor costs, which may be desirable in the long run. "But I don't think robots are a fit for every farm. It really depends on their goals, and what they need," Steinberg said.

In fact, most historical data shows that milking robots are less profitable than conventional milking systems, according to researchers at the University of Minnesota and Iowa State University's extension and outreach office. But "advances in robotic technology, improved management skills, and higher labor costs may change these results," the research said. The Iowa State extension professionals found in 2017 that robotic milking systems still tended to be less profitable than other milking systems, but that profitability was highly dependent on variables like existing labor costs and rising wages, labor efficiency, and parlor efficiency. Typically, a single milking robot costs between \$150,000 to \$200,000 to install, and each robot milks 50-70 cows per day, compared to 150 cows an hour with a conventional milking parlor system. Lely's website says its robots can milk 60 cows per robot, with 180 milkings a day and an average 5,000 pounds of milk per day. DeLaval's website states its systems can milk up to 70 cows per robot, with 210 milkings a day and up to 7,500 pounds of milk a day with a robot launched in 2018. Robots invariably reduce labor costs and increase milk production per worker, but overall cost savings and increased revenue is more variable. Steinberg said DeLaval's milking robots can cost anywhere between \$150,000-\$220,000 to install, depending on the additional equipment needed for a particular installation.



Farm management records collected by the University of Minnesota showed that farms with robotic milking systems had higher milk production and gross margin, but costs were higher, resulting in lower net farm income in some cases.



Despite challenges, robotic milking systems are the future for many dairy farmers. Iowa State estimated at the end of 2017 that adoption of robotic milking systems would increase by as much as 25% per year worldwide. Continued pressure from lack of available labor and rising costs of labor is pushing NY farmers towards automation in their dairy barns. As labor costs continue to increase, so will the transition to robotic systems.

Specialty Crops

New York state farmers reported that manual labor was still critical to planting, managing, and harvesting their specialty crops. Relative to other crops, specialty crops in general are more dependent on agricultural labor for production, harvesting, and processing. However, investment in advancing automation and mechanization for specialty crops is key to the USDA's Agriculture Innovation Agenda and other federal initiatives as specialty crop farmers continue to grapple with labor shortages and high costs. University researchers across the country are rapidly developing automated solutions to improve crop management, including mapping orchards and making yield estimates, detecting disease, deterring pests, and assisting in harvest.

Despite technological advances, researchers agree that the technology is a long way from fully automating specialty crop farming, and in many cases, automation does not replace labor but allows for greater efficiency and reduced occupational injury. Further, NY farmers reported skepticism about adopting automated solutions for specialty crop management and harvesting. Most of the specialty crop farmers interviewed ran highly diversified farming operations, often growing no more than a few acres of individual crops and dozens of different fruits and vegetables. These farmers said they would have to invest in a variety of machines, even if they ever became commercially available, to harvest their diversity of crops, given the high levels of specialization required for automated crop management and harvest machines for specialty crops. For example, picking a strawberry requires a very different set of skills a robot or mechanical harvester would have to be designed for, as compared to an apple. Hand harvesting still dominates these operations in NY.

Even larger growers still rely mainly on hired labor for harvest, with more and more farmers turning to the H-2A program for harvest help.

Mechanization in harvesting has been around since the 1800s, starting with the combine harvester, pulled by animals. However, mechanical harvesters are blunt instruments, most designed to harvest entire plants, making them best suited for field crops like corn, wheat, and soybeans. Specialty crops, on the other hand, have unique horticultural and engineering barriers to mechanization, and there are often fruit and vegetable quality and safety concerns when it comes to automated harvesting. Most fruits and vegetables must be picked off a larger plant, like a tree or vine, rather than cut down entirely, like stalks of corn or wheat. Specialty crops are highly differentiated, meaning a custom harvester designed to harvest lettuce would not be suitable for harvesting strawberries. Given that so many farmers in NY grow a wide variety of specialty crops on a single farm, investing in mechanical harvesters, if they even exist for a given crop, is still much more expensive than hiring labor.

There are many specialty crops, such as berries, peaches, plums, and apples, that do not have an automated picking solution. Researchers are in the process of developing robots to automate harvesting different specialty crops, but some are more effective than others. The challenge with many specialty crops, like strawberries or apples, is that they tend to be fragile and are easily damaged. Shoppers at the grocery store are unlikely to pick up a bag of bruised apples or partially crushed strawberries, and mechanical harvesters or robotic pickers are not yet as good as humans at identifying and picking individual pieces of ripe fruit.

For example, attempts to develop a robotic strawberry harvester have not yet yielded good results. The strawberry harvester, developed by Harvest CROO Robotics, has yet to match the efficiency and speed of human farmworkers. Similarly, attempts to automate apple harvesting, of particular interest to farmers in NY given the state is the second largest apple producer in the country, have been fraught with challenges.

Meanwhile, NY apple growers are adopting harvest assistance tools like raised platform pickers to prevent workers from climbing up and down ladders, and investing in trellising systems to improve harvest efficiency and worker safety.

Mechanical harvesting of apples is common in Europe, but primarily to harvest cider apples, and apples for other processing purposes. The U.S. has lagged behind adopting mechanical apple harvesters, and a paucity of good solutions exists for picking apples for fresh-market sales.

Apple growers in NY, including large-scale apple growers, still pick fruit entirely by hand. When asked about mechanical harvesting, they expressed interest but concern about fruit bruising given current methods of mechanical harvesting involve shaking the tree, allowing the fruit to drop to the ground, and then sweeping up the fruit with another machine.

The current applications for mechanical harvesting of apples lie in harvesting apples for cider or juice processing, a more relevant application in NY as the hard cider industry continues to grow. In 2019, there were more than 100 cideries in operation in NY, including Angry Orchard, one of the largest hard cider producers in the U.S.



Mechanical harvesting, by contrast, is common in vineyards, but again primarily to pick grapes for processing, whether for juice concentrate or for making wine. In fact, the first mechanical harvesters for vineyards were developed in NY by researchers at Cornell University in the 1950s and '60s.

The USDA funds projects across the U.S. to develop automated harvesting solutions for specialty crops through its Specialty Crop Research Initiative (SCRI). Most of the current solutions are designed to supplement human labor, not entirely replace it.

Technology is still some distance away from a commercially available mechanical or robotic harvester for fresh-market apples. However, university researchers and industry players see robotics as the future, especially as part of crop management and harvest in fields, vineyards, and orchards.

Extreme Weather Volatility: “We’re on the Front Lines of Climate Change”

Nearly every farmer interviewed pointed to increasing weather volatility year-round as posing a threat to crop yields, citing heavier rainfalls and more prolonged periods of drought from year to year. (10)

Corey Mosher, 41, owner of [Mosher Farms](#) in central New York, farms 1,200 acres, growing everything from green beans and strawberries to barley. Mosher took over the farm in 2003, but his family has farmed in Bouckville, NY — a small town in Madison County located southeast of Syracuse — since 1918. He said his crop yields began to swing wildly from year to year due to what he termed “drastic” changes in the weather. “We’re on the front lines. I just want to know what normal is now. You can’t operate in this atmosphere. The swings are crazy. We’ve had huge drops in yield in the past few years due to too much rain. Huge fluctuations [in weather] disrupt the stability of what we’re trying to do,” he said.

Academics and policymakers have begun to look at the potential new farming opportunities in the Northeast as the region warms, including double-cropping and new crop options. However, NY farmers have not yet begun to identify new opportunities, largely citing their concerns about a changing climate posing threats to current crops and crop yields. David DeFisher, owner of DeFisher Fruit Farms, grows on average 150,000-160,000 bushels of fruit a year near Lake Ontario in western NY. He said the “most challenging thing has been spring coming too early. The fruit goes into bloom, and then we get a freeze and the blooms die. In 2019 we only had 55% of our crop survive.”

DeFisher acknowledged that his orchards are located about 5 miles off Lake Ontario, meaning he may be experiencing more severe weather volatility than those who are located right next to the water and are able to take advantage of the [weather stabilizing effects of the lake](#).

A [2017 study](#) on the agricultural impacts of climate change in the Northeast pointed to “an extended period of spring frost risk associated with warmer winter and early spring temperatures,” as one of the “greatest vulnerabilities” for northeastern agriculture in the coming decades. Spring frost risk is [especially worrying](#) for NY farmers given the size and importance of the apple and grape industries in the state, both of which are perennial fruit crops that are likely to be killed by spring frosts.

Too much rainfall during the growing season is also a problem, according to the NY farmers interviewed for this report. Growers have experienced direct reductions in yields as well as delayed spring planting. Additionally, use of heavy farm equipment on wet soils is detrimental to soil structure and quality and further limits crop yield. It also accelerates soil erosion. The [NY ClimAID assessment](#), published in 2011, included a chapter on effective climate change adaptation for agriculture. The chapter was written by academics at Cornell University and stated that “high rainfall events,” or two inches of rain in 48 hours or less, are projected to increase. The National Climate Assessment and Environmental Protection Agency (EPA) have also [issued analyses](#) supporting projections of increasing heavy precipitation in the Northeast and its possible negative effects on agricultural production. In fact, the EPA reports that between 1958 and 2012, the Northeast saw a [70% increase](#) in the amount of heavy rainfall, more than anywhere else in the U.S.

Farmers interviewed reported fewer concerns about drought and heat stress than they did about too much rain. But climate scientists have also pointed to drought and heat stress as possible threats to agriculture in NY, and the Northeast in general, in the coming decades. Farmers often cited water availability as a competitive advantage in NY, particularly in comparison to the severe water deficits already being faced by growers in California and the Pacific Northwest. But researchers warn that the level of precipitation in NY may be misleading, especially if more irrigation is needed to maintain agricultural productivity in the state. Very little agricultural land is irrigated in NY — just over 6%, whereas 65% of California's farmland is irrigated.

Prolonged periods of drought, in addition to more warm days and nights in NY, could lead to increased irrigation. The New York ClimAID report pointed out that few specialty crop growers in the state have adequate capacity to meet water requirements of all of their acreage during summer dry spells. Farmers may be required to invest in expensive new equipment and possibly in some regions put a strain on existing water supplies and watersheds. The state's report projects that short-term droughts, one to three months in duration, may occur as often as once a year in the Northeast by 2100 if global emissions continue at their current pace.



Although projections are not certain, experts say it's time for growers to identify new strategies as NY's climate warms. The high-value crops that are part of NY's agricultural production, such as apples and some vegetables including cabbages and potatoes, are likely to be most affected by a warming climate. Dairy production, NY's largest farming sector, could also be affected as heat stress causes declines in milk productivity and calving. This is an area of critical concern for NY given the size of the dairy industry and the production of value-added dairy, like yogurt, cottage cheese, and sour cream, which relies on raw dairy inputs from NY farms. This is not something that dairy farmers are reporting as an issue, but climate scientists warn that this will increasingly become an issue over time.

The Urgent Need for Irrigation

Max Morningstar, owner of MX Morningstar Farms in the northern Hudson Valley, has been farming 35 acres of specialty crops for six years. In 2020, he sold nearly half a million dollars in produce, in part thanks to skyrocketing retail sales as a result of the pandemic. His most urgent challenge, he said, was lack of irrigation. He told us his operation required more water at certain times of the year, making irrigation increasingly necessary. He cited a lack of access to loans to finance the irrigation infrastructure and a lack of technical knowledge to set up an irrigation system. "I need technical help to set up irrigation. I don't know how or where to dig for water. So, I need access to reasonable capital and technical advice on setting up irrigation infrastructure," he said.

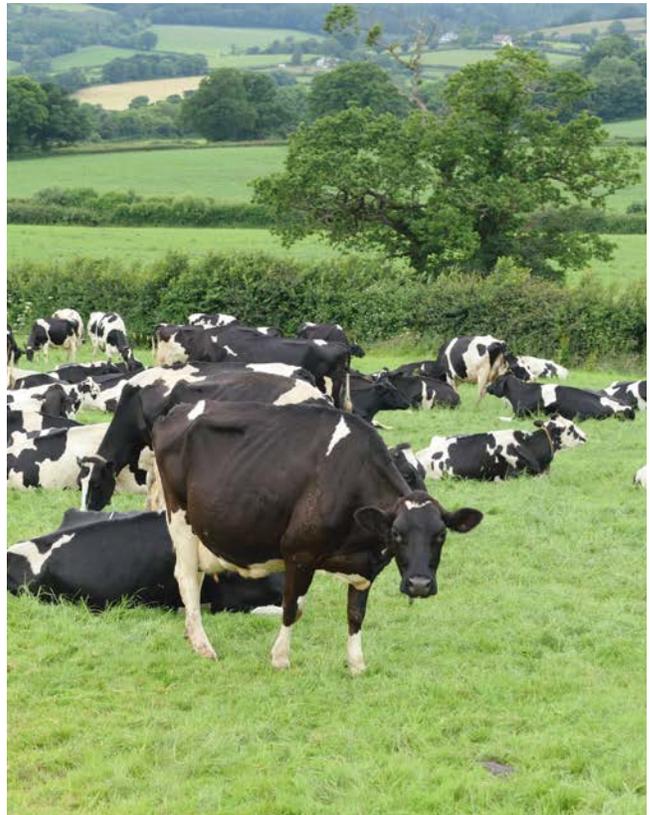
However, the key threat to the dairy industry in NY is any change to the availability and price of crops used for animal feed. As droughts potentially reduce yields for hay, corn, and other silage crops, price increases may inject new uncertainty into the reliability of livestock feed.

That said, longer growing seasons and warmer temperatures could provide an opportunity to grow new crops or increase productivity for certain existing crops. Academics have pointed to examples like European red wine grapes, peaches, tomatoes, and watermelon. However, apple growers near Lake Ontario told us they were skeptical about growing tree fruit typically grown further south due to market competition from states like Pennsylvania.

Jim Bittner, an apple grower operating 500 acres along the shores of Lake Ontario, said he grows fresh-market peaches, which he says are a profitable crop but that he wouldn't consider expanding his production due to competition from cheaper imports from Pennsylvania, southern states, and California. He still relies on apples as his primary crop, with more than half his orchard dedicated to fresh-market and processing apples.

Few of the farmers interviewed discussed climate mitigation strategies explicitly, and the most popular forms of climate mitigation appeared to be organic farming, cover cropping, and no-till farming to protect soil health and prevent soil erosion.

Livestock and dairy farmers in particular were reluctant to discuss greenhouse gas emissions. At least two livestock farmers said, in their view, methane emissions from cattle were eclipsed by emissions from the fossil fuel industry, and they felt unfairly targeted by policymakers and activists looking to adopt climate change mitigation techniques.



There are several existing methane mitigation techniques, including precision livestock feed management to reduce methane emissions from enteric fermentation (basically, methane produced from cow digestion), and better manure management such as “cover and flare” technology, which burns off methane from manure before it reaches the atmosphere. But methane mitigation best practices are not universally adopted amongst NY livestock and dairy farmers.

In 2017, NY's governor announced a [methane reduction plan](#) for the state that included grant funding to incentivize farmers to build more manure management storage systems that used cover and methane capture systems to help offset the costs of implementing the systems. There is also research using natural and synthetic feed additives to reduce enteric emissions, but further research is required to assure these are suitable for commercial use.

The Biden administration has made climate change mitigation a priority, and USDA department head, Tom Vilsack, recently announced a potential plan to make funds available from the USDA's Commodity Credit Corporation (CCC) to support on-farm climate change mitigation efforts, such as creating a carbon bank or incentivizing farmers to adopt sustainable agriculture practices. Several venture capital-backed startups — most notably Indigo Agriculture — and existing corporations have rolled out programs in the past few years designed to pay farmers to adopt sustainable agriculture practices and sequester carbon. Similarly, the Biden administration has backed carbon banking, as a key focus of its climate and agriculture policy, enabling farmers to sell credits for carbon sequestration in their soil.

Carbon farming — also called regenerative agriculture — has emerged as an industry darling to fight climate change. It also draws its share of critics. Emerging criticism from scientists, climate think tanks, and advocates is that soil carbon sequestration alone is unlikely to have the desired impact of reducing net greenhouse emissions. While farming practices such as cover cropping, conservation tillage (reducing plowing in preparation for new planting), and improving grazing land management are all important for improving agricultural sustainability and soil health, strategies like carbon banking have yet to establish standards around quantifiable long-term carbon sequestration on the farmers' part and large, private companies to "offset" their own emissions without changing their practices.

There is also ongoing scientific debate about the actual amount of additional carbon captured and stored in soil as a result of no-till practices and cover cropping.

Certainly, terrestrial carbon removal and sequestration is part of a suite of mitigation practices that should be adopted, but expectations should be tempered around its ability to substantially reduce greenhouse gas emissions from farming in the absence of other measures.

The National Academies of Sciences, Engineering, and Medicine said in a 2019 report that, in addition to carbon uptake and storage by agricultural soils, other key approaches for large-scale implementation should include reforestation and planting new trees on agricultural lands, and changes in forest management practices. The report also said a key barrier to improving carbon uptake and storage in agricultural soils was the inability on the part of most farmers worldwide to fully implement soil conservation practices.

Agroforestry practices have also gained popularity as a way to improve sustainability on farms — by strategically adding some trees back into fields and pasturelands or by managing woodlands to provide grazing for releasing cattle and other livestock — through a practice called silvopasturing. Although not common, the practice has been demonstrated to be effective in NY, and Cornell Cooperative Extension professionals, including Brett Chedzoy and Peter Smallidge, said there is potential for farmers to raise livestock without increasing pastureland.



There are 2-4 million acres of pasture and farm woodland suitable for silvopasturing according to Chedzoy and Smallidge. Most of the farmers interviewed owned substantial tracts of forest they tended to overlook. Smallidge and Chedzoy said there is a dearth of technical and financial resources for farmers to adopt agroforestry practices, including silvopasturing. Adding trees to farmland can sequester large amounts of carbon for a long time and is much easier to measure and verify compared to soil carbon.

In short, regenerative agriculture has the potential to reduce greenhouse gas emissions and sequester more carbon, but it must go beyond familiar agricultural practices like cover cropping and no-till farming to employ the full suite of mitigation techniques addressing carbon dioxide, methane, and nitrous oxide, be properly incentivized, and subject to rigorous standards.



Disease, Pest, and Weed Pressure: Looking for a “Silver Bullet”

Most of the farmers interviewed take disease, pest, and weed control in stride as part of the job, just like the weather. However, many of them pointed to warming winters as playing a role in increasing pest and weed pressure during the growing season.

The farmers interviewed cited a variety of pests and diseases that were persistent challenges on their farms — particularly spotted lanternflies, corn earworms, downy mildew, powdery mildew, [fire blight](#), and late blight. Specialty crop farmers growing mostly vegetables pointed to late blight as a particular threat to potatoes and tomatoes. Apple growers said fire blight was the most serious disease affecting their orchards. Vineyard managers said downy and powdery mildew were consistent threats to their grapevines.

Few farmers said they had noticed an increase in disease, pest, or weed pressure over time, saying that diseases, pests, and weeds have always been a top challenge to manage, regardless of whether they had been farming for five or 50 years. “Every farmer is always dying for the silver bullet to cure all of our pest and disease problems,” said Mark Doyle of Fishkill Farms in the Hudson Valley (Dutchess County). Farmers growing their crops organically expressed frustrations at the lack of tools to deal with pest and disease, and to control weeds. Some conventional farmers employ [Integrated Pest Management](#) (IPM), a strategy promoted by Cornell University, to control pests in a more sustainable way, but it raised issues like cost and availability of pesticides in NY.



Most farmers interviewed were interested in reducing their pesticide use, whether from a desire to minimize environmental impacts or to save on costs of expensive chemicals. This may become more difficult as the climate in NY continues to warm in the coming decades. A farmer in the North Country, Daniel Martin, growing fruits and vegetables, said that although his growing season is short, the cooler climate suppresses disease and pests, meaning he can spray less and grow organically. “We look at the South enviously sometimes [for their growing season], but honestly most plants are better off at cooler temperatures. It slows [growth] down, but heat makes them get sick with disease.”

Climate scientists warn that farmers will have to increase pesticide use unless other control methods are developed. Pesticide use in NY is still much lower than in states like Maryland, Delaware, and Florida, where more generations of insects can cycle through the longer growing season, and a combination of humidity and heat encourages disease. Some farmers are concerned about increasing public policy pressure to reduce or eliminate the use of older chemicals like chlorpyrifos and other insecticides, citing lack of access to effective chemicals and other solutions to protect their crops. NY farmers would benefit from continued innovation in the biopesticides market, as well as novel crop protection techniques to control pests and disease in their fields.

Distribution Challenges: Finding and Accessing Markets, Pre- and Post-COVID-19

Farmers across New York state were asked about where and how they sell their wares, and how COVID-19 has affected them. Challenges differed from farmer to farmer, depending upon whether the farmer sold mostly to wholesale buyers or food manufacturers, or direct to consumer. Farmers selling only commodity products such as cash grains (e.g., corn, soy, or wheat) or dairy were generally not worried about selling their products, given the nature of commodity markets, but worried more about price volatility. Larger, more established farms selling specialty crops to grocery store chains and other wholesale buyers were also less concerned about finding customers but were worried about retention and, similar to commodity farmers, were worried about downward pressure on prices. However, small to midsize farms growing specialty crops and, in a few cases, dairy products, were heavily concerned about finding and retaining customers. Small to midsize farms were more likely to say they struggled to obtain accounts with local or regional grocery stores and other food retailers, and that selling direct to consumer through a farm stand or consumer supported agriculture (CSA) was more profitable but also required significantly more resources to reach and retain individual customers.

When asked about specific challenges around distributing to wholesale and institutional buyers, farmers pointed to “declining loyalty” on the part of buyers. Maureen Torrey, co-owner of Torrey Farms in western NY, blamed a combination of growing global competition and increasing reliance on automated purchasing. “Our buyers don’t even talk to us anymore,” she said. “We just get purchase orders over the computer. They don’t know what’s going on with the weather or the crops.”



Part of Torrey's frustration is what she perceives as buyers — like grocery store chains — having the choice to buy imported produce from California or South America, places she says operate with fewer constraints than farmers in NY.

Luhrman's concerns were echoed by Daniel Martin, a farmer in St. Lawrence County growing produce. "It's an uneven playing field," he said. "If you're selling to grocery stores, you're competing with imports that are priced so low that we can't pay fair wages to our workers or meet environmental regulations. Once a buyer becomes a chain, grocery stores or restaurants, the local farmer has no chance. The grocery stores might advertise that they sell local. But unless you have semi-trailers full of produce, they won't deal with you. You have to be able to supply all of their needs, no matter what, at an unsustainable price."

Some small to midsize farmers said transportation costs for their goods were high, and managing multiple, small-scale wholesale orders to local grocery stores and restaurants could be challenging. However, larger farmers did not report those same challenges. Several of the larger farms that were contacted had full-time drivers on staff and did not rely on contracted transportation for delivery.

In NY, there are two key trends that are driving new challenges and opportunities for local farmers: a rise in demand for local food and increases in farmers selling direct to consumer. The onset of the pandemic in March 2020 dealt a serious blow to local farmers supplying farm-to-table restaurants, farm-to-school programs, and other key institutions that were forced to shut down.

New York City, with its more than 23,000 restaurants, was a key market for many of NY state's farmers, particularly those located in the Hudson Valley. The state's Office of the Comptroller estimates that that up to 50% of restaurants in New York City may close permanently in 2021. However, most farmers we spoke to had managed to successfully shift their accounts to supply grocery stores and to sell direct to consumer. In most cases, farmers said switching to different sales channels was painful at first, but they had successfully made the transition and expected sales to remain strong. The boom in direct-to-consumer sales appears to have helped buoy business for many farmers whose restaurant accounts were cancelled as state-ordered closures put a stop to indoor dining.

CSAs Require Relationships

Raymond Luhrman of Fox Creek Farm is a first-generation farmer growing vegetables on 12 acres of land in Schoharie, near Albany, NY. He sells his produce exclusively through CSA shares. By November 2020, his CSA had grown to 560 customers, a 40% increase over the last year. Luhrman said he believes in the CSA model for smaller farms and says the model makes his business comfortably profitable. However, he said it is challenging to meet customer expectations and deal with customer relations. "Customers don't just want produce; they want a relationship with the farmer. You have to figure out what your story is and how you will relate to your customer. Commodity farmers don't have to worry about that. For us, it's a different story. Marketing is difficult, but it's critical for my operation. It's understanding what people want out of their CSA, and their produce," he said.

Luhrman has been farming for 12 years and started out with just 10 CSA shares. He quickly realized the importance of building a strong brand, and online marketing and sales. When the pandemic struck, he quickly pivoted to doing home deliveries in addition to pickups for his CSA customers. Luhrman built a website and online marketplace where customers could order and pay for CSA shares directly on his website. A full CSA share at Fox Creek Farm includes 22 weeks of produce for \$563.20 (\$25 a week), and home delivery is an additional charge. He says his prices are competitive with high-end grocery stores and his produce is of much higher quality, enabling him to charge a premium.

Luhrman says he has managed to build a sustainable business model for his farm but remains concerned about what he termed "cheap food politics" hollowing out rural communities because small farms are unable to compete with commodity pricing and wholesale marketing by large, consolidated farms. A 2016 study found that small-scale farmers selling locally tended to buy locally themselves and hire more local labor, contributing on average more to the local economy than farms that did not sell direct to consumer.



The “Big City Advantage”

Some farmers and food manufacturers pointed to New York’s proximity to major East Coast markets as a key competitive advantage for agricultural production in the state. Indeed, the Northeast region in general is the most densely populated region in the U.S., and New York City, the most densely populated city. New York City is also one of the most restaurant- and bar-dense cities in the country, in an area of the country where the local food movement has taken off, providing ample opportunity for regional farmers to supply the city’s restaurants.

That being said, it was mostly farmers located downstate in the Hudson Valley and to some extent the southern capital region (near Albany) who reported selling their agricultural products to institutional buyers like restaurants, coffee shops, wholesale markets, and grocery stores in New York City. Upstate farmers cited challenges in finding buyers in a saturated urban market, and even when they did find buyers, noted difficulties in transporting their wares to New York City. While some farmers in upstate NY running larger operations (sales greater than \$1 million annually) said they sold to a variety of wholesalers and grocery store chains across the Northeast, smaller farmers said they generally sold their products more locally and were more likely to sell direct to consumer.

State and Regional Branding Is Important

Some farmers raised labelling and marketing of their produce as “local” and “New York-grown” as a critical issue. The importance of marketing as a NY brand was the sixth most-often-cited issue by farmers who were interviewed. Produce farmers often raised branding as an issue in grocery stores and said grocery stores, especially large regional and national chains, did not do enough to source locally or had excessively expansive definitions of “local.” A [2010 survey](#) of food retailers known to source and market local foods in Oregon found that these retailers’ perceptions of what qualified as “local” was highly variable and sometimes differed from consumers’ and agricultural producers’ ideas of what was considered local. The study found that major food retailers in Oregon defined “local” using geographic regions (the Pacific Northwest in some cases), distances (up to 200 miles), and personal connections. Most retailers in Oregon also labelled products as “local” if they had been processed in the state but not necessarily grown in state. There is no such similar survey of NY food retailers, but Wegmans website says that it [partners with 400 family-run farms](#) along the East Coast to supply its 100 stores in seven states. A [public presentation](#) from Wegmans in 2018 states that the grocery store chain “has a long history of supporting our local, ‘near our stores’ growers.”



In NY, demand for local food has led to the development of the "[New York State Grown & Certified](#)" label that farmers are eligible to apply for to help streamline food quality, safety, and marketing. Besides advertising privileges, members of the label also have access to funding opportunities that promote farm sales, marketing presence, and sustainable farming methods. The label verifies that produce was grown in NY and has met established food handling and environmental standards. According to a [survey conducted](#) by the label, NY residents indicated that 74% would buy more "New York State Grown & Certified" products, and 49% would pay more for it.

Farm-to-Institution Sourcing Presents Opportunities for New York Farmers

Institutional food purchases can have a big impact on local food systems, according to the Union of Concerned Scientists. In 2016, the American Farmland Trust launched the initiative [Farm to Institution New York State](#) (FINYS). The initiative's goal is to grow local food purchasing by NY institutions to at least 25% of their annual budgets. In addition, the establishment of NY's new [farm-to-school](#) purchasing incentive program in 2018 has led to significant increases in institutional buying of local foods from within NY. According to a [2020 report](#) by the American Farmland Trust analyzing NY's farm-to-school program, purchasing of NY-grown food is up across the board. The report's authors found that 72% of schools in the state expect to spend at least 30% of their food budgets on NY-grown food for school lunches, and that \$150 million would be spent by schools at NY farms, generating \$210 million in economic impact statewide by 2024.



While the early results of the program are encouraging, the report also found that schools and other institutions still must navigate barriers like procurement regulations that push them to favor "least cost options." The report says, "When asked what would help food service directors increase their purchasing of NY-grown food, food service directors reported that getting their main vendor, which is often a distributor, to provide more NY food products would be most helpful in getting them to increase the amount of NY food products they purchase." Initiatives like FINYS are providing much-needed educational resources and connections for farmers, distributors, and purchasing institutions, and if the success of the NY farm-to-school program is any indication, there are significant growth opportunities in institutional purchasing of local food by colleges, hospitals, long-term care facilities, private companies providing meals to employees on-premises, and even supermarkets. The institutional food market in NY represents a nearly \$1 billion opportunity, meaning that at least \$250 million would go directly back into the NY agricultural ecosystem.

Spotlight on Craft Beverage

The craft beverage industry ranked the importance of NY branding and marketing for their agricultural goods much higher than farmers and manufacturers in other sectors. Over the past decade, the number of breweries and cideries operating in the state has exploded, especially breweries. In 2012, the New York State Liquor Authority reported there were 97 licensed breweries in the state. As of August 2020, that number was 459 breweries, a 373% increase in just under a decade. Cideries also number over 100 as of 2020, representing significant growth since 2012. The wine industry has a longer history in the state and has also grown significantly, from 324 wineries in 2012 to 456 in 2020.

The wine industry represents the largest contribution to the state's economy of the craft beverage industries — directly contributing \$6.6 billion in economic impact and nearly 72,000 jobs in 2019. The craft brewing industry contributed \$5.4 billion and nearly 20,000 jobs in 2018. "New York State" or similar regional branding was important to the wine, craft beer, cider, and distilling industries alike in NY, but for different reasons. The wine industry was the most vocal about expanding their markets beyond residents of NY and distributing to markets out of state. That being said, most wineries in NY are small, family-run affairs that are reliant on tasting room sales for their business models. They were interested in attracting not only local and regional residents to their tasting rooms but also out-of-state residents. The craft beer industry was less interested in distribution and more reliant on locals for business in their taprooms rather than tourism dollars. The industries' respective economic impact reports validate that divide. The wine industry brought in \$1.8 billion in tourism revenue in 2019, while craft breweries brought in \$317 million statewide in tourism dollars.

Craft Beer

NY branding was important to wineries looking to distribute more widely, but for wineries and craft breweries reliant on tasting room and taproom sales, NY branding was interchangeable in value with "local." Paul Leone, the director of the New York Brewers' Association, said that making craft beer with all NY-grown ingredients, including hops and barley, is a selling point for in-state breweries but that sourcing 100% of the necessary ingredients entirely from within the state was still a challenge.

Ben Brotman and Jamey Tielens, co-owners of Liquid State Brewing Company in Ithaca, NY, said a significant issue for them was sourcing specific hop varieties from within NY. They said NY-labelled beers sell well, and there is strong customer demand for them, but sourcing hops for popular styles like bold, juicy India pale ales was challenging because those hops were often only grown in the Pacific Northwest. Strong Rope Brewery, now located in both New York City and the Adirondack State Park, established itself as a brewery using 100% NY ingredients. The brewery states that it is a "New York state farm brewery" on the homepage of its website. (A "farm" license in NY can apply to a winery, brewery, or cidery and means that the establishment relies on NY-sourced ingredients for the majority of its products.)



Wine

One major roadblock to expanding NY's wine footprint is continued dependence on tasting room traffic as the bulwark of NY wineries' business models. Most wineries sell direct to consumer out of their tasting rooms. The pandemic has encouraged wineries to take another look at their e-commerce platforms to increase online sales and shipping.

One key barrier to increasing customer awareness and sales for NY wineries is the distribution bottleneck, says New York Grape and Wine Foundation executive director Sam Filler. Distributors only carry a few NY wines in their portfolios, he told us. For example, Filler estimates the Opici Wine Group, the third-largest distributor in NY, carries about 20 NY wines. There are 470 licensed wineries in NY.

Distributor representatives told us that getting restaurants and wine shops in New York City to carry NY wines was challenging. Kevin Faehndrich, director of sales at Robert Mazza Inc., in western NY, said that distributors like Opici Wine Group are very supportive of upstate NY wines, but only a handful of upstate NY wine producers manage to make it into their portfolio. He attributed limited capacity for NY wines on the part of distributors to retailers only allocating small amounts of shelf space for NY wines in their stores.



Most wine and retail shops organize wine by location. They are not typically organized by grape varietal. We're seeing more New York wine sections in shops, but they are only going to be a certain size of the shop's overall footprint," he said. "There's a number of small, boutique wine distributors as well, but it's still going to be a fight to get the time with retailers to build those relationships and place wines in their NY section. And from the retailers' perspective, how many of these distributor reps do you really want to be working with? Even those with the best of intentions can only carry so many NY wines on their shelves and by the glass in their wine bars. There's only so many places to put this product. That's why we need to expand our markets beyond NY."

Faehndrich also pointed to the limited capacity on the part of individual wineries in NY (most are small) to market and run their own e-commerce platforms. "If someone approached me saying they had an e-commerce wine shop and wanted to include our wines, I'd say yes," Faehndrich said.





Fred Frank, owner of Dr. Konstantin Frank Winery in Hammondsport, NY, also said the major challenge for NY wineries was out-of-state recognition. The Dr. Konstantin Frank Winery is one of the oldest and most-recognized wineries on the East Coast, let alone in upstate NY. The winery, established in 1962, currently produces up to 50,000 cases of wine a year and distributes to 35 states. Despite the winery's widespread distribution and numerous awards for winemaking, Frank said the winery's largest sales channel remains upstate NY. "The easiest market is the upstate NY market," he said. "For the majority of NY state wineries, upstate NY is their only market. We felt early on it was important to broaden our distribution to go beyond NY state, but that involves quite a bit of investment — travelling, doing tastings, and so on. The other issue is we need to promote better customer awareness of northern European varietals — riesling, gewürztraminer, pinot noir, blaufrankisch, and cabernet franc."

Cider

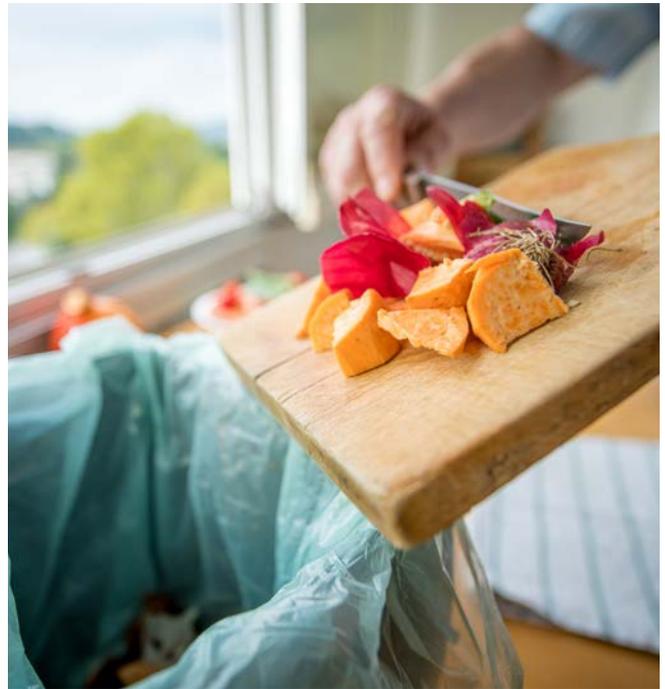
Although newer and smaller than the wine and craft beer industries, cideries are becoming tourist attractions for NY, and interest in specialty hard cider is growing. Given NY's leadership in apple production, top cider-makers like Ryan Burke of Angry Orchard see an opportunity for NY to become a leading producer of high-tannin apple varieties specific to high-end cider making. Much like the wine industry, the high-end cider industry benefits from NY's unique climate and has developed an international reputation for specialty cider.



Transportation, Storage, and Food Waste

Few New York state farmers cited product transportation, storage, or food waste as serious issues, either from an accessing markets standpoint or from a food quality and safety perspective. Most said they had sufficient cold storage and had very little food waste from harvest or transport. However, several Cornell Cooperative Extension (CCE) specialists, as well as farmers in the North Country, said they were concerned about lack of interstate connectivity as well as a shortage of truck drivers. Marie Ulrich, a CCE specialist in Orange County, said that despite the abundance of interstates crisscrossing the county, a shortage of truck drivers was creating a pain point for local farmers. In the North Country, Kelsey O'Shea, a CCE specialist who also works on a large dairy farm, said trucking costs and lack of interstates in her region of the state often made transporting raw milk expensive and challenging.

Concerning food waste, existing research contradicts farmers' responses. The National Resources Defense Council (NRDC) [released a study](#) that cites scientific literature showing significant food waste from farm to consumers' kitchen tables. In fact, the updated 2017 report says 16% of fresh produce is lost at the farm level from food that is never harvested and produce that is "lost between harvest and sale." One farmer acknowledged challenges in harvesting produce efficiently to avoid waste and said mechanical harvesters in particular created more waste in the field. At the distribution and retail stage, 13% of produce is wasted, often from "rejected shipments," an issue several NY farmers raised when asked about sales and distribution.



They said grocery stores and food retailers are often very selective about the standard of produce, and any imperfection can be grounds for rejection. Growers supplying green beans for canning said that sometimes food manufacturing companies would skip over entire fields that would then remain unharvested.

The biggest losses appear to happen [in the household](#). Families in the U.S. throw out 43% percent of the food they buy. In fact, the USDA estimates that wasted food is the largest source of trash filling up our landfills and producing climate-damaging methane gas. Finally, particularly relevant for NY, the largest food categories that go to waste are dairy and produce (fruits and vegetables), 19% and 33%, respectively. A main reason for household food waste in the U.S. appears to be confusion over date labelling, but poor packaging and at-home storage practices are also drivers of food spoilage in the home.

Please see the NRDC's full report for a comprehensive overview of food waste in the U.S.

Healthy Alternatives: Changing Consumer Preferences

A major point of concern for dairy farmers and maple syrup producers interviewed was a drop in consumer demand for their products in favor of plant-based alternatives to dairy and an overall desire to reduce sugar consumption. A maple syrup producer described public health guidance around reducing sugar intake as a “war on sugar,” frustrating their ability to increase sales as part of a balanced diet. Livestock farmers, on the other hand, worried about plant-based alternatives to meat and emerging science enabling production of meat substitutes in labs.

Dairy farmers in particular felt attacked by consumer movements to limit meat and dairy consumption on the grounds of animal welfare, sustainability, and health. Dairy farmers and cooperatives interviewed raised concerns about what they felt was lack of consumer understanding about animal management practices on dairy farms and the nutritional benefits of milk.

NY is home mostly to small-scale livestock production, and the farmers who were interviewed produced mostly pasture-raised livestock to sell through local markets or direct to consumer. They viewed their operations as sustainable and fulfilling a consumer preference for local, sustainably and ethically raised beef, pork, and chicken.

Livestock farmers reported a significant increase in demand as a result of the pandemic as operations at major meatpacking plants in the Midwest were shut down, causing supply chain disruptions and grocery store shortages. Farmers said the pandemic caused people to panic, and they turned to local livestock farmers to supply their meat, even though meat raised on a smaller scale is generally more expensive than meat supplied in the grocery store.

Cellular Agriculture: Competition on the Horizon

Farmers in New York state expressed concern about shifting public opinion around animal agriculture — particularly the negative environmental impacts of livestock farming especially at scale — and new medical research linking the consumption of red meat to disease, including cardiovascular disease, cancer, and diabetes. It is unlikely that animal agriculture will be entirely supplanted by emerging biotechnologies allowing for lab-grown protein. But similar to the popularity of plant-based milks becoming a threat to dairy production, it seems likely that the rise of cellular agriculture — methods of producing animal protein in a lab — will become a competitor to mass-produced meat but will not entirely replace livestock farming, especially local, small-scale, and sustainably raised meat.

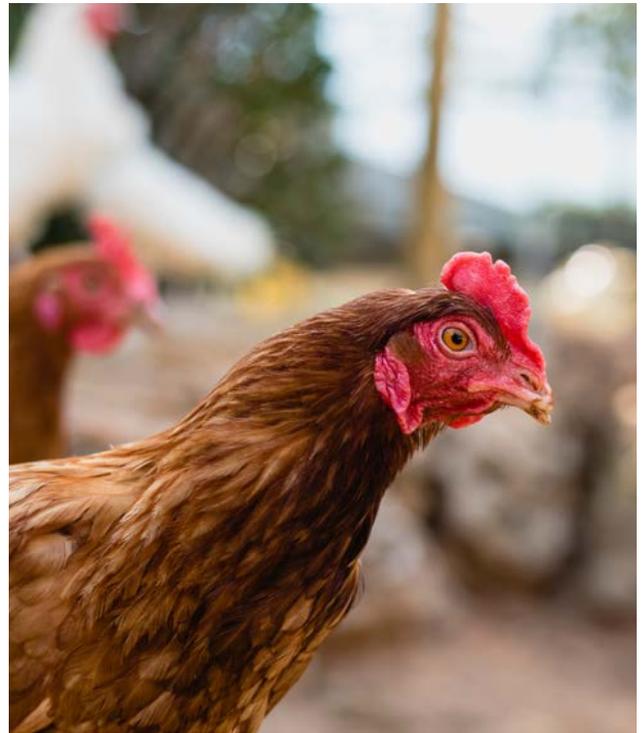
There are currently three types of “meat substitutes” or “artificial meat”: meat alternatives derived from plants and fungi, meat from genetically modified animals, and cell-based meat. Companies developing meat alternatives from plants and fungi are the most advanced, demonstrated by the success of the Impossible Burger and Beyond Meat. Lab-grown meat is still some distance away from becoming commercially viable, but it holds the potential to be a significant disrupter to the current livestock farming and meatpacking industry.

Getting Meat to Market: A Lack of Local Processing

While some cash grain and specialty crop farmers who were interviewed did supply inputs to regional processors, the role that processing plays in their operations — other than as a sales channel — was generally minimal. That is not so for livestock farmers in New York state. Cattle and calves are a significant part of the agricultural landscape in NY, and a growing demand for local meat is fueling interest in local farmers and butchers. In 2017, cattle and calves sold for meat were the third highest grossing agricultural product in the state, after milk sales and cash grains, at \$426 million. Poultry and hog sales similarly ranked 29th and 30th in the nation at \$195 million and nearly \$25 million, respectively. Although NY is not a major source of red meat and poultry for the national food supply, local and regional livestock farmers and meat processing facilities play an important role in meeting the demand for locally raised meat, as well as grass-fed, organic, or otherwise sustainably raised meat.

Agricultural consolidation has not spared slaughterhouse and meat production facilities. The U.S. meatpacking industry consolidated drastically between 1980 and 2000. Cassandra Fish, a beef analyst, told The New York Times in April 2020 that in the cattle industry, as much as 98% of slaughtering and processing in the U.S. happened in just 50 plants, and those plants were highly concentrated in the Midwest.

The meatpacking industry in NY (and the Northeast) is much smaller than in the West and Midwest. NY is mostly dealing with small to midsize livestock farming operations and small to midsize scale processing facilities.



The largest slaughterhouses and meatpacking plants in the Midwest employ more than 1,000 on average, while the average employment per plant in NY is 11 employees. As of 2018, there were 62 USDA red meat processing plants in NY and New England. According to the USDA Food Safety Inspection Service database, there are currently 34 USDA-inspected slaughterhouses handling cattle, 29 processing pork, 26 processing lamb, and 18 slaughtering goats and sheep. It is unclear from the database how many individual establishments exist in NY as the database reports facilities by processing capability, and most slaughterhouses and processing facilities handle beef, pork, and lamb. There are also 13 establishments processing poultry in NY, but all are private, meaning they operate only on chicken farms raising and slaughtering their own birds. All are located in the New York City area. There is just one poultry slaughterhouse and processing facility located in upstate NY — Morning Star Poultry located west of Albany.



Livestock farmers in NY consistently pointed to a lack of processing capacity as their top constraint to business growth, along with labor availability and costs. Meatpackers (processing facilities) as well as experts studying the meatpacking industry in NY and the Northeast were interviewed to better understand the challenges. The primary challenges facing meat processing facilities are heavily related to those experienced by livestock farmers.

Farmers who were interviewed said they had to schedule their processing slots too far in advance, that there were not enough USDA-inspected slaughterhouses, that processing was too expensive, and that mobile or custom-exempt slaughtering and processing quality was too variable. (11) Processors said the seasonality of livestock production meant they were over capacity just a few months of the year (generally the fall) and under capacity the rest of the year. Available data suggests that the seasonal crunch is real and severe. So, why haven't new processing facilities opened or existing ones increased capacity?

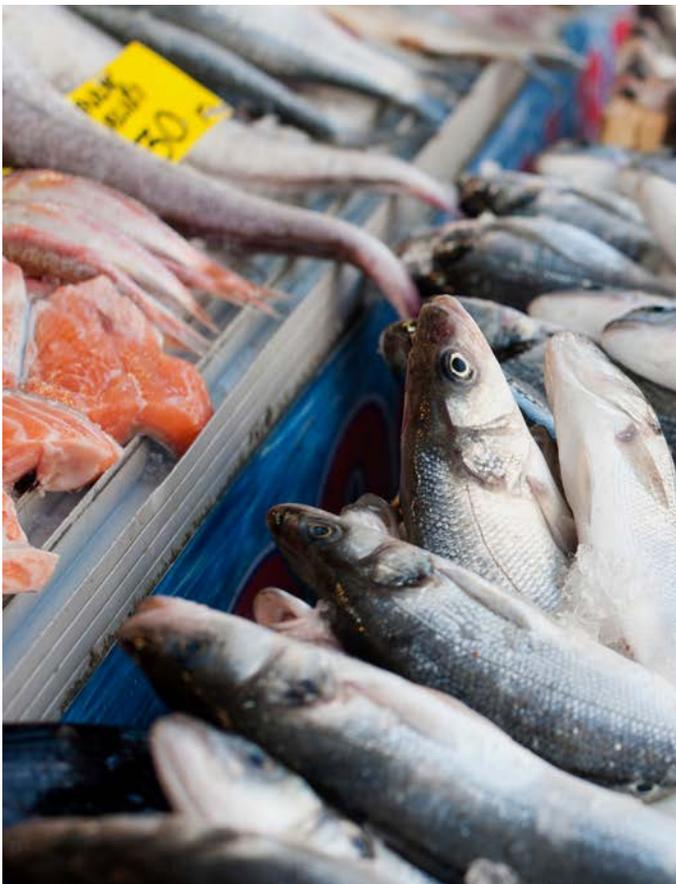
It's costly, says Matt LeRoux, agriculture marketing consultant and extension associate at Cornell University's Charles H. Dyson School of Applied Economics and Management. He is also on the advisory board of the Niche Meat Processor Assistance Network (NMPAN). Most of the time, farmers interested in setting up their own harvest and processing operations need to build a plant, ensure adequate water supply, and set up systems to deal with waste from the plant safely.

The NMPAN estimates the total capital investment for a new facility in a rural area with capacity to harvest and process 25-32 beef cattle per week to be \$2.4 million. The solution, he thinks, is to invest in existing processors by adding more cooler and freezer space, in particular, to accommodate periods of high demand. He also pointed to the need for more workforce training given the shortage of skilled labor to work in slaughterhouses and processing facilities.

A recent survey of USDA-inspected slaughterhouses in NY and New England supported farmers' claims that processing facilities are overbooked in the fall and then often turn away business during busy months mostly due to lack of cooler space and labor constraints. The report recommends that funding to increase cooler capacity, invest in workforce training, and supply value-added processing options (like smoking) would grow NY's capacity.

The report also appears to validate claims that slaughtering and processing animals can be expensive, although most farmers selling locally and direct to consumer can charge a premium per pound for their product. The survey found the price to slaughter beef cattle ranged from \$30-\$130 per animal, with an average of \$77 per animal. Beef processing ranged from \$0.35 per pound to \$1.15 per pound, with an average of \$0.76 per pound. If a 1,200-pound cow yields an average carcass weight of 756 pounds, then the slaughter and processing costs would total about \$650 per animal.

Finally, while farmers and processors alike stressed the importance of food safety and food safety regulations, processors struggled at times with the heavy documentation requirements for preparing and following their written Hazard Analysis Critical Control Point (HACCP) program, and its prerequisite programs including the Sanitation Standard Operating Procedures (SSOP) and Good Manufacturing Practices (GMP). Farmers identified federal inspection standards as a constraint to processing capacity and said limited capacity in USDA-inspected facilities restricted their ability to process animals for retail and wholesale. Some farmers turned to custom-exempt butchering but said that method was of limited use given the variability in custom-exempt butchering quality and the need to sell whole, half, or quarters directly to customers who would then pay for processing themselves.



Getting Seafood to Market

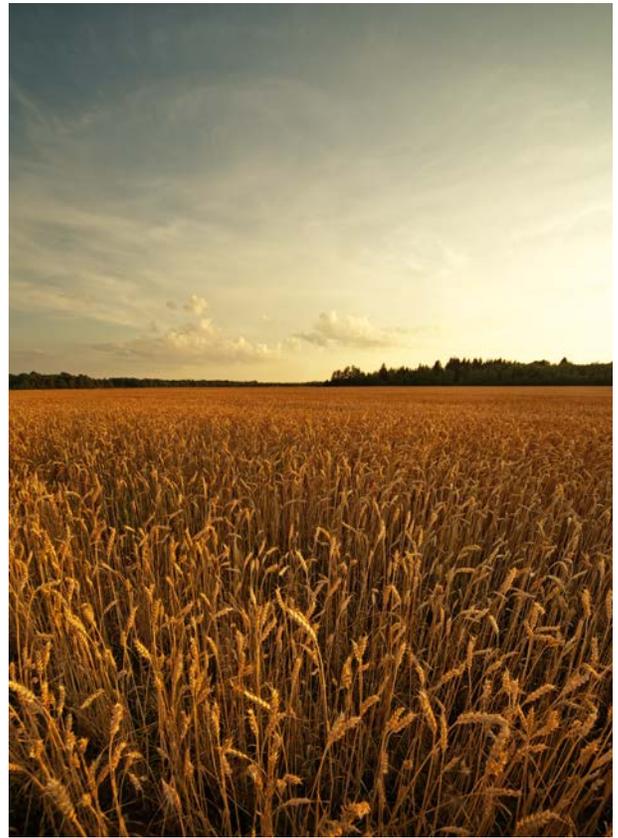
The small but mighty seafood industry in New York state is facing similar challenges to the state's beef, pork, and lamb producers. NY's fishing and aquaculture industry is not large; the biggest port in the state, Montauk on Long Island, brought in 11.5 million pounds of seafood in 2019, according to the National Oceanic and Atmospheric Administration (NOAA). The top 15 ports in the U.S. each brought in over 100 million pounds in 2019. However, as in many other smaller ports, Long Island's catch sells for a higher price point, on average, than some larger producers. (12) Despite their comparatively smaller size, Long Island ports play an important role in supplying a growing demand for locally caught and raised seafood in New York City restaurants. Aquaculture is also a significant and growing industry in NY, with oyster farming leading the way on Long Island. When the pandemic shut down the city's restaurants, the local fishing industry scrambled to redirect supply and identify new markets including direct-to-consumer sales. Like meat processing, seafood processing is heavily regulated and requires strict compliance with food safety regulations to turn raw products like whole fish and shellfish into filets and customer-ready products. According to Michael Ciaramella, an extension specialist in seafood safety with New York Sea Grant and Cornell Cooperative Extension at Stony Brook University, the ability to quickly adapt and switch to alternative marketing strategies is challenging and costly for Long Island's seafood producers.

Some Farmers Struggle to Grow, Others to Get Started

Farmers said main barriers to starting or growing a farm are access to land, capital, and the right advice. However, these issues manifested themselves in very different ways and in some cases weren't an issue at all, depending on the farm size and structure.

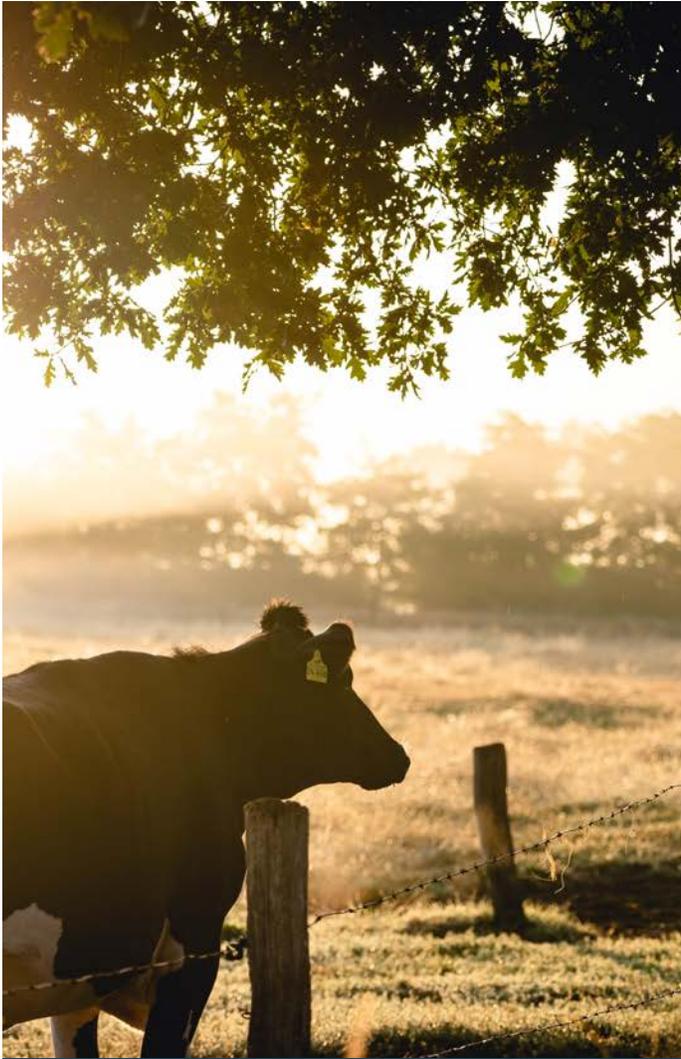
Land and Capital

For new farmers — those with less than 10 years of farming experience — access to land and capital were significant barriers to their operations and to potential growth. For larger, more established farms, access to land was reported as an issue less often, although some farmers pointed out that land is plentiful but land well-suited for growing certain types of specialty crops could sometimes be hard to come by. For example, farmers with large onion operations in central New York were more likely to report access to land as an issue due to the fact that they need to grow onions on “muckland” — organically rich former swampland suited to onion growing. Onion farming is highly concentrated in central and western NY. A large onion producer (who requested their names be withheld) near Syracuse, NY, said there are about 2,100 acres of muckland in their immediate area but most of it is controlled by family farms already in operation, and most of them are larger farms. They said that while access to muckland to grow onions was not an issue for their operation, it would be very challenging for a new farmer starting out to get access to the land they would need. By and large, all farmers interviewed who took over the family farming business had ready access to land, since their families had been farming on the same parcels for decades.



They also had an easier time expanding their operations and buying new land, as they had the assets to leverage for capital and tended to have better networks to identify and buy land in their area.

Farmers located in the Hudson Valley also ranked access to land as a more significant issue more often than farmers in other parts of the state. Given the region's proximity to New York City and its role as a vacation spot for many city residents, there is much more competition for land use, and farmers must compete with developers and non-farmers looking for second homes. This dynamic is a double-edged sword. The closer farmland is to New York City, the more expensive it is to own or rent, but at the same time NY farmers say that close proximity to New York City is key to accessing its markets.



”

It's difficult when you don't have equity to leverage. It's not hard to convince someone to loan you \$50,000 for a tractor, but saying you want \$150,000 to put in an irrigation system gets you some raised eyebrows.

MAX MORNINGSTAR, OWNER OF MX MORNINGSTAR FARMS IN COLUMBIA COUNTY

That being said, access to land is an issue largely affecting new and beginning farmers in NY, as is the case nationwide. Surveys conducted by the National Young Farmers Coalition suggest that “finding affordable farmland” is NY young farmers’ “toughest obstacle.” The barriers to entry faced by new and beginning farmers is especially urgent given that roughly 2 million of New York’s 7 million acres of agricultural land are managed by owner-operators aged 65 or older. The same report found that 92% of those farmers do not have a “young” (under the age of 45) farm operator working with them and no clear succession plan. This is especially troubling as the number of young farm operators have been declining for at least two decades in NY.

Access to capital also ranked as a top concern for new and beginning farmers. Smaller but more established farmers said they also struggle to access capital for infrastructure improvements to invest in new technology and equipment, like mechanical harvesters and robotic milking, and to buy more land or expand operations.

Most expressed an aversion to taking on debt. Their reluctance to take out loans, in combination with barriers to accessing capital, limits investment and growth in their operations. Max Morningstar, owner of MX Morningstar Farms in Columbia County, put it bluntly: “It’s difficult when you don’t have equity to leverage. It’s not hard to convince someone to loan you \$50,000 for a tractor, but saying you want \$150,000 to put in an irrigation system gets you some raised eyebrows.” All farmers interviewed said they would turn to Farm Credit East for financing if they had need of a loan.



Largest Lender to New York Farmers: Farm Credit East

Farm Credit East is the largest private lender to farmers in New York state. Farm Credit East says that 10,244 NY farmers have received \$4.3 billion in loan commitments as of 2019. Nearly 40% of loans went to dairy-related operations, 14% to cash grain crop farmers, 9% to livestock operations, and 8% to fruit. Another key source of capital is the USDA Farm Services Agency, which provides loans to farmers for operating costs including purchasing livestock, seed, or equipment, and capital costs such as buying land or building barns.

As of 2019, the USDA farm loan programs had outstanding loans to 351 applicants for a total of \$88 million across the state. Of that, \$4.5 million was lent to 38 Black, indigenous, and people of color (BIPOC) and women applicants, and \$115 million was lent to 115 new and beginning farmers.

Farm Credit East also runs FarmStart, a Northeast initiative that provides startup funds to new farmers. Over the past 15 years, FarmStart has provided loans of \$10,000-\$75,000 to more than 300 new farmers across the Northeast, nearly half of whom live in NY. Like other aspiring small business owners, new farmers lack options in obtaining loans — especially for buying real estate — if they don't have a solid business plan and the significant savings required for a down payment.

Most small ventures face challenges in securing financing, said Christopher Laughton, director of knowledge exchange and FarmStart program manager at Farm Credit East.

But farmers often have higher capital requirements than other types of businesses, making lack of access to debt financing a steeper hurdle to overcome.

Debt capital at traditional, commercial banks tends to fund ongoing operations and expansion of existing, profitable business. Commercial banks manage risk, and startups tend to be very high risk. On the equity side, venture capital investors are not interested in farms in general because they have too low of a return based on the capital requirements, and their options for exit are limited. It's definitely a significant nut to crack, which is one of the reasons we created FarmStart," he said.

The FarmStart program has provided startup loans to NY-based farms like Black Pearl Creamery, a sheep dairy in Trumansburg, NY, as well as agricultural supplier Hudson Valley Seed Library, based in Accord, NY. "Really, in some ways, the more unusual the better," said Laughton when asked about innovative business models for farms and agricultural suppliers. The Hudson Valley Seed Library launched with the mission to diversify the regional seed supply available to farmers, which they have succeeded in doing through a trial garden and by building a library of more than 400 vegetable, flower, and herb varieties. They used the FarmStart loan to invest in cold-seed storage, testing equipment, and additional employees.

Lack of Resources for Underrepresented Farmers

An important element of access to capital and land, especially as it relates to new and beginning farmers, is the need to aggressively direct resources — both land and capital — to new and beginning farmers of color.

Loss of agricultural land and economic livelihoods of Black farmers because of USDA policies and practices is one of the starkest examples of systemic discrimination against Black Americans.

In 1920, Black farmers owned nearly 15 million acres of agricultural land across the U.S. By 2017, that number was just one million acres. Today, the majority of Black farmers are still concentrated in the Southeast U.S. In NY, there are just 139 producers that identify as Black, out of more than 57,000. A further 606 producers in NY identify as Latinx.

A growing number of organizations and initiatives at the national and state level are beginning to tackle the hurdles facing Black and brown farmers, and the Biden administration has made addressing racial inequality — including in agriculture — a priority.

A Senate bill cosponsored by NY Senator Kirsten Gillibrand, called the Justice for Black Farmers Act, introduced in November 2020, says it aims to “reform the U.S. Department of Agriculture and create a land grant program to encourage a new generation of Black farmers.” The bill will create land grants to Black farmers of up to 160 acres, and have expanded access to loans and other resources to help establish or expand farming operations.



There are also burgeoning private sector initiatives to direct resources to Black farmers. The Black Farmer Fund, for example, is an “emerging community investment fund that invests in Black food systems entrepreneurs in New York state.” Of course, nonprofits like Black Urban Growers have been advocating for Black farmers for years.

As is the case nationwide, the majority of farmers in NY are white (98%), male (62%), and aging, with an average age of 55 years old. The farmers interviewed by and large fit this description, and most were part of multigeneration farming families, sometimes taking over farm ownership as the fifth or sixth generation in NY. However, we did interview nine farmers who qualified as “new” or “beginning” farmers, meaning they had been farming for less than 10 years and were first-generation farmers. There was one woman in this group but no farmers of color.



Production Costs Rise, Market Prices Go Down: The Future of Agricultural Economics

Farmers in New York state expressed frustration across the board with rising production costs, an uneven national playing field, and what they see as unfair competition from cheaper imports. Nearly all farmers who work with major grocery store chains, wholesale distributors, or processing plants said they felt they were consistently being asked to produce more and better food for less money.

Brian Reeves, 63, farms 500 acres of land in Onondaga County (central NY) growing a variety of specialty produce, from sweet corn to strawberries. Most of his business goes to grocery stores in the region. "I get sick of constant downward pressure on prices by grocery stores. Our costs have been going up every year, but sales prices have not. You can't keep squeezing the same blood from a stone. It gets frustrating."

Corey Mosher of Mosher Farms in Madison County (also in central NY) agrees. "Farmers need to be able to have some control, not to price manipulate but to take more of the power to set prices. Farmers can be our own worst enemies. It's a race to the bottom," he said, referring to fierce competition from California and South American imports.

Daniel Martin of Martin's Farm Stand in St. Lawrence County put it most bluntly: "It's an uneven playing field out there. If you're selling to grocery stores, you're competing with imports that are priced so low that we can't pay fair wages to our workers or meet environmental regulations. From a national policy perspective, we are destroying the American produce industry."

Onion farmers and maple syrup producers interviewed felt similarly about what they viewed as unfair competition from Canada, saying that Canada engaged in agricultural "dumping" in the onion and maple syrup sectors by selling items for below the cost of production and cutting into domestic sales. In fact, just last year Senators Schumer and Gillibrand expressed concern about Canadian onions "flooding East Coast markets at artificially low prices" and condemned "unfair and discriminatory pricing practices by Canadian onion exporters."

Some of the USDA Census of Agriculture statistics appear to support NY farmers' concerns about rising production costs and decreasing agricultural prices.

And they are not alone. A decline in agricultural prices is a national trend, and it has been happening over the course of the 20th century. A decline in agricultural prices is a national trend, and it has been happening over the course of the 20th century. Even with some volatility during the World War I and II, the Great Depression, and the early 1970s, the overall trend across the entire 20th century indicates that the prices farmers have received for their goods have gone down, and the costs associated with agricultural production have increased over time. NY's 2017 Census of Agriculture also showed an increase in production expenses, especially for hired labor, as previously discussed. But in terms of production expenses as a percent of total expenditures, most inputs such as chemicals, fuel, fertilizers, and feed have also gone up since 2002.

Consolidation is not a new story in agriculture. But NY farmers emphasized that downward pressure on prices and rising production costs encourage consolidation and make profit margins thin.

Although most farms in NY remain small, the majority of sales are now concentrated on large farms. Most farms — 80% — are small, with less than \$100,000 in sales every year. Just 5.5% of farms had sales of greater than \$500,000. That being said, those few large farms account for more than 70% of agricultural sales in the state. And that share has been growing. In 1997, the very largest farms only accounted for 27% of sales in NY. Although most farms are small, NY is home to a growing number of larger, incorporated farms, approximately 2,500 or 8% of farms in the state in 2017, which is a 20% increase over 2007.

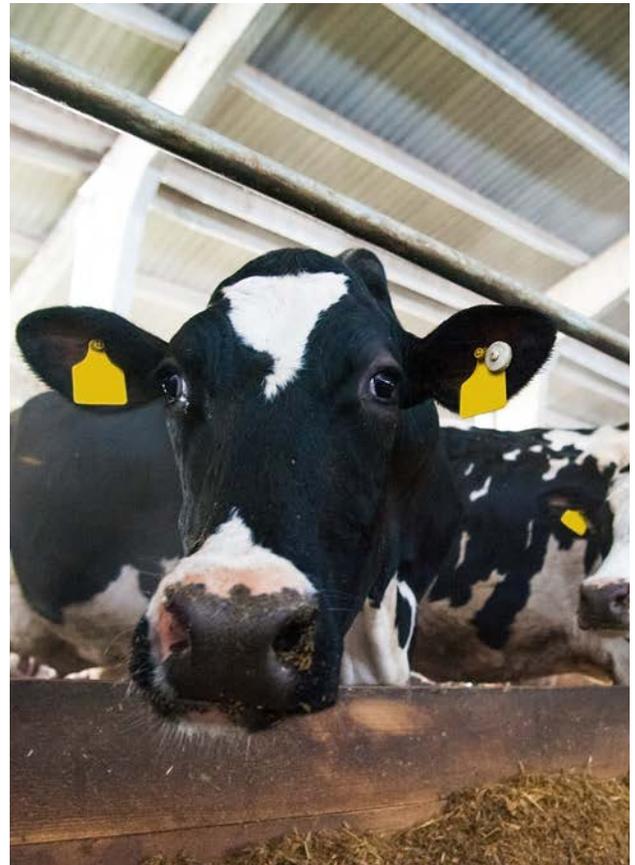
Packaging in the Maple Syrup Industry

New York state is the second largest producer of maple syrup in the country, after Vermont. And according to upstate maple syrup farmers, their biggest problem is packaging. As a niche industry, few manufacturers make containers ideal for storing maple syrup. According to Helen Thomas, director of the New York Maple Syrup Association, maple syrup is best stored in glass, but plastic containers are less expensive and can be used if glass is unavailable. Thomas said just a few companies make glass and plastic containers for maple syrup, and most have a backlog on orders due to supply chain disruptions related to COVID-19.

The owners of Merle Maple LLC, Lyle and Dottie Merle, Kristina Copeland, and Eileen Downs, said they typically use plastic jugs when selling their syrup retail from their 20,000 tap operation in western NY. Their supplier, the Sugar Hill Company, has had trouble sourcing "XL" coating — a coating that keeps maple syrup from darkening and "falling out of grade," which can result in jugs of syrup being pulled from retail shelves and a loss of revenue. They also echoed Helen Thomas, saying that glass containers keep syrup best, but that affordable glass containers have become scarce. "We've seen a plastic bottle once that's as good as glass, but the company went out of business. We're hoping that someone else takes up that business," said Lyle Merle.

Farmers, again, pointed to hired labor as their highest cost but also said the cost of pesticides and fertilizers, and feed for livestock, were significant costs.

Dairy farmers in NY have been especially affected by declining milk prices, due in part to a decrease in milk consumption and growing popularity of plant-based milk. Dairy farms have been decreasing in number for the past three decades in NY. Several dairy farmers with fewer than 100 cows told us they didn't expect their farms to survive to pass onto the next generation. However, dairy farmers interviewed also blamed the business practices of large dairy cooperatives. One farmer, Jamie Baker, sells all of his milk from his 300 cows to a large, national cooperative but said they don't always play fair. At the start of the pandemic, he thought about switching to a smaller cooperative that was offering him fairer prices, but the pandemic hit the small cooperative hard, and Baker was unsure whether they would be able to take his milk. So, he stuck with his original buyer.



Farmers who contracted with Upstate Farms and Hudson Valley Fresh, smaller cooperatives in western NY and the Hudson Valley, respectively, said they were able to sell their milk for a good price and that the cooperative paid them dividends on any processed dairy products (e.g., yogurt and cheese) the cooperative's manufacturing facilities produced. However, the popularity of Upstate Farms and Hudson Valley Fresh meant that they had waiting lists, and not every dairy farmer who has milk to sell can become a member of these cooperatives because of capacity constraints.

In order to survive, and thrive, farmers in NY need to lower costs and increase revenue, while also minimizing environmental impacts and protecting agricultural workers — a tall order but one that's necessary to meet the challenges of the 21st century.



What Others in NY's Agrifood Industry Are Saying

Interviews with members of New York's food and beverage manufacturing sector were conducted, as well as a few distributors and food retailers. Given the complexity of the agrifood industry, the major focus of this report is on farmers. But since farmers operate in a complex supply chain, observations from representatives in other parts of the industry were included in this report.

A critical piece of the agrifood production chain is food and beverage manufacturing — or the actors that turn raw agricultural goods into consumer-ready products. NY is home to major food and beverage manufacturers, including Chobani, Wells Dairy, LiDestri, Seneca Foods, and Constellation Brands — all of which have manufacturing facilities in upstate NY. Interviews were conducted with representatives from food manufacturers like Seneca Foods, LiDestri, Wells Dairy, LoveBeets, RealEats (the winner of the 2019 Grow-NY Food and Agriculture Competition), several smaller-scale dairy processors, and a number of wineries, breweries, and cideries across the state.

By and large, they shared NY farmers' concerns about the rising costs of doing business, particularly of labor in comparison to other states, and the costs of raw agricultural inputs. The notable exception to this was Chobani, which voluntarily raised its workers' wages to a minimum of \$15.00 per hour in 2020 (the state's minimum wage outside of New York City is still \$12.50).

Seneca Foods is the largest producer of canned goods in the country, beating even behemoth food brand, Del Monte. Jeff Johnson, Seneca Foods' agricultural manager, said they source mainly green beans, beets, and carrots from NY, but that the share they source from the state has been decreasing. Johnson said today they source just 25% of their green beans from within NY. The rest is grown in the Midwest, mainly Wisconsin. "We do pay less for product in Wisconsin than in New York," he said. Over the two decades, Seneca Foods has steadily begun moving manufacturing operations to the Midwest, although they maintain four factories or distribution centers in upstate NY. In Wisconsin, they operate nine factories, with seven more facilities in neighboring Minnesota.

Dairy manufacturing is a sector in NY that has experienced a bumpy decade. Although NY is the third-largest producer of fluid milk in the country, the overall decline in consumer demand for dairy products has presented serious hardships for the industry, from farmers to manufacturers. The entrance of Greek yogurt into the marketplace in the early 2000s, spearheaded by the NY-based Chobani, injected new enthusiasm into the industry, and dairy farmers expanded production in response. However, despite new innovation for dairy products, sales levelled off in 2017 and have yet to continue growing.

A trade war with China and a strong dollar during the Trump administration suppressed milk prices further, and caused a drop in milk exports. A key challenge for dairy farmers is finding markets for fluid milk and cream, the products that fetch them the highest price. Milk sold for processing into yogurt, cheeses, and sour cream is usually sold for a lower price. However, NY still ranks first in the nation for production of yogurt (16% of nation's supply), cottage cheese (27%), and sour cream (20%). In 2019, NY exported \$417 million in dairy products.



but we are finding this more and more difficult as market pressures are evolving.

Reliable and Transparent Supply Chains

For food manufacturers and other businesses that rely on fresh produce — such as Seneca Foods, RealEats, and Wegmans — the key challenges constraining sourcing from within New York state is the short growing season and volume. Since the vast majority of NY's farmers are small, they are not well-positioned to supply large grocery store chains or manufacturers like Wegmans with some exceptions, including the apple growing industry, which has established cooperatives and sales channels to supply larger markets across the Northeast.

William Strassburg, the vice president of strategic initiatives for Wegmans, said that the grocery store chain carries locally sourced offerings but in reality looks for larger suppliers to fill their majority of their needs. "We're a \$10 billion company," he said. "For us to supply 104 stores across eight states, we need a supplier that can meet our needs today, as well as the capacity to grow with us over time. That volume can make it difficult for smaller farmers to compete against large-scale growers. We will continue to support and buy specific products from the small farmer that may only supply a few stores directly,

These changes are increasing the need for long-term (year-round) contracts to maintain consistent, high-quality products for our customers."

Strassburg's concerns were echoed by RealEats's CEO and president, Erik Battes. RealEats, the winner of the 2019 Grow-NY Food and Agriculture Competition, is a subscription-based food service like Blue Apron or HelloFresh but positions itself as using only "real food" in its meals. They have a commercial kitchen and manufacturing facility in Geneva, NY, that employs 60 people. He said it was difficult for his business to work with local farmers given that their volume requirements exceed the capacity of most individual growers in the region. "We're in this messy middle stage," he said. "There are short periods of time where local farmers might have enough supply, but if we want to have something on the menu for months at a time, our volume exceeds their capacity to supply." Battes also pointed to the lack of visibility on the supply chain at times when working with regional and national distributors, saying that it's necessary to work with distributors to ensure consistent supply, but that it's difficult to confirm where any particular product is coming from. "I wish I had better communication between businesses like ours, and the local farmers and suppliers.



Managing single source ingredients from multiple sources is very challenging for a business with limited procurement resources. I want to be able to balance the needs of our business, which is why we go through distributors, but the lack of transparency around where the food is coming from is also an issue," he said.

Johnson at Seneca Foods said that NY's short growing season puts it at a disadvantage. "In Wisconsin, we have more ability to extend the growing season by going south. In NY, we'd have to go down as far as Delaware or Maryland. Illinois has a significantly longer growing season. Our plants over there can be smaller because we can operate for more weeks; the growing and harvest seasons are longer."

Silas Conroy, the director of Headwater Food Hub agreed that seasonality is one of the biggest challenges to accessing and building bigger markets for local farmers. He said some of the highest-value crops in NY, like strawberries and peaches, are only in season for a few weeks. Conroy says that Headwater Food Hub buys 90% of its food products from local and regional farmers, and its primary market is Rochester and other towns in the Finger Lakes.

His supply chain is complex, with over 100 different producers in NY, some as small as an acre in production, to multigenerational farming families operating 2,000 acres or more. The key to Headwater's business model is rigorous inventory management and reducing the transaction cost on small purchase orders.

Conroy said that automating as much of the inventory management as possible would make it possible to track inventory levels and producer relationships, and order more efficiently.



Methodology and Limitations

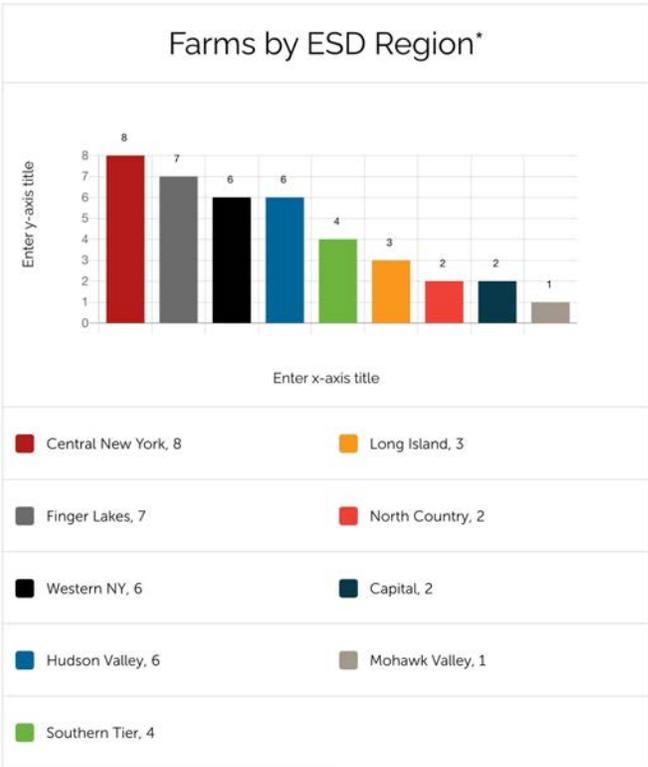
The final report and accompanying materials are based on nearly 100 interviews with farmers, food and beverage manufacturers, food distributors, food retailers, researchers, academics, extension specialists, policymakers, and trade associations. We also conducted extensive data collection and analysis of publicly available datasets, trade, and a review of the available literature. For interviews, we used a semi-structured questionnaire focused on surfacing the constraints and challenges faced by agricultural and food producers along the supply chain in NY. We then developed a ranking system to systematically evaluate patterns of challenges reported to us by New York state farmers. We coded all farmer interviews (n=40) into a set of 17 common challenges we identified based on interview results, and assigned farmer responses to each theme a ranking of 1-10, with 1 being a not applicable/not urgent challenge facing their operations, and 10 being a very urgent challenge actively constraining their operations. We have included the results below.

Challenge and Average Rank

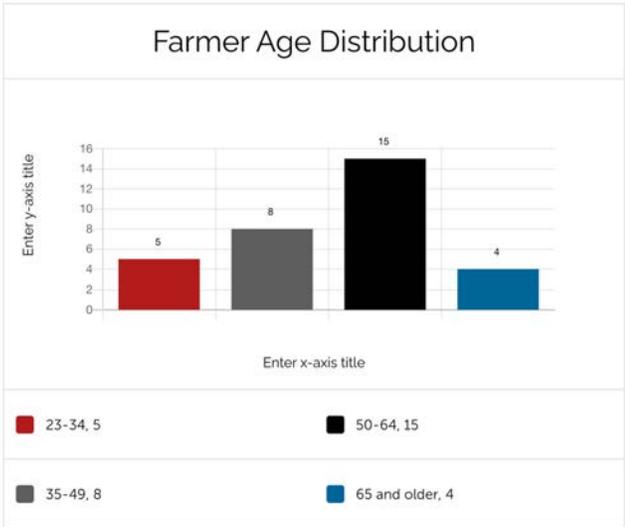
Labor Costs	7.8
Regulatory compliance for labor standards (workers' compensation, H-2A)	7.2
Climate change and weather volatility	7.2
Disease and pest control	7.1
Access to labor	6.5
NYS/regional brand recognition	6.0
Finding/accessing markets or customers	5.9
Business operations (general)	5.8
Food safety	5.8
Access to land/land costs	4.8
Access to farm equipment/supplies	4.8
Pesticide use and regulatory compliance	4.5
Transportation of product	4.4
Access to capital	4.3
Product storage	3.7
Waste management	3.6
Food waste	2.7

Interview subject selection was guided initially by the advisory committee and then by key outreach partners who included food system service providers, industry leaders, and trade organizations. The goal was to reflect the breadth and diversity of the food and agricultural community in terms of profitability and the growth potential of types of agricultural and food production activity statewide. Interview participation was entirely voluntary. We employed a series of tactics for outreach, including through trade associations, county and municipal councils, and fora across the state where the relevant food and agricultural activity occurs. By necessity, the sampling method was purposive. All interviews were conducted remotely by phone, and where internet capability allowed, by Zoom, FaceTime, or other video conferencing applications. Due to the pandemic, response rates from farmers, distributors, and retailers were lower than expected, and so limited the number of interviews the research team could conduct in the allotted time frame.

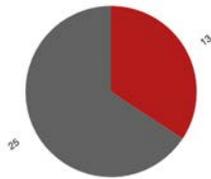
The majority of interviews were conducted between August 1 and December 31, 2020. We sought informed consent from all interview subjects to include their responses in the report and, where relevant, to quote interview subjects by name.



*ESD stands for Empire State Development, a state agency that divides NY into 10 regions: New York City, Long Island, Hudson Valley, capital region, Mohawk Valley, Southern Tier, Finger Lakes, central NY, western NY, and the North Country.

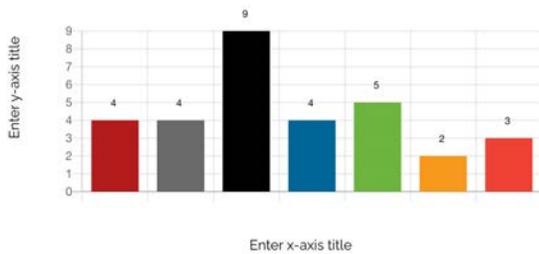


Organic vs. Conventional Farms



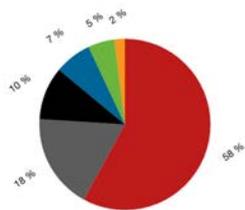
Organic, 13 Conventional, 25

Number of Farms, by Size (Acres)



1 to 9, 4 500 to 999, 5
 10 to 49, 4 1,000 to 1,999, 2
 50 to 179, 9 2,000 acres or more, 3
 180 to 499, 4

Farms by Product Category



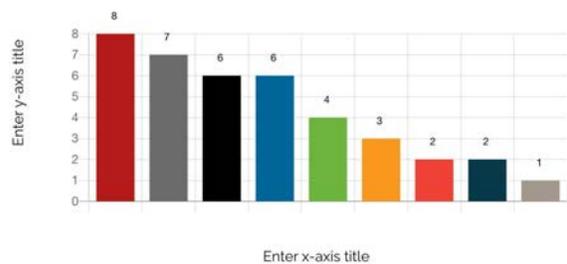
Specialty Crops, 58% Livestock, 7%
 Dairy, 18% Hemp, 5%
 Craft Beverage, 10% Maple, 2%

Farmer and Farm Characteristics

We interviewed 40 farmers from across New York state. We focused primarily on key specialty crops like apple growers and diversified fruit and vegetable operations, as well as dairy farmers. Several farms also had processing operations embedded into their business models, and this was the case particularly for farming and craft beverage operations like wineries and cideries, which usually had farming operations, vineyards, and apple orchards integrated into their operations. The average age of the farmers we interviewed was 51 years old.

The vast majority of our interview subjects were male and white, although we interviewed three women working in a position of decision-making authority on farms. However, we did not interview any farmers of color.

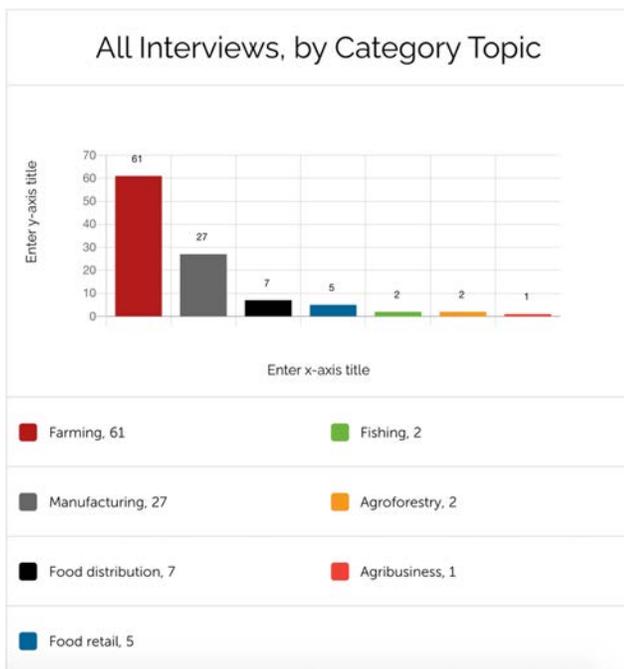
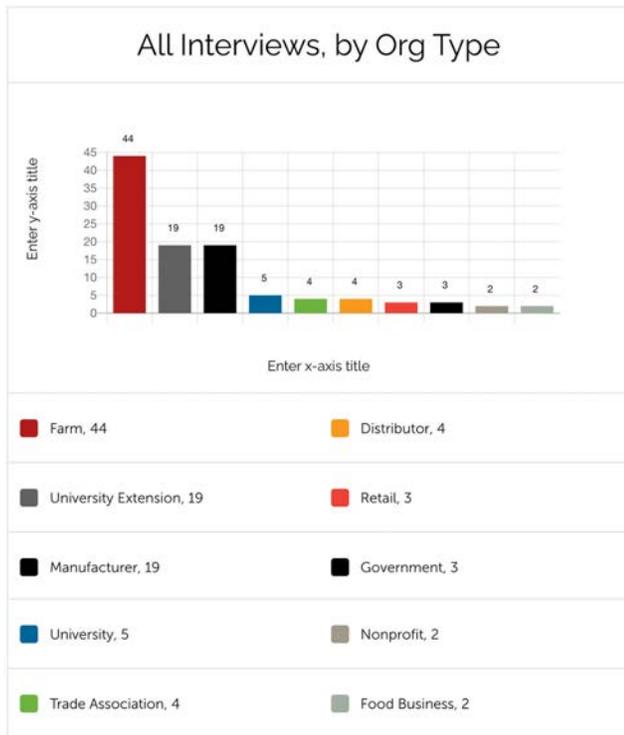
Farms by ESD Region*



Central New York, 8 Long Island, 3
 Finger Lakes, 7 North Country, 2
 Western NY, 6 Capital, 2
 Hudson Valley, 6 Mohawk Valley, 1
 Southern Tier, 4

All Interviews by Subject

We interviewed approximately 105 people about farming, food manufacturing, distribution and retail, and tourism. Below is a breakdown of the interviews by type and subject.



Interviews by Sub-Category Topic

Specialty Crops	20
Dairy	19
Craft Beverage	11
General	10
Hemp	7
Apples	7
Food Manufacturing	6
Livestock	4
Grapes	4
Grocery	4
Maple Syrup	2
Hops	2
Fishing	2
Farm Policy	1
Organic Farming	1
New Farmers	1
Meal subscription	1
Farm Management	1
Local Food	1
Beverage	1

Interviews by ESD Region

Finger Lakes	22
New York State	18
Western New York	14
Hudson Valley	14
Central NY	14
Southern Tier	7
North Country	6
Long Island	4
Capital	3
Mohawk Valley	2
New York City	1

Citations



1) CREA analysis of EMSI-compiled data, provided to CREA by the NYS Department of Labor. EMSI employment and GDP estimates are based on the Quarterly Census of Employment and Wages, U.S. Census County Business Patterns, and the Bureau of Economic Assistance data. The USDA Economic Research Service defines agrifood-related industries to include food service, eating and drinking places, food and beverage stores, textile, apparel and leather manufacturing, food, beverage and tobacco manufacturing, forestry, fishing and related activities, and farms. We included wood product manufacturing as one of our categories for inclusion given the presence of forestry and logging in NY.

2) CEA is different from soil-based urban agriculture and traditional greenhouse farming in that it employs more sophisticated technology, including LED lights to replace sunlight and soilless systems.

3) Analysis of PitchBook and CB Insights data differs substantially because of differences in data categorization, reporting, and collection by each platform. The numbers in this report should be treated with a degree of skepticism.

4) Analysis of CB Insights data downloaded in September 2020 conducted by the Center for Regional Economic Advancement. Also see <https://agfundernews.com/breaking-bowery-farming-raises-20m-series-hire-expand.html>.

5) We ranked each of the farmers' interview responses to 17 common challenges on a scale from 1-10, with 1 being a non-urgent or irrelevant issue, to 10 being an urgent, pressing challenge hindering their operations. Cost of labor ranked the highest of all issues with an average score of 7.75, followed by regulatory compliance with labor standards (7.19), and labor availability ranked fifth on farmers' list of overall concerns with a score of 6.5. Climate change (7.16) and disease, pest, and weed pressure (7.06) scored as more pressing issues for NY farmers than labor availability.

6) The census also reported there were 57,865 "producers" or "operators" in the state employed on farms on a part-time or full-time basis. Producers or operators are defined by the USDA as having decision-making authority on farms and could be owners, co-owners, hired farm managers, or the equivalent. Each farm can report up to four operators employed or self-employed on the farm. It is difficult to accurately estimate the total number employed in agriculture as the definition of hired farm labor includes paid family members and other individuals that may have decision-making authority on the farm. This means there may be duplicative reporting between the number for hired labor and the number of producers and operators in the state.

7) More on hired labor in NY: The number of seasonal and part-time workers in NY was 29,742 in 2017 (6,457 of NY's 33,438 farms or 19% hire seasonal or part-time labor). Additionally, 929 farms hire migrant workers, totaling 11,512 migrant workers on NY farms. About 16,728 farms employ unpaid labor, with 40,269 workers engaged on farms without official pay. Please see Table 7. Hired Farm Labor – Workers and Payroll: 2017 of the 2017 Census of Agriculture – State Data. USDA, National Agricultural Statistics Service.

8) 2017 Census of Agriculture. USDA, National Agricultural Statistics Service. New York, pg. 5.

9) Specialty crops include fruits, vegetables, and nursery according to USDA definition.

10) Farmers interviewed consistently ranked weather volatility and shifting growing seasons as their third most pressing concern, behind cost of labor and labor regulations, with an average score of 7.16 out of 10. Farmers interviewed did not often use the term "climate change," although some did. To avoid risk of politicization in responses, interviewers asked farmers about changes in weather patterns and growing seasons, in addition to using the term climate change to gauge responses.

11) A "mobile" or custom-exempt butcher is not inspected by the state or USDA. In order to sell retail or wholesale, farmers must have their animals slaughtered and processed at a USDA-inspected facility. "Custom" butchering refers to the farmer selling a live animal directly to the customer and the customer paying the processor for their services.

12) In 2019, the port at Montauk, NY (on Long Island), sold its 11.5 million pounds of seafood for an average of \$1.55 per pound. Alaska, on the other hand, is home to 19 of the country's largest ports and brought in \$2.5 billion pounds of seafood in 2019. Alaska's biggest ports — the Aleutian Islands, Dutch Harbor, and Kodiak — sold seafood for less than \$0.50 a pound on average. The Center for Regional Economic Advancement (CREA) analysis of NOAA Fisheries dataset "Landings by Top US Ports"