

CLIMATE CHANGE FACTS

CORNELL COOPERATIVE EXTENSION

FARMING SUCCESS IN AN UNCERTAIN CLIMATE

Climate preparedness makes good business sense. The Earth's climate is always in flux, but today's pace of change is far beyond what previous generations of farmers have had to face. Climate change is already posing new challenges, such as increased risk of flooding, summer heat stress, and more intense pest and weed pressures.

Some farmers are beginning to plan to minimize the risks and capitalize on opportunities. In New York, there will be plenty of both. Making business decisions on future scenarios is always a hair-raising endeavor, even more so with the complication of trying to discern between normal weather variability and long-term climate shifts. Many of the commodities that currently dominate the New York agricultural sector, like dairy products, apples, cabbage, and potatoes, are not well suited for the warming trends predicted for this century. However, there will be profitable opportunities to experiment with new crops or new crop varieties as temperatures rise and the growing season lengthens.



FLOODING

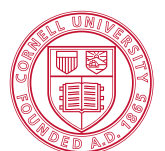
More precipitation is occurring in heavy rainfall events (more than 2 in / 48 hrs), and this trend is expected to continue.

Flooding Challenges:

- Springtime flooding can delay planting
- Root damage and reduced yield due to flooding
- Soil compaction from use of heavy machinery on wet soils
- Soil loss from erosion during heavy rain events
- Contamination of waterways from agricultural run-off

Flooding Solutions:

- Increase soil organic matter for better drainage with practices such as reduced tillage, cover cropping, and use of composts or other organic amendments
- Invest in tile or other drainage systems for problem fields
- Shift to more flood tolerant crops
- Buy or lease new acreage with better drainage
- Shift planting dates to avoid wet conditions



DROUGHT

New York does not face the severe water shortages predicted for some other regions, but the risk of short-term summer drought is expected to increase over this century. Warmer temperatures and longer growing seasons will increase crop water demand, while summer rainfall will remain about the same or possibly decline.

Drought Challenges:

- Declining and more variable yields of rain-fed crops
- Decline in quality of high-value fruit and vegetable crops

Drought Solutions:

- Increase irrigation capacity, particularly for high-value crops
- Shift to drought-tolerant crop varieties
- Shift plant dates to avoid dry periods



HEAT STRESS

The growing season across the state has already increased on average by 8 days. The number of summer heat stress days (e.g., exceeding 90°F) is expected to increase substantially, while winters grow milder. These changes will create both opportunities and challenges for farmers.

New Crops for a New Climate

The increase in average temperatures and longer growing season will allow experimentation with new crops, varieties, and markets. Peaches, melons, tomatoes, and European red wine grapes are a few examples of longer growing season crops that will be favored by a warming climate.

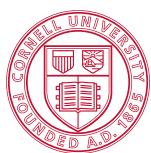


Heat Stress Challenges:

- Warmer summer temperatures have been shown to lower yields for certain varieties of grain crops (field corn, wheat, and oats) by speeding the development cycle and shortening the period during which grain heads mature
- Hot daytime or nighttime temperatures during critical phases of plant development can reduce yield and quality of even those crops considered heat-adapted
- Potatoes, cabbage, snap beans, apples, and other heat-sensitive plants will be more challenging to grow
- Warmer and more variable winters can ironically increase the chance of frost and freeze damage for perennial fruit crops by inducing premature leaf-out and interfering with cold-mediated winter hardening

Heat Stress Solutions:

- Shift planting dates to avoid heat stress during critical periods of plant development
- Explore new varieties of heat-resistant crops, and be prepared to diversify production to reduce reliance on heat-sensitive crops
- Capitalize on the opportunity to grow longer season crops. For example, some field corn growers are already experimenting with new longer growing-season varieties



INSECT INVASIONS AND SUPER WEEDS

Interactions between climate, crops, insects, and disease are complex, but evidence suggests that climate change will require New York farmers to invest in earlier and more intensive pest and weed management. Anticipating the challenge of increased weed and pest pressure will allow for better control and more cost-effective management.

Insect Challenges:

- Spring populations of insect pests will expand, as survivorship rates of marginally over-wintering insect species increase, and migratory insects arrive earlier
- A longer growing season means more insect generations per season, requiring increased intensity of management

Case-Study: Brown Marmorated Stink Bug

If not for its diminutive size, the brown marmorated stink bug (BMSB) could be the subject of a 1950's horror movie. Described as "the bug from hell" after BMSB ate \$37 million of the 2010 MD apple crop, the hungry bugs will munch on anything from orchard crops, to corn and soybeans. First introduced in PA during the '90s, BMSB are teeming northward, taking advantage of recent warm winters and long summers. BMSB was first sighted in NY in 2008, increasing yearly since then. Some pesticides have proven effective against BMSB, but control has been limited.



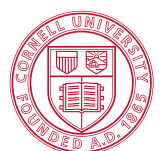
Weed Challenges:

- Warmer weather and increasing concentrations of carbon dioxide in the atmosphere favor weed growth over crop plants in many cases
- Weeds will have to be controlled for longer and weed seed production will be greater
- Certain weed species currently restricted to the warmer south are migrating northward, such as kudzu, while some familiar weed species, e.g. lambsquarters, are projected to become stronger competitors
- Pressure to use chemical control methods will increase as pest and weed infestation intensifies, but studies have shown the climate change may reduce the efficacy of certain commonly used pesticides (pyrethroids, spinosad) and herbicides (e.g. Glyphosphate)



Insect and Weed Management Solutions:

- Improved rapid response plans and regional monitoring efforts will allow for targeted control of new weeds and pests before they become established
- Enhanced monitoring and implementation of integrated pest management (IPM) will help farmers balance pest and weed control while avoiding the economic, environmental and health-related costs of increased chemical application



CHANGE IN THE DAIRY AND LIVESTOCK INDUSTRIES

Heat stress can have devastating consequences for livestock. Keeping cool in the heat of the next century will be critical for maintaining the milk production levels that have made dairy the dominant industry in New York's agricultural sector.

Livestock Challenges:

- Heat stress associated with hotter summers will create dangerous and unhealthy conditions for livestock, reducing productivity and reproductive capacity
- Availability and cost of animal feed will fluctuate as climate affects crops like corn grain and silage
- New costs will be incurred from investments to improve cooling capacity of livestock facilities

Heat Stress and Dairy

- Even moderately warm temperatures, e.g. above 75°F, when combined with moderate humidity, can lead to milk production decline
- In 2005, unusually warm temperatures reduced milk production 5 to 15 lbs per cow per day for many dairies (leading to losses of 8 to 20%)
- The frequency of heat-stress events is expected to increase with climate change



Livestock Solutions—Low Cost:

- Reduce over-crowding and improve barn ventilation
- Minimize heat exposure, e.g. feed during the cool part of the day and maximize shade
- Increase water availability and adjust diet (more fat, less protein)

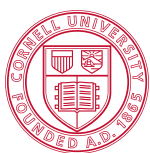
Livestock Solutions—Moderate to High Cost:

- Improve cooling capacity with additional fans, sprinkler or mister systems, and ventilation renovations
- Insulate under barn roofs to buffer extreme heat and save on cooling costs
- Build new barns with adequate cooling capacity for future heat loads

When is it Time to Make a Change?

This will be the critical question for farmers. Climate scientists can provide useful information to help determine when a poor season or two is due to just “normal” bad weather, and when it is due to a shift in the climate that will likely be here to stay. At Cornell, we are working on new decision tools that will allow farmers to examine different future climate scenarios for their region, impacts these might have on crops and livestock, and evaluate various options for timing adaptation investments to minimize negative effects or take advantage of opportunities brought about by climate change.

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