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The Heat is On: From Subways to Dairy Barns, Is New York Ready for Climate Change?

Climate change is happening, and it will transform how New Yorkers live, work, and play in the coming decades. CALS is at the forefront of helping New York prepare for the challenges of a climate in flux while seizing potential opportunities.

By **Amanda Garris**, Cornell University, Reprinted with permission from the Fall 2011 issue of CALS News Magazine

In 2080, will New York City residents take a submarine to work instead of the subway? Will vast irrigation networks be as commonplace in western New York as they are today throughout the western United States? Will once rare catastrophic flooding in the Southern Tier, such as that recently experienced throughout the region, become commonplace?

More than 20 College of Agriculture and Life Sciences scientists—including representatives from the departments of Earth and Atmospheric Sciences, Natural Resources, Horticulture, Plant Pathology and Plant-Microbe Biology, Ecology and Evolutionary Biology, and Animal Science—recently addressed these questions.

Working with colleagues from Columbia, Rutgers, the City University of New York, and the Mount Sinai School of Medicine, the Cornell experts used climate models to examine possible outcomes for New York's farms, transportation systems, waterways, energy sector, ecosystems, telecommunications, public health, coastal zones, and wildlife. The ClimAID report, funded by the New York State Energy Research and Development Authority (NYSERDA), serves as a roadmap to help prepare the state for adapting to climate change.

Floods and extreme weather are immediate, headline-making examples of how incremental increases in the earth's temperature are already affecting New Yorkers, but more fundamental impacts on how New Yorkers live and work will be seen over the coming decades. "Our goal was to provide decision-makers with cutting-edge information on New York's vulnerability to climate change and stimulate planning for adaptation," says Art DeGaetano, professor of earth and atmospheric sciences and one of the report's three principal investigators. "We have the capacity to address many of the risks ahead, buffer the negative impacts, and embrace new opportunities."

The Cornell researchers predict that heat waves will be more frequent and intense. A greater power supply will be required to keep air conditioners humming, particularly in New York City, which presently accounts for half of the state's energy use. Moreover, the predicted sea level rise would jeopardize New York City's low-lying, coastal power plants, railways, and transportation hubs. In other parts of the state, irrigation systems might be regularly required to maintain crops through heat waves.

A New Climate for Farming

Farming contributes nearly \$5 billion annually to the state's economy and occupies about 23 percent of the state's land. Many of New York's iconic and economically important farm products—including dairy products, apples, grapes and maple syrup—will require some strategic adaptations to maintain current levels of production.

Average temperatures—expected to increase 4 to 9°F well before the end of the century—will drive many of these changes.

"Cows produce maximum milk between 30 and 75°F," says Larry Chase, professor of animal science. "With heat stress, cows spend more time standing and walking and less time resting. Ultimately, climate change is predicted to cause a 5-15 percent decline in milk production." The solution: retrofitting barns with ventilation fans and sprinkler systems to keep cows calm, cool, and collected.

For the state's tree crops—including apples and maples—trends in winter present a challenge. Ironically, despite the overall warming trend, extreme temperature swings in recent winters have led to an increase in cold damage.

"Variable winter temperatures can 'de-harden' plants and make them more susceptible to mid-winter freeze damage," says horticulture professor David Wolfe. "Or they may leaf out prematurely in early spring and then get hit by a frost event." The grape harvest, similarly, could be damaged by premature budding and frost vulnerability.

Warmer winter temperatures are already affecting maple syrup production, which requires an alternation between cold nights and warm days to drive the sap for tapping.

"Maple yields have been slowly decreasing for 30 years," says professor of ecology and evolutionary biology Brian Chabot. "Studying the climate models, we anticipate that producers will at least need to begin tapping earlier—in January or February—instead of waiting until March."

A potential advantage for New York under the climate predictions is a longer growing season, which may bring opportunities for farms to diversify into new crops and varieties. Cool season crops such as broccoli, spinach, and peas may be replaced by heat lovers like tomatoes. European wine grapes, grown in several parts of the state, would likely grow better with a change in climate.

Shifting Species

While farmers are starting to learn about the array of options available to them to adjust to climate change, native species are responding on instinct to earlier springs and warmer summers.

“Researchers at the Lab of Ornithology have observed earlier arrival of migrating birds as well as bird populations moving northward within their traditional ranges,” says Wesley Hochachka, assistant director of the Lab of Ornithology and an expert in bird population studies. “The Lab is trying to understand thermal constraints on birds, from direct heat stress to effects on the number of eggs they incubate.”

While birds can take flight in search of more hospitable areas, other species will be limited by their ability to move into suitable habitats. Driven by the predicted loss of unique habitats such as spruce-fir forests and alpine tundra in New York’s Adirondack and Catskill mountains, large shifts in species composition are expected in natural landscapes.

Wolfe, the lead author of the Ecosystems and Agriculture chapters of the ClimAid report, says this creates a need to preserve wildlife corridors to allow animals to migrate out of areas that no longer provide hospitable habitat.

“As habitat disappears, an important policy is to establish migration corridors that would allow animals from insects to large mammals avenues to move to a new environment,” says Wolfe. “Because much of the forested land is privately owned, there will be greater opportunities for citizen science and monitoring.”

Also targeted for monitoring: invasive weeds and insects that will be drawn to the warmer climate. Kudzu, a vine native to China and Japan which already blankets entire landscapes in parts of the American South, will likely climb its way into New York. New statewide tracking systems will be needed to monitor and manage newly arrived pests like the hemlock woolly adelgid, which kills or weakens the trees with a toxin it injects while feeding.

“We need to think about ecosystem services, like air and water purification and flood control,” notes Wolfe. “We’ll need to manage for ecosystem services and biodiversity instead of strict species conservation.”

Water, Water Everywhere?

Results from more than a dozen climate models used by ClimAID researchers, point to more extreme precipitation in the future. Heavy rains and flooding don’t just affect crop yields—flash floods threaten infrastructure and personal property, as more than 120,000 residents in the Binghamton area and northern Pennsylvania found out when they evacuated their homes in the wake of the latest tropical storm.

Overall, precipitation in New York is predicted to increase by 15 percent by 2080, but the pattern of precipitation will change, with more rain falling during the winter months and periods of drought occurring during the summer.

Reductions in the flow of large rivers and lower groundwater tables during summer heat waves could lead to conflicts among competing water users, including farmers, homeowners, and industries.

CALS faculty are already working directly with municipalities to shore up their long-term planning of water resource infrastructure in light of climate predictions.

“We are coaching municipalities on adaptive management—also called non-optimal management—to help them consider possible changes in climate when making decisions regarding when and

where to invest,” says Susan Riha, professor of earth and atmospheric sciences and director of the Cornell Water Resources Institute.

Communities can make critical decisions now about increasing the size of storm pipes, siting wastewater treatment plants outside of high-risk flood plains, and even moving homeowners out of high-risk areas.

The predictions for a plentiful and seasonally variable water supply puts New York in an enviable position for agriculture and summer recreation compared to other parts of the country. But managing the excess water is key, says Riha.

“Climate change was not really a factor in decision-making before now,” says DeGaetano. “But using the climate projections, it’s clear that a larger body of water is a much less risky water source in the long term.”

Tools for Decision-Making

Climate change solutions come at a price, which presents a challenge—at what point does a new climate pattern justify action by New York’s farmers or communities?

With the predictions from the NYSERDA report in place, climate science is transitioning from a focus on projection to strategies for adaptation, mitigation, and the modeling of complex weather patterns.

Wolfe is working with colleagues to develop online decision-making tools to help farmers evaluate when to invest in adaptations such as expanded irrigation capacity or improved drainage systems.

“Farmers will be able to play out scenarios tailored to the unique climate projections for their farm,” says Wolfe. “They will be able to evaluate the difference in profits if they wait five years to invest in irrigation compared to waiting 10 years. We want to give farmers tools to optimize how much and when they invest in adaptation strategies.”

Gang Chen, assistant professor of earth and atmospheric sciences, is developing new methods to predict the location and severity of snow storms. Powerful winter storms can be very expensive to cities due to the cost of snow removal, and were identified in the ClimAID report as a particular threat to citizens in remote rural locations due to service disruptions in power and telecommunications.

Another key partner for decision-makers is the Northeast Regional Climate Center directed by DeGaetano. It is one of six federal centers that collect climate data and develop tools for analysis.

“For years, we have been a trusted source of current and historical weather information for everyone from farmers to lawyers to engineers, and lately we are providing more information about the future climate,” he says.

“One of our goals is to let people know that the weather conditions they take for granted have not only already changed, they will continue to be a moving average.”

Looking to the future, CALS is recruiting researchers who complement existing expertise with new approaches.

“Scientists have been providing information about the impacts of climate change for decades, but what we really could use at this stage is research on coping with the social, economic, and communication challenges,” says Wolfe.

For the full ClimAID report, including climate predictions by region, link to:

http://nysesda.ny.gov/~media/Files/Publications/Research/Environmental/EMEP/climaid/responding-to-climate-change-synthesis.ashx?sc_database=web

