Cornell CALS College of Agriculture and Life Sciences

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"The Role of Climate Research in Supporting Agricultural Resiliency"

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Chairman Scott, Ranking Member Thompson, Members of the Committee, and everyone participating today, thank you for holding this hearing on the critical role of climate research to bolster our food and agriculture systems. I am grateful for the invitation to present on this important topic.

My name is Benjamin Houlton. I am the Ronald P. Lynch Dean of the Cornell University College of Agriculture and Life Sciences, known as Cornell CALS. At Cornell, I hold appointments as a professor of ecology and evolutionary biology and as a professor of global development. My research interests include global ecosystem processes, climate change solutions and agricultural sustainability. I am also founding principal investigator for the Working Lands Innovation Center, directing approximately 100 acres of farmland carbon sequestration projects to improve crop yields and create new financial markets for farmers and ranchers. For nearly two decades I have been working on modeling the global environment and understanding climate change, and for the past decade working explicitly with farmers, ranchers, Indigenous tribes and other partners on solutions for carbon dioxide removal, which is critical to bending the carbon curve and avoiding the most dangerous climate impacts of the future. All of the views expressed in this statement are my own.

At Cornell CALS, we play a critical role in our university's Land-Grant mission to advance the lives and livelihoods of New York residents through our teaching, research and extension activities. New York – as Committee members Maloney and Jacobs can attest – is

an agriculturally vibrant state with a large and diverse array of fruit, vegetable, dairy and livestock production. Partnering with stakeholders statewide, our faculty are committed to translating research findings into evidence-based support for the wide range of farm sizes and types in our state and bringing findings from the field back to campus labs and classrooms. This two-way knowledge exchange is critical to enriching New York farmers, communities and industries with proven methods and technologies.

I believe our agriculture innovation ecosystem can power the breakthroughs needed to tackle society's most dire threat: a rapidly changing climate, which is severely disrupting U.S. and global food production. We have an urgent need for substantial and sustained investment in science-based solutions and strategies that can address our climate challenges while benefiting the farm communities that produce the foods that nourish us. Agriculture has enormous potential to help cool the planet while feeding it — but only if we accelerate development, testing and implementation of our most promising climate-smart farming innovations.

The threats our world and our farmers face

By accessing the expertise and innovation at Cornell and our partner Land-Grant universities, agriculture is poised to lead our next-generation climate solutions. But we cannot afford any further delay: The time to act is now, while there remains an opportunity to protect our food supply from climate extremes. A few examples highlight the urgency of our challenge:

- A recent analysis found that agricultural productivity over the past 60 years was 21 percent lower than it would have been without climate change — the equivalent of seven years of lost productivity growth. This is a disturbing trend, especially when factoring in the growth of our global population, which could reach 10 billion by 2050. This trend is only expected to worsen, with rising global temperatures projected to significantly reduce crop yields in coming decades.
- The western United States has battled increasing droughts and water shortages in recent decades — a trend that is also forecast to worsen in the coming

decades. A recent paper suggests that future megadroughts — extended dry periods lasting two decades or more — will last longer, occur more frequently and create more damage than today's conditions. Climate change is expected to accelerate these effects, pushing Earth nearer to an irreversible tipping point.

- At an average of 49.5 degrees Fahrenheit, 2021 was the third-warmest year on record for the Northeast United States, according to the Northeast Regional Climate Center. Since this record-keeping began in 1895, the three warmest years for the Northeast have occurred within the past 25 years. With increasing greenhouse gas concentrations in the atmosphere, these warming trends are expected to continue, along with more powerful extreme weather events.

- In February 2022, the Intergovernmental Panel on Climate Change — a group organized by the United Nations — issued a report by leading scientists showing major impacts to our world's food systems due to increasing extreme weather events. They signaled a "brief and rapidly closing window to act" to prevent even more crippling consequences.

Every day we see fresh examples of our climate challenges and their dangerous effects. These examples illustrate that climate change is not a faraway or future threat — it is harming lives, businesses and communities right here and right now. And this problem is picking up steam with each passing day, week, month and year. The U.S. along with the rest of the world must act swiftly to address what another recent IPCC report deemed this "code red" crisis for our planet.

Nowhere are the perils more apparent than to our nation's farm and food communities, based predominately in rural areas. High operating costs, volatile commodity prices and stagnating yields are exerting major pressure on farmers, and many are struggling to survive. According to a recent estimate from USDA's Economic Research Service, nearly 90 percent of American farm families require off-farm income to keep their farms afloat.

Further contraction in the agriculture industry and losses in productivity will ultimately threaten our access to safe, affordable food and worsen global hunger, which is already on a menacing rise. Coupled with the fallout of unprecedented crop devastation caused by a fivefold increase in extreme weather events over the past 50 years — triggering rising pest threats and hotter, wetter weather in the Northeast especially — our farming communities and the sectors they support need solutions, now.

Employing science-based solutions to help agriculture fight back and thrive

To put it directly: The global climate is changing steadily from bad to worse. But because we know why it is changing, we can do something about it. Working together, across industry and academia, with local, state and federal governments, hand in hand with our food and farming communities, I am optimistic we can bend the global warming curve to meet our Paris Agreement obligations while ensuring food security for coming generations.

For years the research community has debated whether the most important place to start is by mitigating greenhouse gas emissions or by removing carbon from the atmosphere. The reality is that we need to do both simultaneously: radically reduce emissions and deploy innovative carbon capture methods. Along with these steps, we need to pursue adaptation strategies to keep our farmers in business by helping them to adjust to the stressors of a changing climate. It is going to take every weapon in our arsenal to stop the dangerous warming of our planet and to safeguard our food systems. We are past the point of either/or thinking: We need solutions that create real-time, local adaptation to weather extremes while slashing emissions and capturing greenhouse gases at scale.

This is a major challenge, yet what makes me hopeful are the many promising technologies and methods that are within our grasp. As climate change intensifies, researchers are working hard to help farmers adapt — developing a host of new climate-smart farming solutions, including new drought-resistant crop varieties, improved management practices to conserve water and digital tools to optimize input efficiency.

Significantly, we are finding that agriculture can be a powerful tool for mitigating climate change, and there is much success on which to build additional efficiency gains. The amount of food produced per acre has increased significantly in the U.S., resulting in fewer greenhouse gas emissions per unit of food. The World Resources Institute estimates that increased efficiencies in U.S. agriculture from 1977-2007 led to a 16% reduction in greenhouse gas emissions per pound of beef produced in the United States. Data indicate that livestock and crop production have increased by about 30% from 1997 to 2017 while increasing their greenhouse gas emissions by only 7%. It is critical to celebrate these advancements and recognize the need to do even more in the U.S. agri-food system.

Building on this success, it is clear that farms don't have to be victims of this challenge — they can take active steps to fight against it if the U.S. makes substantial new investments to support practices to capture and store carbon known as "carbon farming." We can increase carbon sequestration in soils by using natural additives such as biochar, compost and rock dust. Add to this such strategies as rotating crops, planting trees and shrubs alongside crops, and reducing soil turning, and farmers can capture and store atmospheric carbon in soils — benefiting our climate while offering new economic opportunity for rural communities.

With farmland making up approximately half of the United States, if American farmers adopted just some of these carbon farming practices today, they would not only reduce their current greenhouse gas contributions but also could capture and store an amount of carbon equivalent to 15% of annual emissions in the U.S. In the long term, carbon farming can even increase resistance to drought, cut fertilizer costs and boost crop yield.

Additional promising new techniques and technologies are under development to broaden farmers' ability to adapt to and combat climate change through reductions in methane, nitrous oxide and other greenhouse gases.

In one exciting example of this work, the Cornell CALS Department of Animal Science, with support from New York state, will install four climate-controlled respiration chambers on campus this year. The first of their kind in the United States, they will support

experiments to reduce climate-warming methane emissions from cattle and other domestic animals, while examining how to optimize animal health, nutrition and production. This innovative project will provide New York dairy farmers with verified, responsible solutions for net-zero operations, ensuring that the technology delivers on its promise before being widely adopted in the marketplace. New science-based technologies to address enteric fermentation coupled with existing technologies, such as anaerobic digester systems and precision manure application strategies, have the potential to significantly reduce methane in the near future, a necessary step to help immediately reduce global warming.

Beyond the existing technologies and approaches, continued pioneering science in boosted photosynthesis can produce higher crop yields while sequestering carbon through new plant varietals. When combined with synthetic biology, artificial intelligence and machine learning, plant geneticists are finding new opportunities to increase photosynthesis and create more resilient seeds for farmers, which will be needed as climate impacts continue to mount.

Equally critical, we must increase financial incentives to support farmers' exploration of opportunities to commoditize carbon and other greenhouse gas emissions and adapt to weather extremes. Not enough farmers in America today can afford to embrace these practices and make a measurable impact. Committing to new practices presents financial risks for farmers already stressed by economic hardship and weather extremes.

As we peruse these strategies, we also need to ensure that we are developing an inclusive culture that delivers on the promise of a more just and equitable farm and food system. The 2017 New York state agriculture census cites that only 1.3% of New York farmers and producers identify as people of color. The lack of money or margins to innovate with climate solutions is felt by farmers of color, many of whom have been historically excluded and tend to own smallholder farms, thus lacking the land and the financial capital to take advantage of these opportunities. Strategies employed by policymakers and granting agencies to target resource allocation for historically underrepresented farmers will be vital for a more just transition to net-zero agriculture.

Through public-private partnerships involving academia, business, government and civic organizations, we can advance the innovative research and scalable technologies needed to achieve this vision. And we can do so in ways that ensure farmers and foresters receive not just public praise for their efforts to sequester carbon, but also support that makes sound economic sense, provides equity and boosts overall farm profitability.

A time for action and investment in our future

As we pursue climate-smart agricultural practices to sustain our world, the Land-Grant system provides a critical research and development test bed to pilot and refine these approaches without placing another financial burden upon our farmers. For all of us to enjoy eating locally produced foods in the decades to come, we need to provide scientists with sufficient and sustained research funding and resources to ensure our crop varieties are climate-adapted in the future, and that we continue to innovate with new tools to help farmers increase production in the face of rapid climate extremities.

As the Committee works to develop new programs and policies to address climate change through research, I'd like to point to two exemplary USDA programs that are models of interagency cooperation and partnership between Land-Grant universities, farmers and communities. First, USDA's Climate Hubs allow collaboration across agencies and with external partnerships to develop and deliver science-based, region-specific decision making, information, and research-informed climate change response. The impacts of climate change span countless scientific disciplines and government programs, so continuing to fund models like this that support holistic research solutions across expertise and federal agencies is key. Another exciting model, the USDA's new Partnerships for Climate-Smart Commodities program, offers grant funding to a wide variety of public and private entities to incentivize market opportunities for commodities that develop and adopt climate-smart practices.

Cooperative Extension programs, which have worked through the Land-Grant system in collaboration with farmers, producers and community groups for more than a century, will be essential to translating scientific research and developing new commercial opportunities from our labs out to the land. The relationships that Cooperative Extension has cultivated among farmers and in communities serve as necessary partners for university-based scientists – they enable us to understand the real-world needs of our stakeholders and assist in deployment of new opportunities, whether they be anaerobic digesters for dairy, new crop varietals for growers, new management practices, or carbon farming through the soil. Even as it is critical that Land-Grant universities continue to leverage Cooperative Extension, it is just as critical that Congress continue to bolster support for these programs. Otherwise, it will be more difficult to succeed at the scale and with the urgency that is necessary to avoid the most dangerous climate outcomes, preserve food security, and revitalize the farm sector and rural communities.

Though helpful, these programs alone are not enough; agricultural research is key to fighting climate change and protecting global food supplies, but pathways to innovation are under threat.

The U.S. has fallen behind competitors China and Brazil in public support for agricultural research, according to a recent report commissioned by Farm Journal Foundation and the American Farm Bureau Federation. U.S. public funding for agricultural research has declined in real dollars since 2003, while investments in other forms of domestic research have risen.

This lack of support means that across the U.S., many potentially groundbreaking studies are significantly underfunded or even unfunded — which can delay or stifle important discoveries. Many universities are in desperate need of infrastructure investments to upgrade laboratories and other facilities for the 21st century. According to the Association of Public and Land Grant Universities, 69% of the buildings and facilities at U.S. schools of agriculture are at the end of their useful life.

Scientific research takes years to refine and develop before new discoveries are ready for the market. Therefore, it is important to prioritize agricultural research funding today, to ensure that our nation's crop and livestock producers can stay one step ahead of the climate crisis. It is disappointing that the U.S. – which is one of the largest and wealthiest consumers and producers of food on the planet – is not leading the world in research and development of climate-smart solutions for agriculture.

Just as important as supporting USDA-funded agriculture research, it is equally critical that Congress support cross-agency research and development programs. We should be encouraging more linkages between the National Science Foundation and its emphasis on translation; the Department of Energy and its focus on synthetic biology, carbon capture and renewable energy; and the National Institutes of Health and its focus on public health; among others. Like-minded federal agency programs could be coordinated with the USDA to develop future-forward "moonshots" for agriculture with a focus on the development of new carbon-smart approaches that create healthier and more equitable food systems as well as energy deployment that empowers rural communities and historically marginalized and disadvantaged people in the United States. Cross-agency programs could spur new innovations and scientific discoveries across disciplines, from computer science to plant breeding, engineering to public health, landscape development and soil science to economics and finance. Just like with the Human Genome Project, we need a concentrated effort in agriculture and food of the future if we are to succeed in reducing emissions and capturing carbon from the air. Doing so will help ensure that the best and brightest scientific ideas make it from our university laboratories into farmers' hands — turning the agricultural industry into a climate change success story and creating a more food-secure future for all of us.