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Written Public Witness Testimony of
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Before the Senate Committee on Appropriations
Driving Innovation through Federal Investments

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The American Society of Agronomy (ASA), Crop Science Society of America (CSSA), and Soil Science Society of America (SSSA), represent over 18,000 members in academia, industry, and government, 12,500 Certified Crop Advisers (CCA), and 781 Certified Professional Soil Scientist (CPSS), as the largest coalition of professionals dedicated to the agronomic, crop and soil science disciplines in the United States. We are dedicated to utilizing science to manage our agricultural system and sustainably produce food, fuel, feed, and fiber for a rapidly growing global population in the coming decades.

We must close the innovation deficit if the United States is to remain the world's innovation leader in food and agriculture. China continues to exhibit the world's most dramatic R&D growth at 20.7 percent annually, compared to the United States at 4.4 percent growth over the same time period. China's investment in agricultural R&D doubled from 2001 to 2008 and government commitments are expected to increase further in the coming years. By 2009, agriculture R&D fell to a historically low 0.035 percent share of the United States economy, a level far below the total U.S. R&D spending. Investing in research and innovation through the United States Department of Agriculture (USDA) is necessary to meet the critical challenges facing U.S. agriculture in the 21st century.

The Nation's economic prosperity and security depend on our dedication to developing innovative, science-based solutions to meet our growing agricultural needs and managing efficient food systems. Here is a limited sample, restricted only by the page limits, of food and agricultural R&D innovations that began with a federal investment.

Alabama Farmers Reap Big Savings with Precision Ag, Auburn, Alabama

Alabama Agricultural Experiment Station scientists at Auburn University began investigating precision agriculture technologies 15 years ago. Now, approximately 60 percent of row-crop farmers across the state who have adopted precision ag technologies or site-specific management strategies on their collective 670,000-plus acres saved an estimated $10 million on crop inputs. Guidance systems, which reduce overlap and input

usage, can on average save approximately 10% on input savings with farmers seeing a possible 15% to 30% overall savings.

Precision agriculture is an ever-evolving approach to farming in which producers use GPS, aerial images and geographic information systems software as well as sensors installed on farm machinery to gather detailed data about how soil fertility, terrain, weed populations, crop yields and other conditions affecting crop growth vary within a given field.

Two Lawrence County farmers, grain producer Don Glenn and cotton farmer Larkin Martin, were among the first growers in the state to venture into the age of precision ag when it was in its infancy, and both credit the tools of precision farming for helping them boost their productivity and profitability. They also acknowledge that the ongoing precision ag research scientists are conducting through the Alabama Precision Ag Program at Auburn and the training and *technical help the Alabama Cooperative Extension System provides have been essential* in advancing the technology.

Changing the Landscape of Food Production in Northeastern US

Between 1982 and 2007, Rhode Island, New Jersey, and three other Northeastern states lost a larger proportion of their agricultural lands to development than anywhere else in the country. The region now has nearly 25% of the United States' population, but only 5% of its farmland. As much as 75 to 80% of the fruits and vegetables consumed in the Northeast come from concentrated production areas like California.

Enhancing Food Security in the Northeast (EFSNE) is a USDA-funded Agriculture and Food Research Initiative (AFRI) that seeks to determine whether greater reliance on regionally produced food could improve food access and affordability in disadvantaged communities, while also benefiting farmers, food supply chain firms and others in the food system.

This research takes advantage of the large amount of highly detailed spatially referenced data available in the U.S. and couples it with sophisticated agricultural modeling tools to provide a framework to assess multiple aspects of critical food security issues. Results, including the Geospatial Agricultural Management and Crop Assessment Framework (GAMCAF), are expected to aide in further assessment of regional production capacity and constraints.

The EFSNE project engages more than 40 individuals at multiple universities, non-profits and government agencies, including: Columbia University, Cornell University, Delaware State University, Johns Hopkins Bloomberg School of Public Health in Baltimore, MD, Penn State University, Tufts University, University of Vermont, USDA Agricultural Research Service, Beltsville, MD, USDA Economic Research Service, Washington, DC, West Virginia State University, and the Northeast Sustainable Agriculture Working Group, 12-state network of over 500 participating organizations over Connecticut, Delaware, Massachusetts, Maine, Maryland, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia

Improved Crop Monitoring Takes Flight, Kansas State Univ, Manhattan, Kansas

Dr. Kevin Price turns aerial images of fields into information a farmer can use to make management decisions. Unmanned aircraft systems (UAS) in agriculture, commonly known as drones, equipped with cameras can be flown just above crops to monitor conditions such as nitrogen fertilizer status or disease.

Working closely with the companies RoboFlight Systems, Inc. and Goldfinch Technologies, the team has now created new software called AgPixel. The program converts the pixel data in digital photos into a key measure of plant growth and vigor. With just a few clicks farmers can have AgPixel compare values across the entire field to those from a reference strip where crop plants are given all the nitrogen fertilizer they can handle. The final output is a map of variation in plant growth linked to crop nitrogen status that can be used to apply fertilizer where it's needed to boost crop yield. A UAS can collect the needed image data from a 640-acre field in about 20 minutes.

After becoming commercially available in August 2013, AgPixel has captured the attention of more than 130 companies in 40 countries. According to a recent study by the Association for Unmanned Vehicle Systems International small-unmanned aircraft will be an $85 to $100 billion industry by 2025, with 80% of that money being spent in agriculture.

Crop Sensing Using Active Light Source Sensors, USDA-ARS, Lincoln, Nebraska

Precision agriculture technologies are becoming an integral part of farming operations for crop production, including fertilizer management in the U.S. Corn Belt. In early 1990, Dr. James S. Schepers, leader of ARS Soil and Water Conservation Research Unit in Lincoln, Nebraska, developed remote-sensing technology using electronic sensors perched atop high-clearance crop canopy sprayers. The sensors measure a plant's photosynthetic activity and vigor then uses the information to dispense liquid fertilizer at variable, rather than fixed, rates. The sensors reduce fertilizer application across fields by about 25-30 pounds per acre, while maintaining crop yields, increasing profitability, and promoting equitable land stewardship.

This research, as well as similar at research at Oklahoma State University, led to commercially available sensors. The companies Ag Leader, in Nebraska, and Trimble, in Oklahoma and California, manufacture CropCircle ™ and GreenSeeker ™. Farmers using crop canopy sensors technology generate an increase in returns ranging from $5 to $20 per acre.

Climate And Social Scientists Help Refine Climate Tools For Agriculture

AgClimate View$_{DST}$ and Corn Growing Degree Day$_{DST}$ are the first two of a suite of products from the Useful to Usable project (U2U) to help farmers manage increasingly variable weather and climate conditions.

The project, funded by the USDA's National Institute of Food and Agriculture, is composed of a team of 50 faculty, staff and students from nine universities who specialize in applied climatology, crop modeling, agronomy, cyber technology, agricultural economics and other social sciences. Dr. Linda Prokopy, associate professor of forestry and natural resources at Purdue University in West Lafayette, Indiana, leads the team.

The social science research on the front end helped the team create easy to use tools that make climate data accessible and useful to the agricultural community. A goal is to demystifying climate data one user at a time so that producers will use the information to make better decisions and ultimately increase yields with minimal environmental impact

U2U project partners are: Iowa State University, Michigan State University, South Dakota State University, University of Illinois, University of Michigan, University of Missouri, University of Nebraska, University of Wisconsin, High Plains Regional Climate Center in Lincoln, NE, Midwestern Regional Climate Center in Champaign, IL, and the National Drought Mitigation Center in Lincoln, NE.

Farmer Perspectives on Agriculture and Weather Variability in the Corn Belt: A Statistical Atlas, Iowa State University

Climate change-related threats to agricultural sustainability are leading to increasingly urgent calls for the development of effective adaptation strategies. In 2011, the USDA funded the Climate and Corn-based Cropping Systems Coordinated Agricultural Project (CSCAP). The project seeks to increase resilience and adaptability of Midwest agriculture to more volatile weather patterns by identifying farmer practices and policies that increase sustainability while meeting crop demand.

The effectiveness of any adaptation or mitigation action in Corn Belt agriculture depends on the degree to which the region's farmers are willing and able to act. A primary objective of this project is to conduct social science research that assesses farmer understanding of climate change and attitudes toward adaptive and mitigative practices and strategies. Toward that end, a survey of 5000 farmers from 22 watersheds in 11 Corn Belt states was conducted in February 2012.

The survey was conducted in partnership with the Useful to Usable (U2U) project, another USDA-funded climate and agriculture project. The 11 institutions comprising the project team include: University of Illinois, Iowa State University, Lincoln University, Michigan State University, University of Minnesota, University of Missouri, The Ohio State University, Purdue University, South Dakota State University, University of Wisconsin, and USDA-ARS Columbus, Ohio.