Testimony of

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On

Innovation in American Agriculture: Leveraging Technology and Artificial Intelligence
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Good morning, Chairwoman Stabenow, Ranking Member Boozman and Members of the Committee. I'm happy to be here today to discuss the topic of leveraging technology and artificial intelligence for innovation in American agriculture.

My name is Mason Earles and I'm an Assistant Professor at the University of California, Davis. I'm also a Co-PI and Agricultural Production Cluster Lead at the USDA funded National AI Institute for Next Generation Food Systems, along with a Co-Founder and CEO of an emerging agricultural technology startup called Scout. Prior to joining UC Davis, I worked as a Data Science Engineer at Apple, and before this I studied fundamental and applied plant physiology. Today, my lab at UC Davis sits at the crossroads of agriculture and artificial intelligence, or AI. I lead a team of engineers, computer scientists, and biologists who are making AI-enabled sensing systems that aim to help agricultural producers manage more precisely, efficiently, and sustainably. However, I'm not here just to talk about what we do in my lab but I want to more broadly discuss the rapidly

growing trend of AI and technology in agriculture and food systems, and the role of research institutions in spurring such innovation.

We're sitting here today because of unprecedented advancements in hardware and software which have massively expanded the capacity of AI computer programs to learn from complex real-world data like what we see in agriculture and food systems. Before going any further, however, I would like to define "AI" using a relevant example. Put simply, an AI is a computer program that takes in one or more inputs, like an image, audio recording, or table of data, and outputs some prediction or physical action. As an example, let's say we input into our computer program thousands of images taken from a camera mounted on a tractor weeding implement in a carrot field and we want the AI to predict if an invasive weed, such as nightshade, is present in the image; which could in response trigger a precise herbicide spray application. We typically train these AI computer programs by showing them many examples of inputs with "correct" outputs. In our carrot versus nightshade example, this means that a human first categorizes which images do or do not have nightshade – literally clicking "yes" or "no" on a screen. The AI computer program then repeatedly tries to predict which images contain nightshade versus carrots and is penalized for incorrect predictions. Once training reaches a desired performance target, this AI can then be used to automate the detection, and potentially spraying, of nightshade based on input images without the need for human categorization. This is just one of many, many possible examples of the growing number of current and potential applications of AI in agriculture and food systems.

At the AI Institute for Next Generation Food Systems, our team of more than forty researchers across six national institutions aims to accelerate critical solutions to big challenges in the food supply chain, from crop breeding and farming to food processing and nutrition. Imagine if AI could bring together genomic and sensor data to uncover novel molecular patterns to enable

plant breeders to discover more flavorful and nutritious strawberries. Now, imagine those same strawberries growing in a field where hundreds of cheap, paperclip-sized soil sensors are measuring nutrient and water stress, and wirelessly sending data to a drone that flies overhead each day. After harvest, these strawberries are transported to a processing facility that rapidly samples washwater to rule out the presence of *E. Coli* pathogens using AI-enabled microscopy. Finally, a consumer points their phone at their plate which uses AI to estimate the macro- and micronutrients of the strawberries and every other ingredient they're about eat. Critically, the socioeconomic and ethical risks of introducing AI tools across the food supply chain, such as data privacy and security, and potential effects on labor must be considered. Our researchers and industry partners at the AI Institute for Next Generation Food Systems are investigating each of these topics, among many others. We see ourselves as one of the world's leaders in research, development, and commercialization of such novel open-sourced AI-based solutions in food and agriculture. We do this through a three-pronged strategy of multidisciplinary science, industry engagement, and workforce development.

Such a massive effort and innovation is made possible by more than $20M in funding provided over five years by USDA's NIFA as part of NSF's National AI Institutes. In fact, four additional National AI institutes focused on food and agriculture are funded by USDA NIFA, totaling more than 30 research institutions and industry partners across America. These National AI institutes are working on programs that aim to relieve labor shortages via AI-driven robotic harvesters in tree crops, monitor the health and stress of livestock using AI-enabled sensors, and predict climate and crop risk by building AI-accelerated models that could eventually be used to precisely control irrigation and nutrient emitters. Each of these AI Institutes is focused on tech transfer and meeting industry needs, with partners including dairy producers, soybean farmers,

chemical and agricultural machinery producers, among others. Thinking to the future of our workforce, in 2021 more than 161,000 undergraduate and graduate computer science degrees were awarded in the U.S. alone. While we don't have exact numbers, a very small fraction of these students ends up working in the agricultural and food sector. This needs to change. Building on these accomplishments and to keep America as a global leader in agricultural innovation, I strongly encourage the Committee to continue, and even expand, funding for these National AI Institutes among other funding sources provide through the USDA that focuses on AI solutions for food and agriculture. I believe that this is how we will accelerate more research innovation and industry collaboration, and create a wider funnel for motivating more computer science and engineering students to solve the big challenges in the agricultural sector via AI and new technology.