

**Congress of the United States**  
**U.S. House of Representatives**  
**Committee on Small Business**  
2361 Rayburn House Office Building  
Washington, DC 20515-0515

**MEMORANDUM**

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TO: Members, Subcommittee on Innovation and Workforce Development  
FROM: Rep. Jason Crow, Chairman  
DATE: January 9, 2020  
RE: Subcommittee on Innovation and Workforce Hearing entitled “Farming in the 21<sup>st</sup> Century: The Impacts of Agriculture Technology in Rural America” on Thursday, January 9, 2020 at 10:00 a.m. in Room 2360 of the Rayburn House Office Building

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**On Thursday, January 9<sup>th</sup> at 10:00 am in Room 2360 of the Rayburn House Office Building**, the Subcommittee on Innovation and Workforce will hold a hearing entitled: “Farming in the 21<sup>st</sup> Century: The Impacts of Agriculture Technology in Rural America”.

Like every industry, technology is changing how business is conducted - modern farming and its operations are no different. Advanced machinery, robotics, sensors, information technology, and aerial imagery are making food production more efficient and creating jobs in rural communities.

The hearing will give Members the opportunity to hear from experts in the agricultural technology (ag-tech) industry, farmers that are leveraging technology to be more sustainable and profitable, and startups in the ag-tech field. Members will have the opportunity to hear about benefits that ag-tech can provide to farmers and rural communities, as well as the challenges facing businesses in the space.

Witnesses include:

- Mr. Kevin France, President and CEO, SWIIM Systems, Denver, CO.
- Dr. David Potere, Head of GeoInnovation, Indigo Agriculture, Boston, MA.
- Mr. Roberto Meza, Co-founder and Farmer, Emerald Gardens, Bennett, CO., Testifying on behalf of the Rocky Mountain Farmers Union
- Dr. Douglas Jackson-Smith, Assistant Director, School of Environmental Resources, The Ohio State University, Wooster, OH.

**Background**

Innovation and adoption of digital technologies are changing the way business is done. Like other industries, the business of agriculture around the world is undergoing a technological revolution. Agriculture Technology, or ag-tech, can be any kind of innovative technology that enhances

agriculture by increasing productivity, improving the efficiency of resource use, and reducing ecological impacts.<sup>1</sup>

Advances in digital technology and innovation are transforming the way our food is produced, processed, distributed, and sold. Ag-tech, like precision agriculture, helps farmers increase yields and reduce waste, thereby increasing productivity. Through deployment of real-time data in the fields, farmers can pinpoint and address issues that are causing poor production. Technological advancements such as Global Positioning System (GPS), drones, robotics, satellite imagery, big data, and artificial intelligence are becoming an indispensable part of doing business and helping America's farmers and ranchers become more productive, sustainable, and profitable. As a result, ag-tech has the ability to change the way food is produced, spur innovation, create jobs, and reduce environmental and ecological impacts.

## **Types of Ag-Tech**

### *1. Precision Agriculture*

Advances in ag-tech have led to the adoption of “precision agriculture” - using technology to make farming more accurate and controlled. GPS guidance for tractors is considered the first use of precision agriculture, which John Deere pioneered in the 1990s.<sup>2</sup> Using GPS location data from satellites, farm equipment can steer autonomously based on the coordinates of a field.<sup>3</sup> The precision that comes with GPS technology reduces steering errors and overlapping passes on farm fields, resulting in more efficient use of farm inputs such as seed, fertilizer, fuel, and time. The adoption of GPS technology is now so widespread globally in agriculture that it is possibly the most commonly used example of large-scale precision agriculture today.<sup>4</sup>

### *2. Digital Devices*

Innovation in ag-tech has moved beyond GPS-guided equipment to include the use of information technology and a wide range of digital devices such as remote sensors, robotics, drones, and data software. For example, remote sensors and sampling provide farmers with real-time information about their soils, land, water, animals, crops, weather and other externalities. Using variable rate technologies, computer software and GPS technology, they can then leverage this information to precisely control the use of water, fertilizer, and pesticides. These technologies are applicable in every aspect of the agricultural supply chain such as physical inputs, information inputs, plant and animal farming, food processing, and logistics. As a result, modern farms can have higher crop production, while minimizing the use of water and fertilizer which keeps food prices down.

### *3. Data Collection*

With agricultural technology, farmers are not just growing and harvesting crops, they are also generating and harvesting massive amounts of data. As briefly mentioned above, technology allows farmers to collect data on crop yields, animal health, plant health and growth, soil moisture,

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<sup>1</sup> JAMES MANYIKA, ET. AL. DIGITAL AMERICA: A TALE OF THE HAVES AND HAVE-MORES, MCKINSEY GLOBAL INSTITUTE (2015).

<sup>2</sup> Gina Anderson, *How NASA and John Deere Helped Tractors Drive Themselves*, NASA SPACETECH (April 18, 2018), [https://www.nasa.gov/feature/directorates/spacetechn/spinoff/john\\_deere](https://www.nasa.gov/feature/directorates/spacetechn/spinoff/john_deere)

<sup>3</sup> Gina Anderson, *How NASA and John Deere Helped Tractors Drive Themselves*, NASA SPACETECH (April 18, 2018), [https://www.nasa.gov/feature/directorates/spacetechn/spinoff/john\\_deere](https://www.nasa.gov/feature/directorates/spacetechn/spinoff/john_deere)

<sup>4</sup>Remi Schmaltz, *What is Precision Agriculture*, AG FUNDER NEWS (April 24, 2017), <https://agfundernews.com/what-is-precision-agriculture.html>.

weather conditions, weed competition, and other factors on every acre of every field. This measurement data can help better manage their operations and identify efficiencies that can lead to higher productivity and lower input costs.

## **Benefits of Ag-Tech**

### *1. Food Production*

By 2050, the population of the planet is expected to reach around 9.3 billion people.<sup>5</sup> This increase in population will cause worldwide food demand to rise by 70 percent by the year 2050.<sup>6</sup> In other words, over the next 30 years the world's farmers must produce as much food as has been grown in the last 8,000 years of agriculture combined.<sup>7</sup> Producing food to meet rising global demand will not come without challenges.

Ag-tech is well suited to address pressures on global food production and many see world agriculture ripe for a “technological” revolution.<sup>8</sup> Thanks to a range of technologies, such as GPS guided tractors and precision guided planters, farmers have been able to increase yields in a variety of staple crops. With corn, for example, farmers have gone from 30,000 plants per hectare in the 1930s to over 80,000 today.<sup>9</sup>

Advances in technology also help farmers continue to operate, even in the face of farm labor challenges. Advancements in robotic, such as robotic milkers on dairy farms or robotic fruit pickers in orchards, is technology that is being developed rapidly. Many medium-sized family farms are looking to adopt robotics and utilizing farm labor in more innovative ways. Advances in robotics may be one of the technological advances that tip the economic balance back towards modest-sized family farms.

### *2. Environment and Conservation*

Agriculture systems across the globe are highly dependent on a stable climate, as well as access to arable land and fresh water. However, unpredictable weather patterns and climate change are having disastrous impacts on agricultural production. Modern industrialized farming traditionally relies on crop treatments such as pesticides and fertilizers that are formulated and recommended for farmers to use in average conditions. Because of the wide variability in farms such as, soil type, weather patterns, and other externalities, this has led to over- and under-applications of herbicides, pesticides, irrigation, and fertilizers.<sup>10</sup> Chemical excesses from blanket applications end up running off or leaching from fields into ground water and surface waters.<sup>11</sup>

Ag-tech can help to reduce farming's environmental impact and carbon footprint through a highly efficient use of resources—everything from fertilizer and pesticides to water and seeds. Ag-tech

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<sup>5</sup> U.N. Dep't of Econ. and Soc. Affairs, *World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100*, <https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html>

<sup>6</sup> U.N. FOOD AND AGRIC. ORG., *HOW TO FEED THE WORLD IN 2050* (2009).

<sup>7</sup> U.N. FOOD AND AGRIC. ORG., *HOW TO FEED THE WORLD IN 2050* (2009).

<sup>8</sup> JAMES MANYIKA, ET. AL. *DIGITAL AMERICA: A TALE OF THE HAVES AND HAVE-MORES*, MCKINSEY GLOBAL INSTITUTE (2015).

<sup>9</sup> Linus Blomqvist, *Precision Agriculture: Bigger Yields from Smaller Farms*, THRIVE, March 20, 2017.

<sup>10</sup> U.S. DEP'T. OF AGRIC. *PRECISION AGRICULTURE IN CROP PRODUCTION*, <https://nifa.usda.gov/precision-agriculture-crop-production>

<sup>11</sup> *Id.*

sensors, algorithms, and image-recognition software all have the potential to make farming more efficient by reducing farm run-off, decreasing the amount of pesticides used in blanket applications, and improving fertilizer use. Through more scientific soil, water, and animal management, ag-tech can help to significantly reduce agricultural greenhouse gas emissions.<sup>12</sup>

### 3. Job Creation and Economic Development in Rural America

Driven in part by the digital revolution in agriculture, towns and businesses are seizing on the opportunities to bring well-paying tech jobs to rural areas. Ag-tech businesses are often located around places that can help them connect with their farm customers. Thanks to both public and private investment, rural America is seeing a sizeable uptick in startups, tech ventures, and private equity investments in ag-tech.

In the short run, precision agriculture and increased mechanization will mean that fewer workers will be needed for production.<sup>13</sup> GPS guidance allows farmers to accomplish more and reduce fatigue, especially in peak periods. In the longer run, ag-tech is creating a demand for more skilled workers. Across the country, skilled tech workers are already in high demand and small businesses in rural America are facing the same challenges as other parts of the country, namely bridging the skills gap and finding, hiring, and retaining qualified workers. Already agricultural suppliers and farm equipment companies worldwide are competing for employees who understand GPS, sensors, drones, and spatial data analysis.<sup>14</sup> While investment in the heartland is poised to hit record highs, the inability for small firms to build a reliable workforce potentially weakens the deployment of that capital.<sup>15</sup>

Beyond farms themselves, ag-tech opportunities can have staggering ripple effects on the rural communities. Investments can help bring improved broadband access to rural communities, as well as increased support for other infrastructure development. As technology drives our future forward, investing in digital infrastructure is vital to give every community the opportunities to participate. Overall, the digital revolution in agriculture can help farmers be more efficient, reduce the demands of on-farm labor, and can help drive demand for high paying jobs in both ag-tech and farm services sectors.

### **Entrepreneurship, Small Business and Investment in Ag-Tech**

Considering the challenges that agriculture is facing, and the promises of ag-tech, there are numerous opportunities for small businesses and entrepreneurs. The sector has great investment opportunities due to the certainty in increasing demand for food, fuel, and fiber as the world's population continues to grow. Globally, investment in technology across the food and agricultural supply chain reached \$16.9 billion in 2018.<sup>16</sup> There has been a fourfold growth in investment in these sectors since 2014. In 2017, more than \$1.5 billion was investing in ag-tech startup

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<sup>12</sup> Tamme Van Der Wal, *Precision Farming Could Help Reduce Climate Gas Emissions*, FUTURE FARMING, March 31, 2018.

<sup>13</sup> Jess Lowenberg-DeBoer, *Yield of Dreams: How Precision Agriculture Will Help Feed the Planet*, TREND, June, 12, 2017.

<sup>14</sup> *Id.*

<sup>15</sup> Pete Wilkins, *Why The Midwest Drives Top Venture Returns*, FORBES, May 16, 2019, <https://www.forbes.com/sites/peterandrewwilkins/2019/05/16/why-the-midwest-is-among-the-best-places-for-venture-investment/#533615c54742> (last visited Sep. 26, 2019).

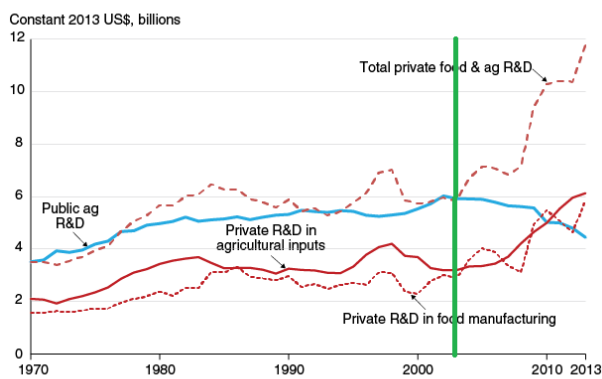
<sup>16</sup> AGFUNDER, AGRIFOODTECH INVESTING REPORT, 2018.

businesses.<sup>17</sup> In 2018, this number increased to over \$2 billion. This influx of investment has led to number of accelerators and other resources available for tech startups in the food and agriculture industry.<sup>18</sup>

While there has been robust private investment in ag-tech, Federal investment in agriculture research has decreased in comparison. In 2013, \$16.3 billion was spent on agricultural research and development (R&D) in the United States, of that only about \$3 billion came from the Federal Government.<sup>19</sup> By 2018, the amount the USDA invested in agriculture research and development decreased to about \$2.5 billion. Yet it was public investment in agricultural R&D that was the driving force behind most innovations, helping to lead the increase in the United States agricultural industry’s efficiency in the 20th century.<sup>20</sup> Unfortunately, while other countries continue to increase investment in agriculture research, public funding for agriculture R&D in the U.S. is down over 30% from 10 years ago.<sup>21</sup>

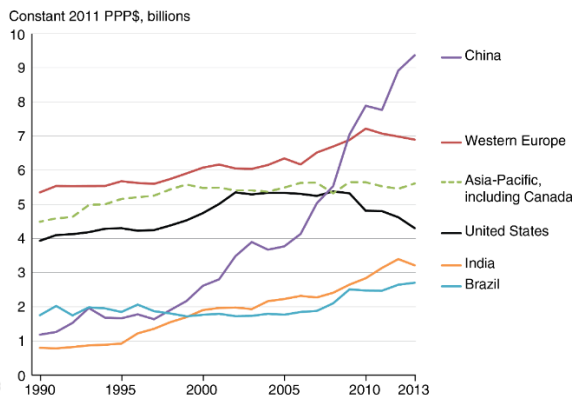
This presents an opportunity for public-private partnerships (PPP) to support investments that address the needs of farmers and rural communities. For example, leveraging the work done by public Land Grant Universities with private sector investment has the ability to generate innovation in agriculture technology that leads to improved production, cultivation, and resource management.

Private sector and public sector funding of R&D begins to diverge significantly in the early 2000s



Annual spending on research is adjusted for inflation by a research price index constructed by ERS. R&D = research and development. Source: USDA, Economic Research Service.

U.S. public sector funding for agricultural R&D falls as spending by China and India rises



PPP = purchasing power parity. Source: USDA, Economic Research Service and Agricultural Science and Technology Indicators (ASTI), Organisation for Economic Cooperation and Development.

### Small Business Ag Research

One program that supports small business agricultural innovation and research is the Small Business Innovation Research (SBIR) program. This highly competitive program encourages domestic small businesses to engage in Federal Research/Research and Development (R/R&D) that has the potential for commercialization. Through a competitive awards-based program, SBIR

<sup>17</sup> Jane Bryne, *Agriculture is the least digitized sector globally, so it is ripe for disruption*, FEED NAVIGATOR, Oct 22, 2019.

<sup>18</sup> Jane Bryne, *Agriculture is the least digitized sector globally, so it is ripe for disruption*, FEED NAVIGATOR, Oct 22, 2019.

<sup>19</sup> MATTHEY CLANCY, ET AL., UNITED STATES AGRICULTURAL R&D IN AN ERA OF FALLING PUBLIC FUNDING. USDA ERS, 2016.

<sup>20</sup> MATTHEY CLANCY, ET AL., UNITED STATES AGRICULTURAL R&D IN AN ERA OF FALLING PUBLIC FUNDING. USDA ERS, 2016.

<sup>21</sup> MATTHEY CLANCY, ET AL., UNITED STATES AGRICULTURAL R&D IN AN ERA OF FALLING PUBLIC FUNDING. USDA ERS, 2016.

enables small businesses to explore their technological potential and provides the incentive to profit from its commercialization. The SBIR program at the U.S. Department of Agriculture (USDA) awards grants to qualified small businesses to support research on important scientific problems and opportunities in agriculture, that could have a public benefit. The SBIR program also fosters and encourages participation by women-owned and socially or economically disadvantaged small businesses. By including qualified small businesses in the nation's R&D arena, high-tech innovation is stimulated, and the United States gains entrepreneurial spirit as it meets its specific research and development needs.

Specifically, the USDA SBIR program focuses on: 1) forests and related resources; 2) plant production and protection; 3) animal production and protection; 4) air, water and soils; 5) food science and nutrition; 6) rural development; 7) aquaculture; 8) biofuels and bio-based products; small and mid-size farms; and 9) plant production and protection. The program remains a very important part of small business innovation and assists in the future of farming.<sup>22</sup> Overall, the USDA SBIR program supports small business innovation and development of ag-tech, and in the future of agriculture.

### Reliable Broadband

Access to reliable, affordable, high speed connectivity, such as broadband or cellular service, is not only crucial for economic development in rural communities but is necessary to power and support ag-tech. Much of the farm data is collected in real-time and transmitted via broadband and cellular signals, ultimately ending up on the cell phones, tablets, and computers of farmers.

Despite federal programs and support, rural America has not seen broadband deployed at the same speed and effectiveness that we saw electricity and telephone infrastructure developed almost a century ago. According to the USDA, 73% of farms have access to a computer, 75% have access to the internet, and 52% have a smartphone.<sup>23</sup> This is significantly lower than the general population, where 89% of households have a computer, 81% have internet access, and 67% have a smartphone.<sup>24</sup>

When connectivity isn't reliable enough to support digital devices, or farmers don't have access to devices, the benefits derived from ag-tech are substantially diminished.<sup>25</sup> Recognizing the challenges and opportunities of ag-tech, the 2018 Farm Bill called for the Federal Communications Commission to work with the USDA and bring together a Precision Agriculture Task Force, to enhance the productivity and efficiency of farms and ranches through broadband-based technologies.

Digital technology and infrastructure perform a similar function as other types of infrastructure, such as roadway systems. Without this infrastructure, farmers are not able to realize the full benefits of ag-tech. Expanding digital infrastructure should be incorporated into a broader

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<sup>22</sup> U.S. DEP'T. OF AGRIC., REQUEST FOR APPLICATIONS, SBIR PROGRAM PHASE 1, 2019.

<sup>23</sup> U.S. DEP'T. OF AGRIC., A CASE FOR RURAL BROADBAND, APRIL 2019..

<sup>24</sup> U.S. CENSUS BUREAU, COMPUTER AND INTERNET USE IN THE UNITED STATES: 2016, AMERICAN COMMUNITY SURVEY REPORTS, Aug. 2018.

<sup>25</sup> U.S. DEP'T. OF AGRIC., A CASE FOR RURAL BROADBAND, APRIL 2019.

infrastructure plan so that the U.S. can achieve its goal of providing broadband access for all U.S. residents.

### **Conclusion**

Agriculture, both large and small, face tremendous challenges to produce healthy, affordable food to feed a growing population in the face of climate change. Thanks to innovation across the ag-tech space, large farms are able to take advantage of data and information to help address these challenges. However, small farms that don't have the same efficiencies and economies of scale as larger industrial farms, and have not always been successful in benefiting from advances in ag-tech. Because of increasing research, development, and entrepreneurship, ag-tech is growing into a dynamic sector that is creating jobs across the country, supporting rural communities, and is increasingly assessable and affordable for smaller farms. The rapid and widespread adoption of technology like smartphones suggests that if precision agriculture companies and researchers can develop technologies that solve farmer problems at a low cost, there is a tremendous market waiting.