

Congress of the United States
U.S. House of Representatives
Committee on Small Business
2561 Rayburn House Office Building
Washington, DC 20515-0515

Memorandum

To: Members, Committee on Small Business Subcommittee on Agriculture, Energy, and Trade
From: Committee Staff
Date: October 2, 2017
Re: Hearing: “High-Tech Agriculture: Small Firms on the Frontier of Agribusiness”

On Thursday, October 5, 2017 at 10:00 A.M., the Committee on Small Business Subcommittee on Agriculture, Energy, and Trade will meet in Room 2360 of the Rayburn House Office Building for a hearing titled, “High-Tech Agriculture: Small Firms on the Frontier of Agribusiness.”

This hearing will examine rapid development of the agricultural technology (agtech) industry driven by the private sector. Entrepreneurs are tackling industry challenges and facilitating technology transfer from the lab to the farm to the table. Agricultural regions are competing to be the next great innovation hub, which has spurred rural revitalization. The discussion will explore issues beyond the headlines to understand the role of small businesses and the perspective of small family farmers.

I. The Agtech Industry

Agricultural research and development (R&D) investment is a major driver of United States agricultural industry strength. Compared to 1948, today’s farmers use less land and labor due to technological advances and declining costs of chemicals and machinery.¹ The farm sector’s adoption of structural, organizational, and technological advances resulted in a 156 percent output growth over a sixty year span.² R&D investment generates innovations while extension activities and infrastructure facilitate farmers’ access to new technologies and methods.³ Extension activities are outreach programs by state and county experts to educate farmers, such as farm practice demonstrations, workshops, farm visits, publications, and online information.”⁴

Historically, public research investments have triggered private sector investments in similar agricultural programs.⁵ Studies have found that private sector research complements, but does

¹ SUN LING WANG, ET. AL., AGRICULTURAL PRODUCTIVITY GROWTH IN THE UNITED STATES: MEASUREMENT, TRENDS, AND DRIVERS, ECON. RESEARCH SERV., U.S. DEPT. OF AGRIC. 19 (Jul. 2015), https://www.ers.usda.gov/webdocs/publications/45387/53417_err189.pdf?v=42212 [hereinafter SUN LING WANG, ET. AL.]

² *Id.*

³ *Id.* at 2.

⁴ *Id.*

⁵ *Id.* at 40.

not replace, public sector efforts.⁶ Private sector R&D invests heavily in food manufacturing and crop advancement to develop marketable goods, whereas public sector R&D prioritizes efforts that directly benefit farmers and the general public.⁷ Private sector R&D funding has grown rapidly with an average growth of two percent per year, whereas public sector funding had an average growth of 0.87 percent per year.⁸

Private sector participation in agriculture R&D surged as a result of four main developments. In the 1970s and 1980s, intellectual property rights were extended to accommodate biotechnology innovations which encouraged enough private sector R&D to make public crop breeding programs obsolete.⁹ In addition to attracting private investment, the field of biology absorbed techniques from physics, engineering, and mathematics and produced significant technologies for agriculture.¹⁰ Increased access to foreign markets and demand for U.S. agriculture technologies generates greater and faster returns on R&D investments, thus spurring more private R&D.¹¹ Finally, the private sector has a larger share of total agriculture R&D because public funding has declined.¹² In 2008, China surpassed the U.S. in major public agricultural R&D spending.¹³

a. Global Effort

In 2009, the Food and Agricultural Organization of the United Nations (FAO) convened a forum titled, “How to Feed the World 2050,” and presented findings that have become a rallying call for agtech advocates. FAO reported that agriculture productivity must increase by 70 percent to feed a global population of 9.1 billion.¹⁴ This challenge has motivated a new wave of participants in the agtech industry and expanded its reach. Today, most private sector agtech investment deals are made in the United States, India, Canada, the United Kingdom, Israel, and France with the United States, China, India, Canada, and Germany having the highest dollar funding totals.¹⁵ Startup accelerators have been launched in Australia, Argentina, Uruguay, Brazil, and Eastern Europe.¹⁶

⁶ *Id.*

⁷ *Id.* at 41.

⁸ *Id.* at 42-43.

⁹ Matthew Clancy, Keith Fuglie, & Paul Heisey, *U.S. Agricultural R&D in an Era of Falling Public Funding*, Amber Waves, Econ. Research Serv., U.S. Dept. of Agric. (Aug. 7, 2017), <https://www.ers.usda.gov/amber-waves/2016/november/us-agricultural-rd-in-an-era-of-falling-public-funding/>

¹⁰ *Id.*

¹¹ *Id.*

¹² *Id.*

¹³ *Id.*

¹⁴ FOOD & AGRIC. ORG. OF THE UNITED NATIONS, HOW TO FEED THE WORLD 2050, HIGH-LEVEL EXPERT FORUM, 1 (Oct. 12-13, 2009), http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Technology.pdf.

¹⁵ AGTECH INVESTING REPORT, YEAR IN REVIEW 2016, AGFUNDER 34 (Jan. 31, 2017), <https://agfunder.com/research/agtech-investing-report-2016>.

¹⁶ *Id.*

b. Agtech Categorization

The agtech industry derives its power from necessity— everyone needs food— and the diversity of actors, strategies, and technologies tackling challenges along the food chain. Because it is a relatively new, complex, and dynamic field, there is no standardized method of categorization. For the purposes of this hearing, the Committee will use the classification system depicted in Chart 1 from the October 2016 Boston Consulting Group and AgFunder report “Lessons from the Frontlines of the Agtech Revolution.”¹⁷ Agfunder is an online venture capital platform that connects public and private companies in the agtech sector with accredited investors from across the world.¹⁸ The company has leveraged its networks to produce periodic industry research as well as daily news on innovation and investment through AgFunderNews.¹⁹

Many of these technologies fall under the umbrella of precision agriculture, which “is a suite of technologies that may reduce input costs by providing the farm operator with detailed spatial information that can be used to optimize field management practices.”²⁰ Investment activity by number and volume of deals varies considerably across the sectors. In 2016, biotechnology, data-enabled agriculture, alternative business models, and supply chain technologies received the most investment funding.²¹

AGTECH CLUSTER	TECHNOLOGY
AGRICULTURAL BIOSCIENCE	Biologics
	New chemicals
	New crops
	Genetics
	Seeds
DATA-ENABLED AGRICULTURE	Sensors and connectivity
	Data storage and aggregation
	Optimization hardware
	Software platforms
	Big data and analytics
AUTOMATION AND ROBOTICS	Electrification
	Autonomous equipment
	Drones
	Robotics
SUPPLY CHAIN AND LOGISTICS	Crop storage
	Packaging and shelf life
	Food security and traceability
	Asset and fleet optimization
AGRICULTURAL PROCESSING	Processing
	Biofuels and bioenergy
	Biomaterials
	Biochemicals
ALTERNATIVE BUSINESS MODELS	Alternative foods
	Indoor agriculture
	Technology-enabled sharing
	E-commerce
	Farming as a service

¹⁷ BOS. CONSULTING GRP., AGFUNDER LESSONS FROM THE FRONTLINES OF THE AGTECH REVOLUTION 6 (Oct. 2016), <https://research.agfunder.com/BCG-AgFunder-Lessons-from-Frontlines-of-the-Agtech-Revolution-Oct-2016.pdf>.

¹⁸ *Company FAQ*, AGFUNDER, <https://agfunder.com/company-faq> (last visited Oct. 2, 2017).

¹⁹ *AgFunder Resources*, AGFUNDER, <https://agfunder.com/> (last visited Oct. 2, 2017).

²⁰ DAVID SCHIMMELPFENNIG, FARM PROFITS AND ADOPTION OF PRECISION TECHNOLOGY, ECON. RESEARCH SERV., U.S. DEPT. OF AGRIC. 1 (Oct. 2016), <https://www.ers.usda.gov/webdocs/publications/80326/err-217.pdf?v=4266>.

²¹ AGTECH INVESTING REPORT, YEAR IN REVIEW 2016, *supra* note 15, at 16.

II. AgTech Ecosystem

a. Farmers

Farm sector net cash income (gross cash income minus cash expenses) peaked in 2012 and 2013, but declined 35 percent between 2013 and 2016.²² Small family farms with a gross cash income less than \$350,000 make up 90 percent of U.S. farms but only 25 percent of the value of production.²³ Yearly cash income for farm businesses can vary considerably due to changes in rotations and yields, commodity prices, input costs, land and labor contracting, and government payments.²⁴

Farmers have shifted spending levels among the four major inputs, now investing more in capital and intermediate goods than labor and land.²⁵ Innovative technologies can improve the quality of inputs and enable farmers to expand their operations at a lower cost and higher rate of profit.²⁶ However, farmers are cautious about their investments due to farming's unpredictable nature. Historically, publicly-funded extension programs facilitated the transfer of new technologies and methods from the lab to the farm. Private firms have entered the arena to serve as middlemen between tech firms and potential farm clients. Regardless of public or private origin, it may take years for a product to navigate through the laborious regulatory systems at the state and federal level. If it takes a decade for a technology to hit the market and be available to farmers, it's not cutting edge. The delays to innovation are a detriment to its originators and customers.

In August 2017, the United States Department of Agriculture (USDA) and the United States Small Business Administration's Service Corps of Retired Executives (SCORE) announced a partnership program to encourage new participants to agri-business.²⁷ USDA and its partners will provide SCORE with agriculture expertise, and SCORE will extend its mentorship resources to new farmers. SCORE Vice President of Field Operations, Steve Records, explained that the partnership "allows both SCORE and USDA to serve more people while providing America's farmers added support to lead to more sound business operations, create profitable farms with sustainable growth and create new jobs."²⁸

b. Entrepreneurs

According to the Kauffman Foundation, we are in the early stages of the "Third Wave" of entrepreneurship ignited by increased access to the Internet and decreased barriers to entry.²⁹ In

²² Daniel Prager, Christopher Burns, & Nigel Key, *Examining Farm Sector and Farm Household Income*, AMBER WAVES, ECON. RESEARCH SERV., U.S. DEPT. OF AGRIC. (Aug. 7, 2017), <https://www.ers.usda.gov/amber-waves/2017/august/examining-farm-sector-and-farm-household-income/>.

²³ *Id.*

²⁴ *Id.*

²⁵ *Id.*

²⁶ *Id.*

²⁷ *USDA and SCORE Launch Innovative Mentorship Effort to Support New Farmers and Ranchers*, U.S. DEPT. OF AGRIC. (Aug. 5, 2017) <https://www.usda.gov/media/press-releases/2017/08/05/usda-and-score-launch-innovative-mentorship-effort-support-new>.

²⁸ *Id.*

²⁹ ARNOBIO MORELIX, E.J. REEDY, & JOSHUA RUSSELL, 2016 KAUFFMAN INDEX GROWTH ENTREPRENEURSHIP 4 (May 2016),

this era, the growth of entrepreneurship “is possible anywhere in the United States and in any industry. Third Wave entrepreneurs will be farmers, factory workers, chefs, and artists; and they often will bring innovation to the industries and cities they are already in.”³⁰ This is great news for technology entrepreneurs who have greater flexibility in deciding where they want to hone their skills; they can settle in the American heartland and access world-leading research facilities (both labs and farms) and businesses. The heartland has all of the necessary ingredients and now offers a variety of resources to support entrepreneurial development in the region.³¹

c. Startup Resources

Agtech initiatives have sprouted in traditional agricultural areas such as Des Moines, IA, Cedar Rapids, IA St. Louis, MO, Durham, NC, Fargo, ND, Memphis, TN, and Salinas, CA. Cities, states, and regions are developing business-friendly environments tailored to attract or retain agtech talent and stimulate local revitalization. Today there are over one hundred different resource vehicles to develop agtech entrepreneurs and small businesses: nearly half are accelerators.³² AgFunder organizes these resources into seven categories that use unique methods to achieve the industry goal of bringing scientific innovations to market and scale.³³

1. **Accelerator:** A set duration program where a cohort of selected early-stage companies get access to a business development curriculum and mentor and/or investor network. On average, accelerators retain 4-9 percent equity in exchange for \$50,000, in addition to the in-kind value of the services given to the startup.³⁴ Accelerators share a basic model but compete for talent with unique perks like demo days and field trials. This is the most common private sector resource available for small agtech businesses.³⁵
2. **Corporate Incubator:** Access to capital and resources of a corporation, usually with the intention of being acquired. These provide up to ten times more funding than accelerators but have a limited focus: these companies are looking for new products.³⁶ There are not many specific agtech corporate incubators, but the practice itself is commonly used by consumer goods companies seeking innovative products.³⁷
3. **Incubator:** Physical workspace or lab that provides support to small businesses such as technological expertise and mentorship; no fixed duration; rolling acceptance.³⁸ They are often collaborative ventures including universities, grower organizations, and business development organizations to develop early stage startups.³⁹

http://www.kauffman.org/~media/kauffman_org/microsites/kauffman_index/growth/kauffman_index_national_growth_entrepreneurship_2016_report.pdf.

³⁰ *Id.* at 5.

³¹ SUREN G. DUTIA, EWING MARION KAUFFMAN FOUNDATION, AGTECH: CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE GROWTH 5 (Apr. 24, 2014), <http://www.kauffman.org/what-we-do/research/2014/04/agtech-challenges-and-opportunities-for-sustainable-growth>.

³² AGTHEMATIC, A GUIDE TO STARTUP RESOURCES FOR AGRICULTURE & FOOD TECHNOLOGY INNOVATION 1 (Nov. 4, 2016), <http://agthentic.com/reports/>.

³³ *Id.* at 2.

³⁴ *Id.* at 4.

³⁵ *Id.* at 9.

³⁶ *Id.* at 5.

³⁷ *Id.*

³⁸ *Id.* at 6.

³⁹ *Id.*

4. Network/Ecosystem: Virtual networks that provide access to peers, mentors, investors, and industry insight through trainings, hackathons, and newsletters.⁴⁰ Online communities fill the gaps for small businesses that lack access to traditional business assistance centers.
5. Pitch competition: One-time events that give entrepreneurs the opportunity to pitch their ideas to industry experts and investors, but no prize money is awarded. Startups are judged based on technological viability, market opportunity, idea originality, team strength, and overall presentation.⁴¹
6. Prize: A multi-stage selection process that provides businesses' access to mentors and culminates with pitch competition and prize money from corporate sponsors.⁴² This is the second most common option for startup capital with more than a dozen programs operating internationally.⁴³
7. Venture Development Organization (VDO): VDOs use multiple channels to commercialize a portfolio of innovations and early stage ventures and sometimes provide consulting services for later stage startups.⁴⁴

Small businesses in agtech have a growing list of industry-specific resources, but have significantly more options through generalized programs open to startups of all industries. Because agtech is a relatively new as an independent industry, the long term impact of industry-specific resources is unknown. Only time will tell which strategies can most effectively foster the businesses transforming technologies into commercialized products.⁴⁵

III. Challenges in the AgTech Industry

Entrepreneurs, industry experts, and investors tout the benefits of technological innovations, but farmers assume the risk when using new technology.

a. Technology Adoption on the Farm

The most important player in the agtech industry is the most likely to be ignored as new technologies are developed, which has led to extraordinarily low rates of technology adoption by farmers. Investing in precision agriculture “includes purchases of equipment, installation charges, and the time and effort spent learning how to use and maintain the technologies.”⁴⁶ While there is no shortage of literature to dissect farmer decision making, technology adoption rates remain low, especially for small farms. Studies have identified the influence of “farm size; costs reduction or higher revenues to acquire a positive benefit/cost ratio; total income; land tenure; farmers’ education; familiarity with computers; access to information (via extension services, service provider, technology sellers); and location.”⁴⁷ The top three factors for technology adoption are level of education, farm size/income, and location.⁴⁸ Large farms with

⁴⁰ *Id.*

⁴¹ *Id.* at 7.

⁴² *Id.* at 8.

⁴³ *Id.* at 9.

⁴⁴ *Id.* at 8.

⁴⁵ *Id.* at 11.

⁴⁶ SUN LING WANG, ET. AL., *supra* note 1, at 13.

⁴⁷ EMANUELE PIERPAOLI, ET. AL., DRIVERS OF PRECISION AGRICULTURE TECHNOLOGIES ADOPTION: A LITERATURE REVIEW, *PROCEDIA TECHNOLOGY* 64 (2013), <https://doi.org/10.1016/j.protcy.2013.11.010>.

⁴⁸ *Id.* at 64.

money to invest are more likely to integrate new technologies if they are useful, easy to use, and profitable.⁴⁹ This dynamic is likely to accelerate the dominance of large farms and the digital divide across rural America.⁵⁰

b. Technology Impact on the Farm

Past the investment stage, farmers must apply technologies properly to reap the benefits. The volume of data available continues to expand; however, the individual proprietary systems don't necessarily sync with external data and systems, thus limiting the potential for analytical use.⁵¹ Firms typically provide service in a specific step of the data value chain: capture, aggregate, analyze, and prescribe. However, farmers need an all-encompassing platform that is compatible with third-party applications to fully inform management decisions.⁵²

IV. Conclusions

In the eyes of entrepreneurs, the potential for innovation in agtech is limitless. Global investors remain cautious due to unpredictable markets and regulations. Small family farmers are risk averse and can be skeptical of new tech solutions. Although agtech draws its strength from diversity, it is missing cohesion. The industry as a whole must develop ways to facilitate communication and trust among stakeholders.

This hearing will provide Members with an introductory look into a revolutionary phase of agricultural modernization. Although small business participation in agtech R&D is a recent trend, there are many commonalities shared with small businesses across all industries. Members will hear familiar themes operating within the agtech context including: access to capital, intellectual property, regulatory burden, rural-urban divide, data security, trade barriers, labor shortages, and tax complexity. The Committee looks forward to increased collaboration, mutual benefit, and shared growth between small family farms and small businesses in the agtech industry.

⁴⁹ *Id.* at 64-65.

⁵⁰ Rich Cooper, *The Seeds of Innovation – Big Data Reshaping U.S. Agriculture*, U.S. CHAMBER OF COMMERCE FOUND. (Mar. 13, 2014), <https://www.uschamberfoundation.org/blog/2014/03/seeds-innovation-%E2%80%93-big-data-reshaping-us-agriculture>.

⁵¹ ALEXANDROS KALOXYLOS, ET. AL., FARM MANAGEMENT SYSTEMS AND THE FUTURE INTERNET ERA, COMPUTERS AND ELECTRONICS IN AGRICULTURE 131 (Nov. 2012), <https://doi.org/10.1016/j.compag.2012.09.002>.

⁵² BOS. CONSULTING GRP., AGFUNDER *supra* note 17, at 9.