

RESTORING RURAL AMERICA: HOW AGRITECH IS REVITALIZING THE HEARTLAND

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None.	
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None.	
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None.	

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THURSDAY, FEBRUARY 15, 2018

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SMALL BUSINESS,
SUBCOMMITTEE ON AGRICULTURE, ENERGY, AND TRADE
Washington, DC.

The Committee met, pursuant to call, at 9:30 a.m., in Room 2360, Rayburn House Office Building. Hon. Rod Blum [chairman of the Subcommittee] presiding.

Present: Representatives Blum, King, Radewagen, Comer, Curtis, and Schneider.

Chairman BLUM. Good morning. I call this hearing to order.

Thank you to the panelists for being here this morning. We already had our mini hearing in front of this hearing. This is going to be a great hearing.

I consistently hear from family farmers back in Iowa about the many challenges America's small farmers are facing, including burdensome and confusing regulations and excessive taxation. Agricultural innovations and technologies have the ability to increase farm productivity, reduce resource use, which is a good thing. We have runoff issues I know in Iowa that are of concern. And boost profits, which are also a good thing.

At last October's Subcommittee hearing, witnesses emphasized the importance of agritech entrepreneurs and farmers working together so that small businesses and small family farms will benefit from the emerging technology and innovations. Agritech entrepreneurship activity is also spurring rural revitalization with agritech initiatives in America's Heartland and other regions, attracting talent, dollars, and jobs to those communities.

Corporate and angel investors, trade associations, land grant universities, and state and local governments are partnering not only to connect entrepreneurs and innovators with startup capital which is so important, but also to mentor those entrepreneurs and set them up for success in the marketplace.

These organizations can also facilitate relationships between entrepreneurs and farmers so that the risk of farmers trialing new innovation is minimized or even monetized, best case scenario.

Our witnesses today will discuss how these diverse stakeholders are working together to attract startup activity to the Heartland and how creating a strong, local support system providing talent, infrastructure, and capital is vital. They will also discuss their efforts, including training workers for skilled tech jobs, to keep the

startups local so that we may bring additional jobs and investment to their local communities.

I want to thank all of you again for being here today, and we really look forward to this hearing today and to your testimony.

I now yield to the Ranking Member, Mr. Schneider, for his opening statement.

Mr. SCHNEIDER. Thank you, Mr. Chairman. And thank you for holding the hearing today.

The agriculture industry plays a critical role in our personal lives and the United States economy. Unfortunately, we do not spend enough time thinking about the current state of affairs of the industry and how it can, and should, and must, move forward. It is, therefore, noteworthy that this is the second hearing of this Congress discussing something as important as agricultural technology, also known as agritech. This sector offers an opportunity to combine the newest technology and ideas with agriculture in a way that has the potential to revitalize our economy and our future.

Most importantly, this hearing focuses on rural America, and I am lucky to have constituents who are working hard to sustain our food supply. Our rural economy has shown an ability to adapt and change with the development of new technologies. It has created opportunities by adding different uses for their products, from investing in renewable energy, to identifying foreign markets for their products, farmers have been resilient, and our local economies and the country have benefitted from it.

Farmers have been investing more in technology to disrupt the industry, reverse stagnating prices from oversupply, and combat extreme and unpredictable weather patterns. In fact, we saw a jump in agritech startups in 2017 as more than \$700 million was invested compared to just \$332 million in 2016.

As we have seen in the past year, there is no denying that our planet is experiencing more frequent and more damaging, natural disasters. We saw it with Hurricanes Harvey, Irma, Maria, and Jose, just to name a few. We also saw how wildfires and California's 5-year long drought have devastated farms, ranches, and forests.

Extreme weather continues to impact our country. These often result in scarce supplies, decreasing nutrient levels, and other factors that threaten the continuing success of the agriculture industry. As the planet warms, weeds, pests, and fungi that thrive in warmer temperatures are expected to force farmers to spend more than \$11 billion to combat them.

Meanwhile, there is a real epidemic among our Nation's most important commodity, farmers. In recent years, it has been concluded that the suicide rate for farmers is among the highest of any profession. Much of their distress comes from lagging prices from oversupply and low prices. This is where agritech can truly make a difference by streamlining operations and protecting farmers and ranchers from low commodity pricing.

America has always been a country of innovation, creativity, and invention. We must harness these skills today and find the balance between government oversight and technological advancements without hindering business opportunity. The promise of agritech can change lives and positively disrupt an entire industry,

which is why I am hopeful we can find a way to grow investment in this area.

I am thankful to all the witnesses for being here today and look forward to your insights on the industry and how technology is really a valuable investment for the Ag industry.

Thank you, and I yield back.

Chairman BLUM. Thank you for those comments, Brad.

If Committee members have an opening statement prepared, I ask that it be submitted for the record.

I would also like to take a moment now to explain the timing lights that are somewhere there in front of you. You will have 5 minutes to deliver your opening testimony. The light will start out as green. When you have 1 minute remaining, the light will turn yellow. And finally, at the end of your 5 minutes it will turn red. And we would like to have you try to adhere to that time limit.

I would now like to introduce our witnesses. Our first witness is Mr. Kevin Kimle—I think I pronounced that right—the Director of Agricultural Entrepreneurship Initiative at Iowa State University in Ames, Iowa. Mr. Kimle is also a cofounder of the Ag Startup Engine, a program to fund and to help agtech entrepreneurs and to increase startup creation at Iowa State. I have heard a lot of good things about that program. Thank you for being with us today.

Our next witness is Mr. Sam Fiorello. And I did a double take. I went to Loras College, a small school in Iowa back in the 1970s, and we had a young man from the Southside of Chicago that ended up being the National Wrestling Champion Division III, and his name was Sam Fiorello. So I was wondering if that was—

Mr. FIORELLO. It was not me.

Chairman BLUM. It was not you. Okay. All right.

The Chief Operating Officer of the Donald Danforth Plant Science Center in St. Louis, Missouri. He is also a cofounder of the Ag Innovation Showcase, a gathering for the agricultural innovation community. Welcome, and we appreciate your testimony today.

Our next witness is Mr. Pete Nelson. Welcome. Vice President of Agricultural Innovation at the Memphis Bioworks Foundation in Memphis, Tennessee. Mr. Nelson is also the President of AgLaunch, a joint initiative with the Tennessee Department of Agriculture to create agricultural innovation opportunities in the Midsouth. Welcome. We appreciate your testimony.

And I now yield to our Ranking Member, Mr. Schneider, for the introduction of our final witness.

Mr. SCHNEIDER. It is my pleasure to introduce Dr. Michael Fernandez, a Senior Fellow at the George Washington University's Food Institute and Sustainability Collaborative. Prior to GW, he was the senior director of Global Public Policy for Mars, Inc., and served as executive director of the Pugh Initiative on Food and Biotechnology. He has also held leadership roles as USDA, EPA, and on the Senate Committee on Agriculture, Nutrition, and Forestry. Dr. Fernandez holds a degree from Princeton University, and Ph.D. in Biochemistry and Molecular Biology from the University of Chicago. Welcome, Dr. Fernandez, and thank you for testifying today.

Chairman BLUM. And I would now like to recognize our first witness, Mr. Kimle, for 5 minutes.

STATEMENTS OF KEVIN KIMLE, DIRECTOR, AGRICULTURAL ENTREPRENEURSHIP INITIATIVE, IOWA STATE UNIVERSITY; SAM J. FIORELLO, CHIEF OPERATING OFFICER, DONALD DANFORTH PLANT SCIENCE CENTER; PETE NELSON, PRESIDENT, AGLAUNCH, VICE PRESIDENT, AG INNOVATION, MEMPHIS BIOWORKS FOUNDATION; MICHAEL FERNANDEZ, SENIOR FELLOW, FOOD INSTITUTE, GEORGE WASHINGTON UNIVERSITY

STATEMENT OF KEVIN KIMLE

Mr. KIMLE. Thank you, Congressman. Good to be with you this morning.

I serve as director of a program, as the congressman mentioned, called the Agricultural Entrepreneurship Initiative at Iowa State University. The program was founded in 2005 to be one of the foremost programs for training and developing agricultural entrepreneurs inspirationally in the world. Our activities really have their foundation in the land grant university mission of teaching, of research, and of outreach. So from a classroom perspective, as an example, a class that I teach, Entrepreneurship and Agriculture, this semester has 108 students. Starting next week, they will begin the process of developing three concepts for new businesses, and in May, instead of a final exam, their final will be to present their favorite of those three business concepts to panels of bankers, investors, entrepreneurs, and so on. And that class has become a primary feeder for agtech business development activities.

We do a lot of things out of the classroom, experiential learning activities, business plan competitions, and so forth. We place students as interns with startup companies, many of which now are founded by former students who had their own startup companies in the agtech arena.

As the congressman mentioned, one of our initiatives is called the Ag Startup Engine. It is an investment platform in the Iowa State University Research Park intended to provide early stage funding and mentoring for agtech entrepreneurs. We currently have five companies that are part of our portfolio. Just as one brief example, there is a company called Smart Ag. They have a software platform for self-driving tractors. Their first program is for a self-driving tractor that pulls a grain cart. So there were two farmers in Iowa last fall who had tractors that were driving themselves, pulling a grain cart between the combine and the truck harvester.

Just a brief question. Can Iowa, can the Midwest be a hub for agricultural entrepreneurship? Well, a lot of the activity that we have seen and what we do is really based on animal protein supply chains. And so the technology that we have developed to create more sustainable, more productive agriculture is really what it is about. And so we have a lot of new and exciting things that are happening, a lot of new initiatives, certainly not just in Iowa but across the Midwest, but we still have a lot of work to do. Most certainly, the environment today is a lot better than it was when I founded my first agtech company back in 1996. So many more sources of funding, support, and mentoring than there were, but we still lag. The Midwest, at least in the way that I count the Mid-

west, last year got about 4.7 percent of venture capital dollars in the United States while we have about 20 percent of the U.S. population, so we are not kind of punching up to our weight in terms of gathering venture capital funding.

In terms of ecosystems for agricultural entrepreneurs, some of our challenges, you know, funding always is a challenge, but again, the sort of shark tankification of our culture created a lot of new contests, kind of a new language for startups for competitions and so on.

Mentoring is a really big deal. As a former founder of an agtech business when I was younger myself, finding somebody else who has done that before is a really key part of it. So finding the right mentor at the right time is a key part of the challenges that we try to address.

Creating what I would call a change-making culture is a big part of it as well. The Iowa nice culture that we have I think is certainly a good thing but there are some parts of that that may not work when it comes to celebrating entrepreneurship. There is an old saying in the Midwest, you know, nothing is punished in small towns like success. And that may not work so well when it comes to entrepreneurship.

Finally, economists talk about a concept of agglomeration; right? When a lot of people come together in one place who do the same thing, and some of the benefits for talent, for money, for expertise. The congressman was talking about that in Utah when we were visiting out front before. Agriculture by its nature is spread out in a lot of different places, and so finding ways to get together to exchange information is a big deal.

So for agtech ecosystems in the Midwest to become more vibrant I think three things are critical to conclude. I think exposing more young people to the concept of entrepreneurship and that being an option as part of their career is a big deal. So certainly, university programs like we run at Iowa State University I think are big, but even high school programs. Fewer young people today grow up on farms and small businesses, in entrepreneurial families, and so exposing them to that, I think, is a big deal. We need to continue to develop more parts of early stage funding. Those things are so key to getting things off the ground. And then finally, from an agtech perspective, you know, I think we need more venture funds in the Midwest. We have some new ones that have been formed but I think having home-based funding will be a big part of continuing to develop the agtech ecosystem in the Midwest. Thank you.

Chairman BLUM. Thank you, Mr. Kimle.

Mr. Fiorello, you are now recognized for 5 minutes.

STATEMENT OF SAM J. FIORELLO

Mr. FIORELLO. Thank you very much.

Good morning, Chairman Blum, Ranking Member Schneider, and also good morning to you, Congressman Comer and Congressman Curtis.

My name is Sam Fiorello, and I am the COO of the not-for-profit Donald Danforth Plant Science Center in St. Louis, Missouri. It is the center's largest institute of its kind with over 240 scientists and staff working to improve the human condition and strengthen the

economy of the region. I am also president of the Bioresearch and Development Growth Park, BRDG Park for short. It is a research park on our campus.

Fifteen years ago, a farmer would tell me with great pride that he could fix anything on his farm with baling wire and a blow torch. Today, the nearly million dollar tractor he drives has more computing power than the Apollo 11 spacecraft that went to the moon and back. That is progress, but that progress comes with challenges. Today, the average farmer in the U.S. is over 58 years old. Tech savvy young people are leaving rural communities for urban centers where 21st century jobs are more readily available.

We believe that Ag innovation is a crucial component to help reverse this trend and is one of the few undertakings that can help bridge our Nation's urban versus rural divide. Our discoveries are the basis for creating products and services that meet critical needs of farmers and ranchers, food processors and manufacturers, distributors and grocers. Because of the growth of ag-focused innovation, young people now have an outlet to put that interest and technology to use in their local communities. Imagine if you will a kind of a Geek Squad in rural America that would go across and be deployed to help get a tech-heavy piece of equipment up and running in hours versus days.

Conducting best in class research is not the only way the center contributes to the creation of the region's agtech innovation system. We also provide open access to our core facilities, facilities like greenhouses and growth rooms and chambers and Biocomputing. These are valuable pieces of infrastructure for small companies. They could not simply advance their businesses or build something like this on their own, so access to ours makes it a critical way to advance businesses.

As I mentioned in my opening, in addition to our research center, the Danforth campus is also home to the BRDG Park, an agtech-focused research park. BRDG Park is home to 14 companies that employ nearly 300 people. Of these companies, six are from our region and eight moved to St. Louis from Germany, Israel, India, and across the U.S. BRDG Park companies and the Danforth Center spinoffs account for close to \$200 million of invested capital in our region.

In 2009, BRDG Park partnered with the St. Louis Community College to create a workforce training program. This 2-year training program boasted a 95 percent placement rate with graduates hired to work at companies throughout our region at salaries upwards of \$45,000 a year. Program trainees are young people who come from disadvantaged neighborhoods or older workers who have retooled to start completely new careers. One example of such a trainee is a gentleman named Dave Busby. Dave worked for more than 15 years making truck seats at a Chrysler plant in St. Louis. When the plant closed, Dave, who was in his mid-30s, needed to start a new chapter in his working life. In 2011, Dave enrolled in the community college's Plant and Life Science technician training program, and upon graduation was hired by the Danforth Center. Today, Dave is the assistant director of the center's tissue transformation facility.

In part because of our success, this innovative training model is being deployed at community colleges throughout the state. One example includes the precision Ag and robotics training programs at Three Rivers Community College in Saxton, Missouri. For the last 10 years, our center has held an agtech-focused investor conference, the Ag Innovation Showcase. This event brings the agtech community from more than 25 countries together to advance the industry. Central to the event is a segment called “Voice of the Farmer,” which features farmers from across the U.S. sharing their challenges with innovators and investors to help ensure a direct path to useful solutions. Since inception, companies involved in our agtech business plan competition have raised more than half a billion dollars in investment capital to grow their businesses.

The Ag Showcase is not alone in the rise of popularity and agtech entrepreneurship and investing. According to the publication Ag Funder, venture capitalists invested over \$6.9 billion in 2015 in a rage of agricultural-related innovations. Last year, invested capital approached \$9 billion. To give you context, when I started the Ag Showcase in 2009, that figure was less than half a billion dollars.

We hope to build on our early success. In 2016, with the help of a EDA planning grant, the center and its partners launched a 600-acre innovation district called the 39 North District. The district is designed to attract talent, ideas, and capital to our region.

We are building on our regional strengths. Today, St. Louis is already home to nearly 1,000 plant Ph.D.s and hundreds of companies employ close to 100,000 people and contributing over \$4.6 billion to our regional economy.

If I can leave you with three things that I think are vital to help keep this going, one is rural broadband. We need to have access. We cannot use these technologies if farmers do not have broadband. Two is an educated and trained workforce. And three, we need to continue to fund ag research, basic Ag research, because it is the beginning of the virtuous cycle. Thank you very much.

Chairman BLUM. Thank you, Mr. Fiorello, for your testimony.

I would like to recognize the Chairman of the Full Small Business Committee that just walked in, Chairman Chabot. Thanks for being with us today, Chairman.

Mr. Nelson, you are now recognized for 5 minutes.

STATEMENT OF PETE NELSON

Mr. NELSON. Good morning. And thank you, Chairman, and Ranking Member Schneider, and members of the Subcommittee for the opportunity to share with you some thoughts regarding this important topic.

My name is Pete Nelson. I am the vice president of Ag Innovation, Memphis Bioworks Foundation, which is an economic development nonprofit focused on life sciences, including agriculture. In this role, I get to serve in a unique public-private partnership as the president of AgLaunch, which is a joint initiative between Bioworks and the Tennessee Department of Agriculture.

AgLaunch envisions a transformed regional agriculture and food economy centered around farmers, innovation, and equity. It was conceived as part of the Tennessee Governor Bill Haslam’s Rural

Challenge in 2012, and specifically named in 2016's Governor's Rural Taskforce. The initiative is supported by a broad and diverse group of partners, including Farm Bureau, USDA, Launch Tennessee, and our agriculture universities. Although our work is anchored in Tennessee, our agricultural leadership supports the regional collaborations we are developing. This includes a particular focus on Memphis and the Mid-South Delta Region, a five-state area that includes Arkansas, Kentucky, Mississippi, Missouri, and Tennessee, as well as other regions that have distressed counties or food access areas, such as the Appalachian Region.

The Delta Region is characterized by its highly-productive agricultural systems, first-class logistics capabilities, and a large number of food and agricultural companies. This region is also home to chronic poverty, population decline, health disparities, and limited opportunity.

The agtech revolution is offering the ability to rethink how Tennessee and the surrounding region can become a leading innovation hub for food and agriculture. This means jobs, new business opportunities, improved food access, and new opportunities for our farmers.

Farmers have traditionally been at the forefront of developing and implementing new innovations and technologies. Over time, the role of the farmer in adopting new technologies, and this is key, has become one of "customer" rather than one as "partner". Currently, there is a large amount of new technology that gets presented to the farmer, but the value is not always clear. There is also an increasing disconnect between those creating new innovations and the farming community. This fact was outlined in the memo presented here last year on the topic and in the hearing itself.

To address this disconnect, AgLaunch has initiated a three phase startup program called AgLaunch 365, which provides participating startups with direct access to AgLaunch's network of innovative farmers to actually ground-truth these products or services. The program allows the startup founders to acquire unbiased feedback and incorporate these observations into the development of their product. Participating farmers get access to new technology and the opportunity to participate in the upside of the business.

Since the creation of the program, dozens of companies have received support. A good example of the power of this farmer network is a startup company called Ag Voice, which has a voice recognition technology for agriculture that simplifies crop scouting and other recordkeeping efforts and was validated through the network. The validation process included answering simple questions like "Will the technology work in the cab of the tractor or combine when it gets noisy? Will the ear piece stay on your ear when you are in the middle of scouting a hot soybean field? And will the lexicon be robust enough to record all the farm practices necessary, and will the records be accurate?"

The results of this real-world field trial generated data and farmer testimonials used to raise further investment and attract additional customers. The participating farmers were rewarded with opportunities for equity and ability to get favorable terms for accessing the technology.

AgLaunch has worked to assemble several tools that can be leveraged and replicated specifically in the agtech opportunity to provide early-stage capital to companies in the program. These are included in our written testimony. One that I would like to highlight is our work with the Tennessee Department of Agriculture to pilot a cost-share program for farmers to incentivize participation in trials of pre-commercial startups.

AgLaunch and its partners are positioning Tennessee and the surrounding region to be a leading innovation hub while also sharing key learnings to other states and regions. We believe in the role of the farmer as a partner in innovation and that our approach will change the current agricultural investment thesis. This will create more successful startups and bring forth solutions that more efficiently address real-world agricultural problems. Ultimately, and this is important to us, this will mean job creation, increased food access, and new opportunities in rural areas and urban areas.

Mr. Chairman, I would like to thank you again for inviting Memphis Bioworks Foundation to share with you the AgLaunch story and look forward to any questions.

Chairman BLUM. Thank you for your testimony, Mr. Nelson.

Dr. Fernandez, you are recognized for 5 minutes.

STATEMENT OF MICHAEL FERNANDEZ

Mr. FERNANDEZ. First of all, thank you, Mr. Chairman, and Ranking Member Schneider, and all the members of the Subcommittee for giving me the opportunity to be here today.

I am Michael Fernandez. I am a senior fellow with the Food Institute at George Washington University.

This morning I would like to briefly offer three general observations and three points to consider as you are thinking about the role of technology in rural development.

So the first observation is that agritechnology is critical to sustaining vibrant rural communities. Food and agriculture is the bedrock of most rural economies and the entire food sector is really already being transformed by new technology. How we grow our food, how we manage complex supply chains, how we buy food, how it gets to our homes all are being transformed by new technology. And these changes present exciting new opportunities for capturing added value in rural communities both on and off the farm, but we need to be thinking about the infrastructure, education, and the training necessary to take advantage of them. If we want vital rural communities, we cannot let this technological revolution pass us by.

So my second observation is that we need to think about Ag science and technology as a critical part of the public infrastructure supporting rural America. Public funding for food and Ag R&D is really what supports the basic science underpinning this technological innovation and revolution that we are seeing, and it is critical to sustaining the science talent pipeline necessary for long-term success. I know that infrastructure is an important topic right now and it is great to see rural infrastructure being part of that conversation. I just hope that we do not lose sight of this important component of rural infrastructure.

My third observation is we are on the cusp, actually, of what I think is a new agritech revolution, which is gene editing of plants and animals. Now, what makes this new form of genetic engineering potentially so transformative is that it gives scientists the ability to go in, find specific DNA sequences within a plant or animal genome, and make targeted changes. So you can kind of think of it as a search-and-replace function in a word processor. You go in and can find the one word in the whole document you are looking for and change just a few letters. It is fundamentally different from the first generation of genetic engineering techniques, and it potentially opens up a whole new range of applications.

And in addition to being more precise, gene editing technology also promises to be relatively easier and cheaper, making it more accessible. So that means there is a real possibility that a whole ecosystem of scientists and small businesses will spring up in rural communities around this technology, and you have already heard from the witnesses this morning about how that is happening. It also means that there may be more incentive for developers to work on kinds of crops and trades that would not be economically viable otherwise, and therefore bring benefit to a wider array of farmers.

So as you are looking at how new agritechnologies, including gene editing, could help revitalize rural America, I would like to offer three points. First, we want to make sure that these new technologies actually benefit farmers of all kinds. So we have heard we have an aging farm population. We have a new generation of farmers that will be taking over and it is going to change the rural landscape. These younger farmers will be more tech savvy than their predecessors, and they are probably also likely to be working more on smaller operations and be more dependent on a mix of farm and off-farm income. So we need to make sure that new technology meets the needs of these new farmers and the rural economies around them.

Second is that new agrifood technologies must be acceptable to consumers. The first generation of genetically engineered products was geared more toward farmers than to end-consumers. American consumers are ever more focused on food, what is in it, where it comes from, how it is produced, and that trend is not going away. So the best way to build acceptance is to offer products that provide tangible benefits that consumers can embrace and to be transparent about it to build consumer trust.

Which really leads me to my last point which is that consumers will not have trust if they do not have confidence in the underlying regulatory system. The products of gene editing will be different from earlier GMOs, and we are going to need to tailor our regulatory approach accordingly. But a robust, scientifically justifiable, and transparent system is absolutely critical to ensuring success at home and to accessing markets abroad. New product developers are already starting to knock on regulators' doors and there really is not a clear system in place.

So I know that talking about the benefits of regulation is counter to the current trend, but the window to craft a clear, credible pathway to market that gives developers some certainty on the one hand and consumers confidence on the other is narrowing rapidly.

We cannot let this opportunity go to waste and risk killing this technology before it even starts to deliver on its real promises.

So with that, thank you again, Mr. Chairman, and I am happy to answer any questions.

Chairman BLUM. Thank you, Dr. Fernandez.

I will now recognize myself for 5 minutes of questioning.

I think almost everyone today mentioned funding, so I would just like to chat a little bit about funding. Someone, maybe Mr. Kimle, mentioned a 4 percent number, retracting just 4 percent of I think the venture capital in the country, and I would just like to have your thoughts on why is it only 4 percent? Why are venture capitalists not viewing the agricultural marketplace as someplace they want to put their investors' money? I know a few years ago when farm prices skyrocketed, Warren Buffet and lots of capitalists, investors were talking about investing in venture capital in the Ag sector. Now, I do not know if since the downturn in farmland prices has coincided with may be the 4 percent number. So if you could address that.

And then also, it is kind of an interesting industry because we have these startups but they, unlike other types of businesses, they need to get farmers to try a lot of these things. And so what incentives are you seeing for farmers? Do they want to be paid to try or is it enough to say, well, the promise is you are probably going to get better yields out of this acre of land? If you could discuss that as well. So funding I am sure is an issue.

Mr. KIMLE. Well, I will give it a start. Yeah, funding is a big deal. Why? Kind of disproportionate performance in the Midwest. Probably a combination of things. You know, funding is kind of a chicken and egg sort of a thing to use an agriculture metaphor. You know, you need deals to invest in and then you need money to invest in it. So both need to rise at the same point. And at some point it all improves and it definitely is, so I think programs that produce more quality new businesses is part of it, and we definitely see that going on. And then at the same time, more localized money for that to happen. So just have not had a tradition of venture capital funding. You know, we have built things in Iowa, at least, like the ethanol industry with a lot of investment and money but the models for that are a little bit different from venture funding, I guess. So it is probably a matter of some of our capital in places like Iowa learning kind of how they might want to participate, if at all, in venture capital, as well as bringing some new talent. And we see some of that.

Chairman BLUM. How important is projected rate of return? If you are an investor out in Silicon Valley and you say, I can invest in this Ag startup, but the Ag income is not that great and that can negatively impact the marketplace for product A, or I can invest in the next Amazon, perhaps. Okay, I can see that. Is that part of the issue? Part of the problem is farm income?

Mr. KIMLE. It can be. Certainly. Yeah.

Chairman BLUM. The ability of farmers to afford maybe this new technology?

Mr. KIMLE. Certainly for solutions for the crop industry, which has been under economic stress. You know, I think that can be part of it. And part of it, too, is probably just having some deals that

succeed that are more localized in the Midwest. You know, so we have had deals in agtech that have certainly, from an entrepreneur and investor perspective, been successful. Climate Corp. being purchased by Monsanto, Granular being purchased by DuPont Pioneer in 2017. Those are sort of big deals. We have not had anything like that yet out of our program. That sort of things happen and other people see investors and entrepreneurs having success and I think it sets a precedent that is important. But certainly, underlying economics in the industry affect it too, to your point.

Chairman BLUM. Anyone else want to have a thought on the funding in general?

Mr. FIORELLO. A couple points. I totally agree with Mr. Kimle. I would also add that investors tend to invest near where they live, and so you have this concentration of investors in Silicon Valley and in Boston, so we need to get them into the Heartland. So things like our investor conferences that we hold in St. Louis, part of our goal is just to get them here and to say this 12:38:58xxx and see how this works. Two, investors look for big exits, big sales. We have had a few of those but not many, and investors look for a path, a many-pronged path to an exit. And early on, a lot of these deals happened to be in the seed space, for example, and there were just a handful of paths. There were four, five, six companies that could acquire business. I think as you have seen this stretch out into more technology across the spectrum, you are going to see more exits because there are more paths for this technology to go. So I am quite optimistic the trend is going to change.

Chairman BLUM. Good to hear.

Mr. NELSON. Just a couple comments. One, agriculture is fundamentally different. The investors have not understood the industry, so the timing, how we think about interfacing with the customer, the farmer, has been different. And so, we have spent a lot of time thinking about how we align the capital sources, both regionally, but also tactically with what we are doing. So, for example, our cost-share program allows the farmer to be a first customer, have skin in the game, but also not bear full risk to get started, which allows you to prove and validate to get to the next step. We are also working with farm organizations, Iowa Corn Growers would be an example. There are actually farmers that have investment funds that understand the space, and so that knowledge is building. But that is sort of a big key part of that.

I would love at some point to also address the farmer issue. I am not sure if we are out of time.

Chairman BLUM. I will come back in a second round.

Mr. NELSON. Okay.

Chairman BLUM. Dr. Fernandez, you are anxious to jump in.

Mr. FERNANDEZ. Yeah, I am not sure that I have a whole lot more to add other than to say that I think it is interesting we are seeing a lot of what have been the traditional tech investors in Silicon Valley starting to be more interested in food and Ag, and I think that is a great thing to provide additional money. But as we just heard, they do not understand food so well, so I think there is going to be a learning process. And the time-lines in terms of the rate of return I think may be a challenge for some of those investors. But having the investment funds based in the Midwest and

by people who really understand how food and Ag work I think is where we are going to really see the most success.

Chairman BLUM. Thank you.

And I will recognize Mr. Schneider, the Ranking Member, for 5 minutes.

Mr. SCHNEIDER. Thank you. I have a lot of questions. But I am going to start with a quick story that kind of links to what you are talking about.

Ag is different. Maybe not so much. I want to go back, Mr. Fiorello, you said 15 years. I am going to take us back 32 years. A personal story.

I was working and developing oil and gas software. This links our Committee, Energy and Trade. And we finished. It was accounting software that ran on the old Compaq computers. We finished in 1985, which was the peak of a boom and became a bust, so we had to find new markets. And in the Spring of 1986, our new market we found, I was in Irrigon, Oregon, installing our accounting system onto a farm—and this fits to everything—a former consultant had moved out to Oregon. He wanted to be a farmer and he was at the cutting edge of technology. And I just remember being in his office with a lot of green CRTs. But he was there. And at that time it was a 286 chip, less technology than was on the moon. We now have more technology in our pockets on our phone, so we have come a long way. But it is important I think how far we have come really matters.

And maybe this is a segue to my question for Dr. Fernandez, because in your testimony you said the United States is falling behind. What is the implications of the United States falling behind in technology long-term?

And I will ask a second question. What recommendations to us as policymakers do you have that we can get back to where we should be leading?

And then I will come back and talk about the Heartland in a second.

Mr. FERNANDEZ. Thank you very much. Yes, this was in the staff memo. This is not new to you all that in terms of basic R&D investment, the United States public funding has dropped something like 20 percent in real-term dollars in roughly the last 10 years. So we have gone from being the world's leader to where now China is spending almost twice as much in terms of public investment in R&D. We have seen a huge increase in private investment in R&D, which is great, but I think that the overall levels are still below where we have been.

I think the challenge here is that support for underlying basic science is the engine for the technological innovation that is coming next. What is the next big thing? What is the next new technology? And we need to really be supporting that. And thinking about that as part of, as I said, part of the public infrastructure that will support rural America. And the danger is that we fall behind clearly, you know, in the long term.

Mr. SCHNEIDER. I will take it a step further in the broader economy. We are a fraction of the global population. We are still the breadbasket for the world in many cases, but other countries are getting to self-sustaining agriculture. But they are only going

to sustain that with technology. If we can be at the cutting edge of technology, we can export that to the world. Again, it is jobs here in the United States and hopefully jobs in the Heartland.

Mr. Kimle, if I can ask you, you are at Iowa State in Ames. You have got these startups. Have you faced the issue of, as they start to get funding, your startups move either from Ames to the big city or out of the Midwest and to the Coast? How many companies have done that?

Mr. KIMLE. No, we have not as yet. We have had some success at attracting companies to come to Ames, fortunately, but we have not lost any.

Mr. SCHNEIDER. Fantastic.

Mr. KIMLE. And that is part of the thing that is different from when I started my first company in 1996. So I have my own history as well. We had a company doing electronic commerce on the Internet starting in 1997. It was new then. Hard to believe now. And we had revenue to begin with but we thought, well, we will go out and look for some money. Anyway, to make a long story short, we went out looking for a million and a half dollars but people in Iowa, some of the prospective investors were like, well, the Internet, I do not know if it is really going to be that big. And you guys have DuPont as a customer and Dow, but gosh, I do not know if you have really proven, you know, that you can get customers. And so, anyway, we had money from Silicon Valley, New York, and Atlanta that came in. Money that said if you are happy being in Ames where we were headquartered, that is fine, but you really should consider moving to Silicon Valley. We made the choice not to do that. I am happy to say that in 2018, sometimes the money is not developed but the issue of moving to be someplace else, especially for things that face the industry that we are surrounded by in the Midwest has not been that big of a challenge.

Mr. SCHNEIDER. I think one of the issues, you want to be close to your customer. I mean, this is my segue to you, Mr. Nelson, because I think you said it very well. The industry has treated farmers as customers only, not as partners. And if you would elaborate on what does it mean to treat the farmers as partners in the development of ag-tech?

Mr. NELSON. There is a perception in agriculture that the farmer is kind of, you think about the overalls and the pitchfork, and we do not have that perception. My entire career has been partnering with farmers to innovate technologies earlier. That was, for us, the first call we ever would make when we would try a new idea. So, what we are doing is institutionalizing that idea and also supporting other groups that are doing that. So, the way we do that is we work with farmers to screen technology. Without that part in place you would have basically farmers getting hit with, you know, if you get the reputation as a first mover farmer you are going to get hit with hundreds of things every year to try, so we work through screening that process, working with the growers, bringing technology, and making sure that the farmer has a combination of things that give them an advantage besides the rights to, oh, great, if this works you get to buy it later. So that is participation in the deal flow, equity, potential to invest at a favorable valuation rate, distribution rights, and a portfolio of options that

are organized between the company and the farmer to make sure that they have got a favorable advantage for their time. And that is all tied back to their time and energy. And we are now replicating that in other places. We have started that with row crops but have found dairy and beef and other sectors also want that service and to pull that piece together. There are great models out there right now if you are already further along in the pipeline to pay cash for those kinds of services. What was missing was the ability to do that early with the really early-stage technologies like Dr. Kimle and others are working with and to match that with the farmer. So, we are doing that.

And I love your farm shop analogy. What we believe, where the deals get done, and I am in this every day, is on a farm shop in Ripley, Tennessee, or in Savannah, Tennessee. Typically, a lot of technology and computers that you referenced earlier, but also some muddy boots and the ability to get in and out on the field, and it is that combination of what really anchors these technologies in the rural areas, you know, the theme of today.

Mr. SCHNEIDER. I am way over my time. I will close with this. Mr. Fiorello, you raised the issue of broadband, rural broadband. And we are talking infrastructure, and others have talked about it. We did have a hearing on this Committee on rural broadband. We understand the impotence. If we are going to connect our communities in the Heartland to markets, to opportunities across the globe, that rural infrastructure, that rural broadband has to be a piece of it.

So with that I yield back, and thank you for the extra time.

Chairman BLUM. Thank you, Mr. Schneider.

Now the gentleman from Kentucky, Mr. Comer, is recognized for 5 minutes.

Mr. COMER. Thank you, Mr. Chairman. My questions are going to all go to Mr. Nelson. I appreciate the long-working relationship you have with my flagship agricultural university in my district, Murray State University.

So my first question, can you elaborate on how Memphis Bioworks has used the agritech industry to stimulate regional revitalization?

Mr. NELSON. Yeah. We realized early that even for Bioworks's original vision of stimulating life sciences in Memphis without reaching out and building a collaboration, and so we have now morphed that into the AgLaunch vision, which again starts with that five-state vision.

We have to mention our mutual friend, Tony Brannon, who helped bring that together and had the vision. It is not easy to collaborate across state lines or to think regionally, but we think it is important both for the food access area—that is where we grow the crops—the commonality, and then also the ability, when we think about how we are positioning our region, we are going to Tel Aviv, London, all over the world and saying “Here is a place to implement your technology with real farmers, and that we can do rice in Arkansas. We can do tobacco and corn and soy in the Purchase area of Kentucky.” So that is part of it.

We also, back to your district, thinking about places like Hopkinsville that are already models of value-added agriculture with

the ethanol facility and the flour mill there, how do we implement tech into that? And so, we see tech as a way of bringing the farmer along in the process and then being able to build more businesses like you guys are already creating in your area. And the collaboration really is centered. Bioworks gets small, and Arkansas State University and Mississippi State University, Murray State, our university partners, and then our development districts and Farm Bureau get large in this partnership as we sort of really continue to mobilize on the rural side.

Mr. COMER. What is the biggest challenge facing agritech entrepreneurs in your region?

Mr. NELSON. Well, this would be broader than the region. In fact, you will see this common theme with the Farmer Network. When we talk to venture capitalists in agriculture, and these are knowledgeable Ag venture capitalists, they say that there is a 90 percent failure rate for deals that have all the right elements. The intellectual property is good, the market is huge, and the people who run the company have already had exits in other industries, a 90 percent failure from this lack of connecting with the grower. As you know from your background, the grower on the other end of that typically gets hit with a bunch of sort of crazy ideas without a way to incentivize them and build them in. So, we really, the lynchpin of all this is how we connect those two pieces together. So, and for us in Tennessee, building out this cost-share program and then building out an actual organized Farmer Network, as you know, we have done that with alternative crops before. We are now expanding that work into the agtech work. For you all, that is probably interaction with KAIDF and some of the other sources to help farmers get in and work early. We should also comment, we have got some great stories like Ag Connections and others that are already great leaders there in the purchase area.

Mr. COMER. We hear not just in agriculture but every industry, especially small business, about the shortage of skilled workers. What is Memphis Bioworks doing to address the problem so that companies can find the workers they need and that they can keep those jobs in the community?

Mr. NELSON. I am going to address Memphis Bioworks, and if you do not mind, I may pass this to Sam as well because they are leading some programs. So, we run DOL programs targeting specific industry sectors, including agriculture, and have had over 1,000 people come through those programs that are getting training, certificate training or entry level into 2- or 4-year colleges. We are expanding that into this agtech arena pretty dramatically, and the number we like to hold up—there is a big dispute whether it is 20,000 to 60,000, but we have a gap in the ag industry of anybody that is opposed to an associate degree and try to sort of address that logically with getting feedback. And I love Sam's comments on Geek Squad and others.

Is that okay to pass and let them also comment on that?

Mr. COMER. Absolutely. Absolutely.

Mr. FIORELLO. Yeah, I think there is a tremendous amount we have to do. We have to, if I start backwards, like I said, we partner with community colleges in areas to try to get them to customize programs that will help, gift certificates and training programs

that will directly impact precision ag and the modern farm. But we have to move backward a step and make sure that in high school and elementary school these kids have some exposure to computing and computers and what data means and robust mathematics. Also, I am lucky to live in a suburb near a university, and so my daughter is exposed to things like classes on innovation and entrepreneurship not when she gets to Iowa State level but in fifth grade they have business plan competitions.

And we were talking before the meeting, there was a terrific program that Warren Buffett's son, Howard, launched a couple years ago, a national Ag entrepreneur contest. We saw high schoolers from across the state get involved and great excitement. Unfortunately, that plan fell off but those kinds of things to, first of all, give these kids a view, a path towards what it can be, and then give them the tools to get there I think are critical.

Mr. COMER. Thank you, Mr. Chairman.

Chairman BLUM. Thank you, Mr. Comer. Good questions.

The gentleman from Utah, Mr. Curtis, is now recognized for 5 minutes.

Mr. CURTIS. Thank you very much.

I would like to express my appreciation to the witnesses for coming today. I found this conversation very interesting and stimulating. I would like to return to the rural broadband issue.

Much of my rural area is owned by the federal government. Some of my companies have as much as 90 percent of the property is owned by the federal government. And we are struggling with permitting across those federal lands. I have joined with Senator Hatch to introduce a bill called the Rural Broadband Permitting Efficiency Act of 2018, to hopefully break that log jam.

Mr. Fiorello, you brought it up, and any of you are welcome to jump in on this. Can you comment? Do you have any experience with federal lands? And is this bill helpful and the type of thing that we need?

Mr. FIORELLO. Congressman Curtis, I do not have specific experience with federal lands, but I do know that there are enormous swaths of rural America where intensive farming happens where it is just dark. There is no Internet connection at all. We are creating all this innovation. We are creating this high end Ferrari and putting it on a gravel road. We cannot utilize the fruits of these innovations without broadband. I think it is a critical issue and until we fix that underpinning, that access to the broadband technology, we are really going to hold back rural America.

Mr. CURTIS. I had a unique opportunity to bring Google Fiber to my city in Provo, Utah, and learned that density is critical. How do we deal with that? The infrastructure, the cost of bringing broadband to these rural communities? Do you have some thoughts on that, on how we get past that?

Mr. FIORELLO. I know that folks talk about the cost. As technology advances, the cost is coming down. The problem is we cannot afford to wait because it is not just the deployment of technology; it is the kids in the classroom that do not have access to the tools. And you cannot be a fourth and fifth grader again; right? You could lose an entire generation. So I think we are going to have to really move in any sort of infrastructure funding that

comes from the federal government, this has got to be moved to high up on the list because I think it is a critical shortcoming and we are just going to have to invest in it.

Mr. CURTIS. So you bring up a good point. I have watched President Trump's plan for infrastructure and an emphasis on rural, and I would like to use this bully pulpit for a minute to say rural structure is not just roads. Or infrastructure is not just roads. And this clearly has to be a topic.

I do not know if any of the others want to jump in on the importance of this and how we get past this problem of just the cost. The number of users per mile makes this very difficult.

Mr. Kimle, you look like you are ready to give me the answer.

Mr. KIMLE. Not an answer but just to reinforce the importance. You know, the startup that I mentioned earlier, Smart Ag with the self-driving tractor relies on wireless to get that done and they have had to have some workarounds to get that done. And so they can be creative in getting it done, but clearly, a solution, whether it is a self-driving tractor or just information passing from one node to the next is an important part. And almost any part of rural America that you go to you are going to find challenges.

Mr. CURTIS. So you are telling me the hot spot on their phone may not drive that tractor?

Mr. KIMLE. Not quite enough.

Mr. CURTIS. I am also curious about the culture. I am listening to you thinking on the one hand our farmers really are the first entrepreneurs in our country; right? The risk takers. They fit all the characteristics. But in many ways they are not your stereotypical entrepreneur. And do you have some suggestions on how we bridge the cultural gap between our traditional entrepreneurs and our farmers and get them thinking along an entrepreneurial line? And then the second part of that question is are we in danger of leaving people behind? As technology becomes successful, how do we deal with those who do not adapt to technology and love the baling wire and torches?

I will throw that open to whoever feels best qualified to answer that.

Mr. NELSON. The interaction with the farmers, I would argue that generally the ones that are in business and are growing viable farm operations are fully entrepreneurs. They have the culture you described, Creating ways, Sam is doing it with his event that they do in September. We are doing it by actually getting investors and other kinds of techno entrepreneurs on the farm and actually going out and seeing. This phenomenon is just amazing. Like I said, in a farm shop is where this work actually gets done, and it is now a highly technical place with a lot of interesting innovation. So, making, creating those matchmaking environments is really, really important. There is also, and this touches I think a little bit on what Dr. Fernandez was getting to on technology, there also are a lot of new farmers that are coming in that are tech savvy in other things beyond technology and agriculture. So typically, they are small farmers that are interested in only organic or certain types of production, and so helping them get connected in with the larger farmers and overall community to understand some of the really interesting ramifications with gene editing, CRISPR, and some of

these other technologies. So, there is the problem of the outside people connecting in, and then within agriculture, really building a common vision on how we feed the world and create these new types of innovations and entrepreneurship.

I also want to comment that typically, the industry has not—a lot of folks say “Are you trying to build the next Silicon Valley?” And we say, “No, we are trying to build an innovation hub but also that has women and minority participants in a meaningful way.” And that is another part of this culture. It really is a new culture that has to be created around the best of the innovators, the tech people, folks from the West Coast, with the growers and then with new entrants into the space.

Mr. CURTIS. Thank you. I am out of time, Mr. Chairman.

Chairman BLUM. Thank you, Mr. Curtis.

In Iowa, we do not call it Silicon Valley. We call it Silicorn Valley.

It is my pleasure now to recognize the lady with the beautiful flowers in her hair from American Samoa, Ms. Radewagen, for 5 minutes.

Ms. RADEWAGEN. Talofa. Good morning.

I want to thank the Chairman and Ranking Member for holding this hearing today, and I want to thank all of you for testifying.

My first set of questions is for all of you. You are aware of the Rural Prosperity Taskforce led by Agriculture Secretary Purdue. Can you respond, each of you? Yes?

Mr. KIMLE. Yes.

Mr. FIORELLO. Yes.

Mr. NELSON. Yes.

Mr. FERNANDEZ. Yes.

Ms. RADEWAGEN. Okay. Well, so as a follow up, if Secretary Purdue reached out to you for advice, what would be your number one recommendation? Mr. Kimle?

Mr. KIMLE. Good question. What would be my number one advice? You know, I have always had this notion that prosperity is—and I am economist, right, but it is more than just economics. So a notion of really flourishing. And so certainly, as we have done outreach work with rural communities around startups and that sort of thing, is tried to bring that idea of real flourishing, of engaging people in creative and impactful work, and hopefully, you know, higher incomes, improve training as part of it. But what we are trying to do as part of our programs at the Agricultural Entrepreneurship Initiative is to train people to have careers of impact. And that means something different for everybody but it is kind of this idea of flourishing. And we can see it in the Midwest as we go from one community to the next. Some that seem to have all the pieces in place—the leadership, the people for flourishing, and others that clearly have work to do to get that done.

Ms. RADEWAGEN. Next?

Mr. FIORELLO. I think, Madam Congressman, if you asked me to pick one, I, again, access to rural broadband would be there because it addresses a number of important needs. One, of course, access to technology, but also ability to deliver mentoring and education remotely. I mean, some of these kids, a lot of these kids have never really seen a successful entrepreneur. If you had the ability

to do a live broadcast and connect an entrepreneur and have him or her tell their story of how they got to where they are. And again, I am talking about fifth and sixth graders, not college kids. So if you asked me to pick one, my pick would be, again, the critical need for access to real broadband for all.

Mr. NELSON. Mine is a two-parter. Expand the existing programs that affect farmers' ability to innovate or get involved in value-adds. That would be value-added producer grants with USDA, innovation grants within NRCS, and other programs that directly stimulate the farmer getting involved in new innovation. And then the second part of that would be adding programs that allow farmers to be incentivized to connect in with some of these early-stage entrepreneurs, building the networks and other things that we described about in the hearing. And make sure that that is front and center. Again, repositioning the farmer as sort of the middle man. But this is what we did to stimulate the ethanol industry when farmers said we do not want to deal with the bases. We do not want to haul our grain. We want to make products here. Doing that in this tech sector is well where the farmers have an advantage to participating. And when we say farmers, a lot of times you get the view of a large, huge soybean, corn, or cotton farm. When we think farmer, we mean everything from the urban small farmer to the one doing a specialty vegetable crop to the large farmer. We view that there are programs that can cross all those but stimulate the technology early adoption and testing.

Mr. FERNANDEZ. Thank you for the question. I think what I would say is that we really need to make sure we are supporting a diversity of farms and a diversity of types of kinds of farms and the coexistence of all these farming operations.

I am a biologist originally, and we all know that diverse biosystems are the strongest and have the most resilience and are the longest lasting. And so I think about it in that way, making sure that we can support all of the farmers in whatever their endeavors.

Ms. RADEWAGEN. So my second question is especially important to the people of American Samoa as our telecommunications are severely lacking and it is of vital importance that it is developed, especially after Hurricane Gita devastated American Samoa last weekend. This Committee and the Rural Prosperity Taskforce have advocated for a Federal Government regulatory regime that supports and fosters growth in the telecommunications industry. How will greater access stimulate rural economic growth? All of you?

Mr. NELSON. Let me make sure I understand your question. You are saying stimulating more rural telecom access, how will that stimulate rural growth?

Ms. RADEWAGEN. So for a lot of the reasons we talked about here all the way down to something as simple as a small farmer in your district that is trying to figure out a market price. If they cannot communicate the use of cell phones across the world, especially in smaller farms have allowed them to actually look at markets and understand their markets better. So even things that would seem simple like that.

I also should have said I am sorry for what happened over the last couple of days and for the loss there.

But so the simplicity of those kinds of things, as well as some of the larger scale innovations that we have talked about that just require connectivity in order to do business. There are also a lot of innovations in our pipeline. I know Sam is a little bit well with some of the different specialty crops, but things, cold storage, the way solar interacts. So you have got off-grid power and other things that are in this pipeline. So again, we end up talking a lot about corn and soybeans and big crops, but a lot of the innovation efforts we are involved in go across that for, again, different scales and different circumstances.

Ms. RADEWAGEN. Anybody else?

If not, thank you, Mr. Chairman. I yield back the balance of my time.

Chairman BLUM. Thank you, Ms. Radewagen.

I would like to recognize the gentleman from Iowa, a fellow colleague of mine, Mr. King, for 5 minutes.

Mr. KING. Thank you, Mr. Chairman. I appreciate you holding this hearing. I hope you accept my apologies for showing up. We have other duties around this Hill, too, so I am glad I got here in time. And I reviewed some of this testimony.

My background is in the construction business, and I have always been fascinated by where technology takes the next generation of humanity. And I regret that none of us are going to live long enough to see where its destination is, but we are watching it accelerate at a really fast rate.

One of the things that I have been impressed by with agritechnology, let's see, if I just look back about 3 years ago I finally got over the shock of watching a planter go through the field with the markers folded up and now I am wondering why the markers are on some of them. They are not on all of them anymore. A lot of them took them off. That says a lot.

And I received a briefing I recall at the Farm Progress Show a few years ago from Monsanto and they said at that time that they were going to team up with a Google operation out of San Francisco to be able to tie together their weather surveillance technology with the technology developed by Monsanto. And so when I began to put that all together and watch it take place and they have since made that merger, it is pretty fascinating to see that I have neighbors that are monitoring their fields every 2-1/2 acres I think it is in a grid pattern, and they get a little text on their phone that says you had better side dress 20 pounds in because you are going to get about an inch of rain soon. You will not be able to get back in the field and the corn needs it. And here is your green days and your temperatures and it is such a fascinating thing, so much different. And also, I think I go down into my man cave most every day I am at home. There are millions of them in America for domestic reasons I will not enter into right now, but I have got two ears of corn down there. And those ears, one of them is from an 1848 open pollinated variety that is preserved by Iowa State University, and that ear yielded between 15 and 25 bushel to the acre. And then the next ear, the ear next to it is an ear from a triple stack hybrid that is a 2015 crop that went across the scales not at 15 to 25 bushel but at 232 bushel. And so that shows me what technology has done for our Ag production.

And I wonder if I could ask Mr. Kimle, what is your view on the GPS components of this and what it is doing for efficiency and where yields are going to go? What am I not observing that is on the horizon?

Mr. KIMLE. Good to see you, Congressman King.

I think you are seeing a lot. And the story of corn, I think, is emblematic of a lot of agriculture. It has been the process of developing plants that can survive at higher populations, but the management requirements to do that effectively are what ag technology will ultimately help with. When you think about the career of a crop farmer, at least in a temperate climate, you know you get about 40 shots at figuring out how to do what you do. And you build on probably what your dad knew and maybe your grandfather knew, what you learned from other people, what you pick up through agronomists, anyway, and that sort of thing. But what technology will allow to accelerate, is that learning? When I look at machine learning and artificial intelligence, and when we think of those technologies, I think we think of things oftentimes outside of agriculture, but it is going to be a really big deal because it will allow us to compress kind of our learning and to getting more out of each season and figuring out is it nitrogen or is it phosphorous or is it some other micronutrient, or is it bacteria in the soil? And so I think absolutely, you know, the trend from the 25 bushel corn to the 225 is there, but what I see and what I think you will see is 300 to 400 bushel being much more common, at least during decent years. And that is exciting, although certainly challenging with what are we going to do with all those bushels?

Mr. KING. I have a picture in my iPhone from an individual that I broke some bread with last Saturday night and the picture is the license plate on his brand new Corvette. It was new in 2008, and the license plate is \$8CORN. Now, they said what paid for that Corvette completely is \$8 corn, but now it is \$3.40 cent corn or less.

So I would say, Mr. Fiorello, do you have any comments you would make on that question?

Mr. FIORELLO. Yeah, I think, Congressman, the paradox is if you overlay the increase in farm productivity, the bushel, let's look at corn as an example, 1975 to today, you have at the same time a declining rural America. There are less jobs, less people, less young people. So the challenge before us is not how to keep producing more because I know we will get there, but how to push some of those benefits of that technology to rural American so that young men and women can see a path to staying in their communities. We talk a lot about urban food deserts. There are plenty of rural food deserts. They are in plenty of communities. We have to get in the car and drive 30 miles to Walmart to get your fresh fruits and vegetables. So I know we will get to 300 bushel corn. The question is how can we recreate the urban landscape so that there is economic opportunity and jobs for all so those men and women can stay there and stay in their communities. That is a tougher one.

Mr. KING. If the chairman would indulge me in a final question. I thank him for his own entrepreneurship, too, by the way. This brings to mind when you address that, I sat in on a little private briefing with a young man who has a project of vertical hydro-

ponics growth of multiple vegetables. And I have seen the pictures of his prototype operation that he set up. He can grow about anything in vertical hydroponics and it is only with the water and the nutrients put in the water that they pump up and it trickles down, and so all of it is used and reused until it is consumed and it is all in there with lights. It only projects the frequency, the spectrum of lights that stimulate photosynthesis. He says that he can raise in one acre inside a building the equivalent of 150 acres of crops that would be raised in the outdoors. Are you seeing anything like that coming along?

Mr. FIORELLO. Sure. We are seeing great trends like that. I think Dr. Fernandez made a great point earlier about we need to have more diversity of farming. We need the entrepreneurs who can think of aquaculture, aquaponics, indoor farming as well as the farmer aspiring to 300 acre corn. But again, we will not get there until we start to address how to inspire young kids in a school and how to give them a path to say I can start my own company. I go to these rural communities. You will not see one kid who will say I have met an entrepreneur and I have gotten to know them. In our worlds, those are folks we meet with every day. So how do we start to change the culture and exposure, and even something as simple as celebrating farmers who have been successful entrepreneurs in our community? So it is culture. It is mindset. It is infrastructure. It is a lot of things.

Mr. KING. I would suggest as I conclude here that we look at some of the models of the successful entrepreneurs, such as the Chairman of this Subcommittee, and ask him to continue to illuminate his life story. And I would yield back to the Chairman. Thank you.

Chairman BLUM. Thank you, Mr. King.

We have about 10 minutes remaining so I am going to be a little less formal. If you want to stay, Mr. King, we are just going to do like a lightning round. I am going to fire a question and then Ranking Member Schneider will. And if Congressman King wants to. So maybe try to keep your answers short and concise because we have about 10 minutes left.

My question is, I am back to the funding again and paying to try the technology with the farmers. What comes to my mind is co-ops. Co-ops in my district are huge companies owned by the farmers. A kind of interesting relationship there. Are any of you in the startup business? Are they looking to partner with co-ops? Because there is money there. The funding of co-ops, which in essence is funding from farmers out of profits. Anybody have experience with working with the co-ops, and are they involved in the startup entrepreneurship?

Mr. FIORELLO. Yes, one quick one. The company that won last year's business plan competition, our event, is a company called NanoGuard. They have a technology to help clean grain. And so the rice millers are partnering with them now, investing early on and letting them set up beta test sites and prototypes. So it is the partnership that Mr. Nelson talked about before that is vital and win-win.

Chairman BLUM. So they are getting involved?

Mr. NELSON. Yes. The co-ops are, and the check off organizations, and the farm organizations, like Farm Bureau, which in essence make, when Dr. Kimle was talking about the cluster and how hard that is, they become sort of the cluster because they have these relationships, as well as capital that you mentioned. So, yeah, and we are fully endorsing any of those kinds of ways.

Chairman BLUM. Good to hear. Good to hear.

Mr. Schneider?

Mr. SCHNEIDER. Thank you. I want to go back to the idea of how do we create the ecosystem within these rural communities, because as you create tech companies, it raises productivity as you touched on. But that raising productivity as farms get larger, technology replaces it, driverless truck, driverless tractors, it lowers the employment opportunities on the farms. If we keep these tech companies within these communities, that creates some jobs but tech companies can grow to scale without a whole lot of jobs. So we need other ancillary jobs around that. How do we create broader ecosystems with the community?

And on another topic, Mr. Kimle, you talked about the fact, and I will use the example of back to 1985, that farmer that I was working with probably was making less than his job in San Francisco financially but there was a whole psychic income of working on the land and waking up and seeing the sun rise and all the things that go with being in agriculture that go with that. But how do we create these ecosystems in these communities that inspire young people to come home, stay home, and create the opportunities for them to succeed?

Mr. KIMLE. I think a lot of the models that were used in larger communities can work in the rural communities as well. Just as one simple example, our program, we have started a larger program. The Ag Startup Engine at Iowa State University is called the Startup Factory. So kind of a training mentoring program, 6 to 12 months and beyond. They started this year a pilot program to work with smaller communities in essentially kind of a train the trainer sort of a thing to take that model, work closely with people in that community, pull in a cohort of startups and work. And so the clear idea is to plant a seed there so that they have kind of the startup support and mentoring that happens there just as it happens. So Spencer is one of those communities and Ossam, Minnesota is the other one that is participating in that. So I think sort of a matter of identifying those communities that have at least a core of kind of leadership and the want-to to get it done and then transferring some of those models and just experimenting and trying things.

Mr. FERNANDEZ. You know, you talked about young people coming back, and I think an interesting observation is that we are seeing a lot of young people who have never been on the farm before; people who actually want to go into farming. And so I think part of what we need to be thinking about is how do we create that ecosystem with those people who did not come from the farm but have that interest, and how do we provide them with the training and the education necessary so they can enjoy the benefits of that lifestyle?

Mr. SCHNEIDER. And that is something—and I will yield back with this comment—veterans coming home are a great opportunity do that.

Mr. KIMLE. And I might, if I can just take one moment, you know, what is different between 1986 and now or when I got my bachelor's degree in 1988 and now, and corn prices may not be good, but it is so different now. You know, moms and dads in the 1980s, telling their sons and daughters, whatever you do, do not come back to the farm. Whatever you do, do not work in agriculture. And we have people coming to Iowa State University from the Coast, from around the world, because they want careers in agriculture. Two, 3 years ago there was one of our ag business students on the cover or the second page of the Wall Street Journal, and the headline—I am going to forget exactly what it was, was about agriculture careers being sexy. I never thought I would see that, but that is a good thing for us.

Mr. NELSON. Can I make one more comment on your question? What Dr. Fernandez talked about with gene editing, if you think about what drove Silicon Valley, it was that Moore's law line that gave investors, you got the dream, but because of the line you knew this is worth keeping on investing and it would weather it. With the cost of genomic sequencing falling faster than the line of Moore's law, what Dr. Fernandez was describing is we can tap in not just corn or soybeans but a huge subset of the other 56,000 identified nutritional plants and start to commercialize those. So, when I started my career, you could not work with a new trait or a new type of breeding unless it had 5, 6 million acres. Now we can do that with this whole realm of new crops. So that is what is going to drive the whole rural change. As you look at these communities, they are going to have all kinds of value-add opportunities, a lot of different kinds of crops, and unlike other industries, the automation, so agriculture at its most efficient—you talked about the corn plan earlier—it is 20 percent efficient compared to a 95 percent efficient indoor factor. So, any automation of everything we do only brings efficiencies to get us up to par with other industries and actually will stimulate in ways that automation robotics do not do. So, the vision is really this compelling rebuild of agriculture to take advantage of these tools that Dr. Fernandez talked about and it will stimulate a whole host of new innovations. I just wanted to add that.

Mr. SCHNEIDER. And then just to link it all together, projected global population of 9 billion or more in 2050, the rest of the world ahead of us right now, we need to invest in the R&D to make sure we are there because this is a growth market that could really lead to growth in our communities.

Chairman BLUM. Mr. King?

Mr. KING. Thank you, Mr. Chairman.

Mr. Kimle, you kind of lit of a memory for me when you talked about what it was like in the 1980s. And, of course, we struggled through that entire decade. And what you said is something I do not remember anybody saying before, at least in a hearing here, is that our children in rural—I will call it Corn Belt, but Ag—our children were raised throughout the 1980s to leave home, go get an education, take your degree, do not look back. And now my neigh-

borhood is full of grandparents that buy plane tickets to fly to the Coast to see their grandchildren. And I always wanted to see that changed. I have a little vignette in my memory though of being at the Tulip Festival in Orange City, Iowa, back in the 1980s, and there were the queen and her court, and there was a corded microphone, which is hard to imagine today, and they passed that around and they said, what are you going to do when you graduate from high school? I am going to go to Northwestern College. That is in Orange City, Iowa. And four of them said Orange City. And the fifth one said, I am going up to Bethel and then I am coming home. Those kids in that county at the same time were raised to have a future there, and they had competition in education. They have entrepreneurs, they have Trans Ova, the very first cloned bovine, anywhere successfully in the world. Now you have got about eight or more spinoff companies off of that. I see what is happening with the technology, the genetic technology that you addressed, Mr. Nelson, and I think also in that same community, about 15 years later, around the year 2000, 2001, I met a family on the street that had 1,300 acres of crop, all corn, except for one acre. And that corn grossed only at \$300 an acre that year, I recall, but they took \$28,000 off of that single acre, which was a glorified garden. And they had irrigated. They did a great job of marketing, and they probably had \$50,000 worth of child labor invested in that one acre. But I bring this up because when you draw the distinction between \$300 an acre corn here and \$28,000 specialty crops out of the same soil, and then you add to that the technology that you addressed especially, Mr. Nelson, it tells me that 7 billion people, 9 billion people, they can be well fed, and we should never worry about being able to feed the planet if we employ the technology we have. We have got the skillsets. We have got the technology. It is a matter now of implementing it.

Does anybody want to comment on those comments?

Mr. NELSON. I will comment first. And you mentioned this a minute ago with the business model of seed company, then traits, and then now selling data. And so, the first comment I will just say is this information in this technology revolution, you are right, but it has to be laid out with the right partners. So, farmers now do not probably want to be you just give me the prescription and just tell me what to do. They want to think, and they want to analyze data. And so, as we think about how we bring these other technologies in, we just need to be thoughtful in how to build the right partnerships. Part of the theme of this one was having the right public and private partners at the table and how we stimulate it. But there is no question that the technology, plus implementation in the field, plus good soil management practices, can lead to solving some of these global problems.

Mr. KING. Anyone else?

Mr. KIMLE. I think your comments about Orange City in Sioux County, just the stuff going on there, I mean it is just a very interesting case study. I absolutely agree that more of that spread around other rural communities is a big deal. When I first came back to Iowa State, I had my own businesses, colleagues did a survey of Iowa State alumni who graduated with our bachelor's degrees between the years 1982 and 2006. For the entire sample, 15.1

percent had started at least one for-profit business. And when you got back to the 1980s graduates, the old people like me, it was upwards of 30 percent. So a really good record of entrepreneurship. The jobs that their businesses had created was like 225,000 that did \$64 billion in revenue. 84 percent of the jobs created, however, were outside of the state of Iowa. You know, so you take a student body that is 70 percent Iowa and they created jobs someplace else. Now, that is okay, but we have not, in Iowa, at least done a good enough job trading our young people who go someplace else and importing somebody else. But what I see that is fundamentally different today is that we are bringing people in to agriculture no matter where it is at. And if we do our jobs as a community, as policy leaders, and so forth, we are going to keep people there and have, you know, and just engage imagination to create a better tomorrow than what we have ever had and how we did things in the past.

Mr. KING. I would like to conclude with a point here that I think came out of the data you quoted, and that is, this is a reference to a theory I cannot find anymore, but it is Coltie's theory. But what it is, it calculates that the economy goes into a cycle, and when everything is down at the bottom, where we were in the 1980s, flat at bottom, that is when you have your innovation and your entrepreneurs because you do not have anything else going. You do not have capital. You do not have cash flow, so you sit around the kitchen table and say what are we going to do? Are we going to move or are we going to come up with a better idea? And that is where the innovation is rooted. And then you start plugging those ideas together and you look for capital, you look for technology, match that together, work your way up. That happened in the 1980s in Iowa and across the Ag community in the country. And as we came out of the 1980s, I saw that capital start to get formed and pulled together and that capital became productivity and efficiency and competition. So that is a cycle I wanted to reference that I think showed up in the data that you quoted, Mr. Kimle.

And I appreciate all your testimony.

I yield back, Mr. Chairman.

Chairman BLUM. Thank you, Mr. King.

As Mr. King said when he sat down, we have other responsibilities. So unfortunately, I want to draw this hearing to a conclusion. I would like to thank all of our witnesses for their excellent testimony. This was a great hearing I thought.

As we heard today from our excellent panel, agritech investment is driving rural revitalization with various initiatives using agritech entrepreneurship to bring jobs and dollars into our local rural communities. Today's witnesses represent a diverse group of stakeholders who are partnering to attract startup activity to the Heartland and other regions. They are also creating ecosystems that set up these small businesses to thrive and compete in the marketplace. We are also reminded importantly that all stakeholders must work together to make sure that the most important stakeholder, small family farms, can benefit from the many exciting technologies and innovations America's brightest entrepreneurs

are developing. This will ensure that family farms, a vital part of Iowa and America's economy and food supply, continue to succeed.

I ask unanimous consent that members have 5 legislative days to submit statements and supporting materials for the record.

Without objection, so ordered.

We are adjourned. Thank you, gentlemen.

[Whereupon, at 10:52 a.m., the Subcommittee was adjourned.]

APPENDIX



Building an Ecosystem for Agtech Startups

Submitted Testimony

**U.S. House of Representatives Small Business Subcommittee
on Agriculture, Energy, and Trade**

Kevin Kimle
February 2018

Agricultural Entrepreneurship Initiative
Iowa State University
Ames, Iowa 50011



Kevin Kimle is the Rastetter Chair of Agricultural Entrepreneurship, Senior Lecturer in the Department of Economics, and Director of the Agricultural Entrepreneurship Initiative at Iowa State University.

Technology is nothing new, of course, whether in agriculture or any other industry. What may be new is the speed and scale at which technology can shape new opportunities and disrupt existing businesses and industries. Agtech is by all indications important. There are many accelerator programs related to starting agtech businesses, funding of agtech startups has grown, etc.

Funding for agtech startups has increased significantly. As tracked by [AgFunder News](#), investment in agtech increased from about \$150 million in 2010 to more than \$800 million in 2016 and more than \$500 million in 2017. Transactions like Monsanto buying Climate Corp in 2013 for \$930 million or in 2017 DuPont Pioneer buying Granular for \$300 million certainly got attention of investors, entrepreneurs and agricultural business professionals.

Both Climate and Granular were founded in Silicon Valley, the hub for tech startups and investing. Will there be a Climate or Granular type exit event for an agtech startup from the Heartland? Is there an ecosystem for agtech startups apart from Silicon Valley?

A 2017 report from M25 examined the Midwest and labeled it as the region that will give rise to the next crop of \$1 billion-plus companies (Schulman 2017). From where does that observation arise? What's going on in the Midwest?

This paper will provide examples of Iowa-based developments in agtech, and discussion of larger issues for the ecosystem for agtech startups in the Midwest and the potential implications for economies in rural areas of the region.

Agricultural Entrepreneurship Initiative, Iowa State University

The Agricultural Entrepreneurship Initiative was founded in 2005 and is one of the foremost programs for training and developing high growth agricultural entrepreneurs in the world.

The Agricultural Entrepreneurship Initiative builds on a rich history of entrepreneurship at Iowa State University. For example, twenty percent of graduates of the College of Agriculture and Life Sciences at Iowa State University between 1982 and 2006 have created at least one business, resulting in creation of almost 57,000 jobs (Jolly, Yu, Orazem, and Kimle 2010).

Agricultural entrepreneurs from Iowa State University have been responsible for innovation, invention, and business creation in important sectors of agriculture and the food industry ranging from seed, agricultural equipment, GPS, agricultural chemicals, biotechnology, pharmaceuticals, and food products.

The Agricultural Entrepreneurship Initiative's activities have a foundation in the Land Grant University mission of education, thought leadership, and outreach. By creating a broad understanding of entrepreneurship among faculty and students of the College of Agriculture and Life Sciences at Iowa State University and its supporting components, undergraduate

programs are designed to supply students with exposure and experience with entrepreneurship, both in the classroom and outside the classroom. A diverse portfolio of educational experiences is complemented by programs in business incubation, public-private partnerships, technology commercialization and industry interaction.

Each academic year, the Agricultural Entrepreneurship Initiative:

- Touches 1,200 undergraduate students in the College of Agriculture and Life Sciences with at least one program. This includes classes, out-of-classroom activities, and internships.
- Takes more than 200 students through an Entrepreneurship in Agriculture course, with students developing startup business concepts presented at semester's end to investor and entrepreneur panelists.
- Places 30 to 40 interns with entrepreneurial agricultural businesses working on various business development and innovation projects. Students are placed in both domestic and international locations.
- Brings to campus more than 150 entrepreneurs, investors, and agribusiness professionals as classroom speakers, student presentation panelists, and industry, market, and technology mentors and experts.
- Supports fifteen to twenty five student entrepreneurs as part of AgEI's Student Incubator program. Notable examples from the Student Incubator Program include Scout Pro, Agriculture Concepts, AccuGrain, and Terva.
- Partners with entrepreneurial businesses for domestic and international travel course projects. Students act as consulting team for participating businesses.
- Creates outreach opportunities such as the Entrepreneurial Agribusiness Executive Conference and the Agricultural Entrepreneurship Unconference.
- Helps foster mentoring and investment platforms for the agricultural entrepreneurship ecosystem such as the Ag Startup Engine, which was founded in 2016 and has invested in five businesses.

The Agricultural Entrepreneurship Initiative has served as a model for other programs, having assisted in creation of new programs in other states as well as Greece and Tanzania.

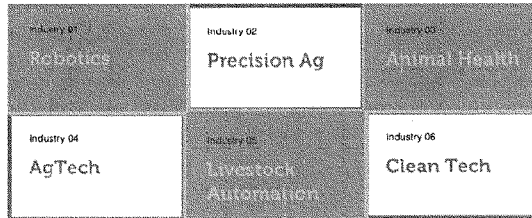
Agricultural Startup Engine, Iowa State University Research Park

The Agricultural Startup Engine is an investment platform based in the Iowa State University Research Park to fund agtech startups. For example, students and alumni of the Agricultural Entrepreneurship Initiative may have a great idea, but not have a clear path forward toward funding. The Ag Startup Engine seeks to leverage an imbalance between quality seed stage ideas in the agricultural space and available capital to create a platform for development of high-growth agtech startup businesses.

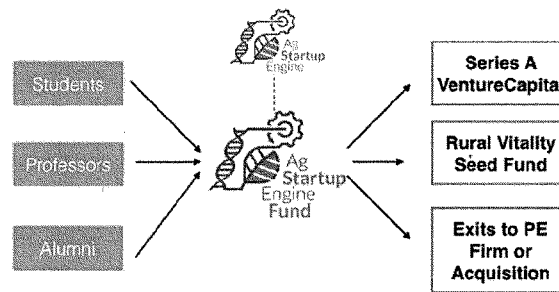
The Ag Startup Engine believes there are two fundamental categories that need to be more robust in the State of Iowa for startups to become more successful:

1. Organized mentorship from successful entrepreneurs and business professionals
2. Early seed round investment (\$25,000-\$50,000)

Targets for investment include startup businesses in robotics, precision agriculture, animal health, agtech, livestock automation and clean tech.



True seed investment helps transform an idea into a startup business that establishes a target market, develops a minimum viable product, articulates differentiation, and establishes traction through customer discovery or successful grant development.



The Agriculture Startup Engine is a supportive agent in Iowa State University's major startup initiative to make it a top 5 university in startup creation. As such, it works in tandem with the Startup Factory, Pappajohn Center for Entrepreneurship, and the Agricultural Entrepreneurship Initiative around agriculture-centric ventures.

Agriculture Startup Engine investors include Summit Agricultural Group, Ag Leader Technologies, Ag Ventures Alliance, Peoples Company, Hertz Farm Management, Veridian Credit Union, Next Level Ventures and Iowa Farm Bureau Renew Rural Iowa, and Peterson Genetics.

The Agriculture Startup Engine has made five investments to date. Portfolio business include:

- SmartAg – Developed a platform for farm equipment automation. First deployment is a self-driving tractor pulling a grain cart.
- Performance Livestock Analytics – Developed a software platform for beef feedlots that automates the feed delivery process, enabling beef producers to make better performance and financial decisions.
- Gross-Wen Technologies – Invented an algal-based wastewater treatment process that recovers nutrients from wastewater. The algae biomass that is produced can then be used as a slow-release algal fertilizer.
- Terva – A farmland software platform that serves farmers, landowners and real estate professionals when buying, selling, renting, appraising and prospecting land.
- Nebullam – Developed aeroponics technology for indoor vegetable production.

The Agriculture Startup Engine aims to invest in 15 businesses in the next three years.

Can the Midwest be a Hub for Agtech Entrepreneurship?

The Midwest is home to the greatest concentration of animal protein supply chain activity in the United States and early-stage agricultural technology activity in the Midwest is particularly relevant to these supply chains. For purposes of this paper, the Midwest is comprised of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin.

The Midwest has a strong concentration of public and private entities focused on developing agricultural technology. It is home to land grant public universities that provide a unique network of cutting-edge basic and agricultural science platforms. There is also a concentration of agricultural businesses engaged in technology development at many different levels. The Midwest is a catalyst of US agricultural innovation, knowledge transfer, and entrepreneurship development.

And yet there is much untapped and undeveloped potential for agtech entrepreneurship and investment-related activity.

Examples of geographic clusters of early-stage agricultural technology development in the Midwest include established public and private organizations that shape the environment for technology development, business development and entrepreneur/startup mentoring and support:

- Des Moines/Ames, Iowa.
 - Multiple plant science agricultural business such as DuPont Pioneer and Stine Seed
 - Iowa State University - land grant public university.

- Iowa State University Research Park - assistance and accessibility for early stage businesses
- Iowa State University Agricultural Entrepreneurship Initiative - development program for agricultural entrepreneurs and agricultural innovation
- Agriculture Startup Engine – investment platform for agtech startup businesses
- Iowa AgriTech Accelerator - Mentor-driven business accelerator designed to foster innovation in the AgTech industry
- Cultivation Corridor – Organization aiming to create a global center of excellence in agbioscience, biorenewables, biotech and advanced manufacturing
- Omaha/Lincoln, Nebraska.
 - Home to agricultural businesses such as Green Plains Energy and Valmont
 - University of Nebraska - land grant public university
 - Nebraska Innovation Campus: support for early stage companies
 - Water for Food Institute - research institute for achieving food security with less pressure on water resources.
 - University of Nebraska Engler Agribusiness Entrepreneurship program - support and encourage entrepreneurship amongst students
- St. Louis, Missouri.
 - Monsanto - plant science agricultural business
 - Bio-Research & Development Growth Park - bio-research facilities for emerging scientific enterprises
 - Danforth Plant Science Center - nonprofit scientific facility to increase understanding of plant biology
 - Yield Lab - agtech accelerator with a stated mission to sustainably increase the global food supply and reduce inputs to agricultural production and distribution
- Twin Cities, Minnesota
 - University of Minnesota - land-grant public university
 - Home to agricultural and food businesses such as Cargill, General Mills, CHS, and Land O'Lakes.
 - Techstars Farm to Fork Accelerator – focused on the tech/digital side of food and agriculture from agtech, manufacturing and supply chains, to food safety, waste reduction and traceability.

Though agtech investing has risen significantly in the U.S. and entrepreneurial activity in the Midwest as evidenced by programs related to agtech has also increased, evidence of significantly higher venture capital funding in the Midwest is limited.

Venture deals in the United States have been most heavily concentrated in Silicon Valley, with up to 50 percent of total VC investment dollars in the country flowing to companies in northern California during some quarters. The Midwest remains underdeveloped relative to other parts of the United States in attracting venture capital funding. While venture capital invested in the

Midwest rose from \$1.8 billion in 2007 to \$4.0 billion in 2017, this represented only 4.7% of the total in the U.S. in 2017, making the Midwest a poor performer in terms of per capita venture capital investing (National Venture Capital Association Data).

Early-stage business activity is difficult to track by its nature. Inventors, entrepreneurs, and investors advance projects without extensive public disclosure, and personal networks are an important means of communication and development. To provide a proxy for the state of early-stage agricultural innovation activity in the Midwest, an analysis was conducted of business plans developed by students at the Agricultural Entrepreneurship Initiative at Iowa State University compared to those tracked by AgFunder in 2016. The dataset offered here is a snapshot of early-stage business development activity, much of it related to agricultural technology.

AgTech Interest by Subsector (2016)

	<u>ISU</u> <i>n=54*</i>	<u>AgFunder</u> <i>n=307**</i>
Alternative Protein	0%	5%
Animal Health & Nutrition	19%	3%
Bioenergy	0%	2%
Biomaterials & Biochemicals	5%	14%
Cannabis Technology	2%	2%
Decision Support Tech	16%	8%
Drones & Robotics	9%	8%
Farm-2-Consumer	26%	3%
Food E-Commerce	0%	32%
Food Tech	0%	2%
Food Safety & Traceability	0%	4%
Indoor Agriculture	9%	2%
Irrigation & Watertech	0%	4%
Smart Equipment & Hardware	9%	1%
Soil & Crop Technology	0%	9%
Waste Tech	0%	1%

* 94 total students pitched a business concept. 57% were AgTech.

** \$1.8 billion invested first half 2016 by 425 unique investors.

This analysis revealed a higher interest by ISU students in production agriculture oriented technologies than those tracked by AgFunder. Areas of activity such as animal health and management, decision support technologies, food science, energy efficiency, feed efficiency, sustainable production systems, environmental mitigation and manure management are more focused on the agricultural activities present in the Midwest.

Ecosystem Opportunities and Challenges

The common metaphor for fostering entrepreneurship as an economic development strategy is “ecosystem.” But what makes an ecosystem vibrant for entrepreneurial activity?

A Harvard Business Review article provided a true/false quiz on the topic (Isenberg 2014).

You know that you have a strong entrepreneurship ecosystem when there are more and more startups. **FALSE**

Offering financial incentives (e.g. angel investment tax credits) for early stage, risky investments in entrepreneurs clearly stimulates the entrepreneurship ecosystem. **FALSE**

In order to strengthen your regional entrepreneurship ecosystem, it is necessary to establish co-working spaces, incubators and the like. **FALSE**

According to entrepreneurs the top three challenges everywhere are access to talent, excessive bureaucracy, and scarce early stage capital. **TRUE**

Wanting a vibrant entrepreneurial ecosystem for agtech entrepreneurs in the Midwest and actually having one are different.

Specific challenges include the following.

- **Funding** – The right money at the right time for each startup business is always a challenge. The good news is that there are many more sources for early-stage funds than 20 years ago. The popularity of shows such as Shark Tank has led to a proliferation of competitions that often have financial prizes, and is a cultural phenomenon that shouldn’t be discounted. There are pitch and business plan competitions, incubation and accelerator programs, a greater array of local and regional funds today than ever before.
- **Mentoring** – Most startup success stories will also have stories about key mentors that provided key advice and perspective at key times. Entrepreneurs break rules and make mistakes in an effort to drive their businesses forward. As with funding, mentoring programs are now much more common than 20 years ago. However, the most valuable mentors for entrepreneurs are entrepreneurs, and those can be difficult to find depending on where you live. For entrepreneurs working to build high-growth businesses, the best advice will come from those who have built their own high-growth businesses. But the number of individuals who have ‘done it’ is not high, especially in a region with lower population density.

- Change-making culture – An element of support for entrepreneurs is cultural. A culture that is accepting of the risks and contrarian nature of new ideas is important. The friendly and egalitarian culture of the Midwest may at times be at odds with widespread celebration of entrepreneurial rule-breaking and risk-taking. There is an old saying in the Midwest that's indicative of a culture that, at times, may not be conducive to entrepreneurs: "Nothing is punished in a small town like success."
- Agglomeration – Economists view agglomeration as an issue important in economic development in that firms and professionals from an industry are often located near to each other. This concept relates to the idea of economies of scale and network effects. As more firms in related fields of business cluster together, their costs of production may decline significantly (firms have competing multiple suppliers; bigger talent pool; greater specialization and division of labor result). Cities form and grow to exploit economies of agglomeration. But what about the Midwest and agriculture? By it's nature, agriculture is spread out. The biggest concentration of agricultural production in the U.S. is in the middle of the continent while the highest populations densities are on the coasts. While it's a good thing that cities and agriculture don't on a large scale compete for land in the U.S., it also means that agricultural professionals and entrepreneurs don't have the agglomeration affects of something like the tech industry in the Bay area of California.

On the other side of each of these challenges lie opportunities. Agtech investing and the popularization of it as a sector unto itself now results in websites, funds, conferences and other events that enable coordination, new relationships and other positive spillover affects.

For the agtech ecosystem in the Midwest to continue to become more vibrant three things are critical.

1. Expose more young people to the concept that entrepreneurship is an option – Whether university programs or even high school programs, young people will benefit from being exposed to entrepreneurship. Fewer young people today grow up in families with farms and small businesses, so we need them to meet others and have experiences that expose them to the idea that they can not only someday get a job, but also make a job.
2. Continue to develop more forms of early-stage funding – The more sources of funding for early-stage startups the richer array of startup businesses that will emerge. Competitive filters on funding, whether a pitch competition or review panels for government programs, are important not only to insure the best ideas rise to the top but also to institutionalize feedback loops. The more sources of early feedback for aspiring entrepreneurs, both positive and negative, the better off they will be.
3. More Midwestern funds – The development of more professional funds in the region, whether angel, seed, venture, private equity, or whatever will benefit the region. Investors from one region and entrepreneurs from another can work sometimes, of course, but location matters. If there are more funds in the Midwest, there will be more investing in the Midwest.

Rural Vitality

Are there implications of agtech development for the economies in rural areas?

The adoption of agtech will result in a more productive and sustainable agriculture. The process of farm to fork will be more automated, connected, sensed, and traced. The ability to do and create new products, services and experiences will create opportunities that can work anywhere, including rural areas.

Will there be agtech startup businesses in rural areas? Yes. Agglomeration effects will still favor more urban environments for many agtech firms, but smaller towns that support entrepreneurs will result in startup activity. As one example, the Startup Factory program at Iowa State University has started to work with rural communities on running parallel programs for entrepreneurs in Ames and in those communities.

The most significant impact of entrepreneurs on rural economies, however, will come from Main Street businesses. The entrepreneurs with high growth agtech businesses to have emerged from programs at the Iowa State University Agricultural Entrepreneurship Initiative are to be commended. But a much higher rate of new business formation and employment has come from the many alumni who have started a new livestock operation, crop farm, vegetable farm, seed business, trenching business, crop input supply business, etc. And many or most of these businesses are in rural areas. We estimate that twenty times more alumni have started these types of farms and businesses than have started higher risk/higher reward businesses.

A 2008 survey of Iowa State University alumni from 1982 to 2006 found that 15.8 percent had started at least one for-profit business. These businesses resulted in creation of 222,569 jobs. These companies had 2007 revenues of approximately \$64 billion. For an indication of magnitude, note that Iowa gross domestic product was \$135.7 billion in 2008.

Of the 222,569 jobs created at the businesses started by ISU alumni entrepreneurs, only 35,242 of those were created in the state of Iowa, 15.8 percent of the total. A higher proportion of total companies founded by alumni were located in Iowa (35 percent), but those businesses located outside Iowa had more jobs created per enterprise. Large metropolitan areas both in the Midwest (Minneapolis, Chicago, St. Louis, Kansas City) and outside the Midwest (Phoenix, Los Angeles, Dallas, Seattle, San Francisco) recorded multiple alumni starting businesses. A alumni base that was greater than 75 percent from the state of Iowa created 84 percent of jobs outside the state of Iowa.

There are likely multiple explanations for this. The top response for business location in the survey was 'where I lived' (82 percent ranking it as very important) indicating that alumni had already moved away from Iowa to pursue their careers when they started their entrepreneurial ventures. Rather than move back to their native state of Iowa, they located their business

where they lived currently and had built their post-undergraduate career and lives. The first business start for alumni was on average 10 years after graduation.

The founding of entrepreneurial ventures by ISU alumni outside the state of Iowa may signify the 'brain drain' problem long cited in the Midwest. But the graduation period for this survey group, 1982 to 2006, had an extended period of economic distress in agriculture and other Iowa industries. Job opportunities for ISU graduates were outside of the state and even region and they settled and started their businesses elsewhere.

Will a future survey of 2007 to 2031 graduates show similar results? Preliminary indications are that no, a higher proportion of entrepreneurial activity will occur in Iowa and the Midwest. Certainly the attractiveness of a career in agriculture in 2018 compared to 1988 is higher based on enrollment at Colleges of Agriculture at Iowa State University and other universities also. More young people seeking careers in agriculture is likely positive for rural areas. 66.6 percent of 2015/16 ISU College of Agriculture and Life Sciences graduates, for example, accepted their first jobs in the state of Iowa.

And more programs, competitions, and cultural celebration of entrepreneurship is also positive for the economies of rural areas. Shark tanks can work anywhere.

References

Isenberg, Daniel. "What an Entrepreneurship Ecosystem Actually Is." Harvard Business Review. May 12, 2014.

Jolly, Robert W., Li Yu, Peter F. Orazem, and Kevin Kimle. "Entrepreneurship and higher education: an overview of the Iowa State University alumni survey." (2010).

Schulman, Katherine. "Agtech in the Midwest: Creating Fertile ground For the Next Unicorn." M25 Group. 2017.

House Committee on Small Business Committee, Subcommittee Agriculture, Energy and Trade
Remarks by San Fiorello, Chief Operating Officer, Donald Danforth Plant Science Center and President, BRDG Park

February 15, 2018

Good morning Chairman Blum, Ranking Member Schneider, and members of the subcommittee. My name is Sam Fiorello and I am the Chief Operating Officer of the not-for-profit Donald Danforth Plant Science Center in St. Louis, Missouri. Since I began working with Dr. Danforth to establish the Center 20 years ago, we have grown to the world's largest institute of its kind with over 240 scientists and staff working to improve the human condition. I am also President of the BioResearch and Development Growth Park a research park on our campus that is home to 14 for profit enterprises and a bioscience workforce training program. Thank you for the invitation to discuss the importance of agricultural research and innovation, a key driver in strengthening family farms and growing the small business sector of our economy.

Fifteen years ago, a farmer would proudly tell me that he could fix anything with a handful of baling wire and a blowtorch. Today, the three quarter of a million-dollar tractor he drives has more computing power than the Apollo 11 that went to the moon and back. That's progress. But that progress has also come with challenges. The average farmer is 58 years old. Tech savvy young people are leaving rural communities for urban centers where 21st century jobs are more readily available.

Our economy has changed. Big business, manufacturing and the like are not the economic engines they once were. According to the Kauffman Foundation in Kansas City, MO, "Without startups there would be no net job growth in the U.S. economy." Entrepreneurs who are now household names like Steve Jobs, Bill Gates and Jeff Bezos, developed ideas and produced new products and services that improved the quality of life for people around the world. In the process, they improved our position in the global economy by creating employment opportunities for communities and served as engines of wealth creation. Newly created wealth, in turn, is re-invested in new economic enterprises that further enrich our communities.

Why is someone who helped establish a plant science research institute, research park and an ag investor conference here to talk to the small business committee you might ask? I am here because plant science and ag innovation are impacting both of the trends I just described.

According to the Report to the President of the United States from the *Task Force on Agriculture and Rural Prosperity*, prospects for innovation in agricultural and food industries are evidenced by their attractiveness to private-sector venture capital. Recent years have seen a sharp increase in venture capital directed at these sectors, especially for information technology and biotechnology innovations. According to AgFunder, during 2014-15, venture capital

funds invested at least \$6.9 billion in a range of agriculture-related innovations, including precision agriculture and e-commerce food marketing. Most of these venture capital investments have been directed at U.S. firms, but some have involved major investments with firms located in Europe, Israel, China, and elsewhere. Last year that figure approached \$9 Billion. To give you context, when I started the Ag Innovation Showcase in 2009, that figure was less than half a billion dollars.

Federal and state research institutes use a variety of means to collaborate with the private sector as does the Danforth Plant Science Center. Some of the venture capital startups are spinoffs from innovations developed in these laboratories or through joint research efforts with private firms. Other major contributors are the more than 100 federally-funded U.S. Land Grant Colleges and Universities, which are key providers of STEM training as well as innovators across many sectors, and have contributed to U.S. world leadership in many high-technology fields. Innovations emanating from these institutions find their way into industries through scientific publications, patents, direct university-industry partnerships, and STEM-trained graduates. Furthermore, these institutions help create internationally-competitive firms and industries.

Now I would like to tell you more about how the Danforth Center has contributed to the creation of a vibrant innovation ecosystem which is anchored by some of the best and brightest scientists in the field, world class facilities; greenhouses, growth rooms, tissue transformation, computational genomics and more. In the last 20 years, we have established networks of individuals and organizations that help strengthen the ecosystem; inventors, investors, business development experts, key industry players who become acquirers of technologies and/or companies, thought leaders, and more.

A sub point of our mission statement is to, strengthen the economy of the St. Louis region. This seems a noble goal, but again, why should we, a research institute, care so much about building an ecosystem that supports innovation and entrepreneurship?

In addition to addressing the need to feed and fuel 10 Billion people by 2050 without choking our planet, what is really special about the agtech and food tech innovation is that it is one of the few undertakings today that help bridge our nation's urban vs rural divide. Our discoveries are the basis for creating products and services that meet critical needs of farmers and ranchers, food processors, food manufactures, distributors and grocers. Young people who are tech savvy now have an outlet to put that love and understanding of technology to use in their communities. Imagine a kind of "Geek Squad" in rural communities across America that can be deployed to help get a tech heavy piece of equipment up and running again in minutes or hours rather than days.

Let me share briefly some of the measurable outcomes that we have achieved. In 2008 the Danforth Center partnered with a leading real estate developer to build the first leg of our research park; The BioResearch & Development Growth Park, BRDG Park for short. Although still in its early phase of development, we can

point to some tangible results. Today the BRDG Park is home to 14 companies that employ nearly three hundred people. Of these 14 companies, six are from our region and eight are transplants from; Germany, Israel, India, and across the U.S. Furthermore, BRDG Park companies and Danforth Center spinoffs account for close to \$200 million dollars of investment capital drawn to our region. Since 2013 two of our BRDG Park companies have been sold, offering financial rewards to their investors.

When we built BRDG park we partnered with the Saint Louis Community College to create a workforce training program to provide skilled hands at the bench, a key element of any bioscience talent pool. This two year post high school training program boasts a 95 percent placement rate and graduates have been hired to work in institutions like the Danforth Center, Monsanto, Washington University and companies throughout our region at salaries upwards of \$45,000 per year. The majority of trainees are young people who come from disadvantaged neighborhoods or are older workers who have retooled to start completely new careers. One example of such a trainee is a gentleman named Dave Busby. Dave worked for more than 15 years making truck seats for the Chrysler plant in St. Louis. When the plant closed Dave, who was in his mid-thirties, needed to start a new chapter in his working life. He typed the words auto plant technician into a job search program on his computer and stumbled upon the community college's "Plant and Life Science Technician Training Program." He had not taken a math or biology class since his sophomore year in high school and wondered if this training program was really for him. But he took a chance and enrolled, graduated in two years and was hired by Danforth Center. Dave has been with the Center for over five years and today he is the assistant director of our tissue transformation core facility.

For the last ten years the Danforth Center has partnered with the Larta Institute to host an annual investor conference, the Ag Innovation Showcase. This event brings the agtech community from more than 25 countries together to create synergy between the multitude of products and projects that are contributing to the explosive growth of the industry. Central to the event is the "Voice of the Farmer" featuring farmers from across the U.S. who share their challenges with innovators who can address them in cost effective, environmentally sustainable ways. Since inception, these entrepreneurs have raised more than half a billion dollars in investment capital. Several of the companies have chosen to locate in our region.

In 2016, with the help of an EDA planning grant, we launched a 600-acre innovation district called 39 North, home to the Danforth Center, BRDG Park, Helix Center Incubator, Yield Lab accelerator and Monsanto Company. The district is designed to attract talent, ideas and capital. Today St. Louis is home to nearly 1000 plant science Ph.D.s, and nearly 45 companies have formed as startups or migrated from other regions because the ecosystem enables the path from discovery to commercial product with remarkable speed. Current operations of the Danforth Center, BRDG Park and Helix Center are estimated to generate a total annual output

impact of more than \$250 million on the St. Louis regional economy.

That's Agtech, and that's real progress.

Thank you for inviting these comments, I am happy to answer any questions.



Statement of Peter Nelson
On Behalf of Memphis Bioworks Foundation and its AgLaunch Program

House Small Business Committee
Subcommittee on Agriculture, Energy and Trade

For the Hearing On

“Restoring Rural America: How Agritech is Revitalizing the Heartland”

February 15, 2018

About AgLaunch®

AgLaunch attracts, creates, and grows agtech startups, facilitates the development of new agriculture and food value-chains, and builds collaborative farmer networks, with a commitment to intentional inclusion.

AgLaunch.com | 88 Union Ave, Ste. 600, Memphis, TN, 38103 | Follow us on Twitter @AgLaunch

Good morning and thank you Chairman Blum, Ranking Member Schneider, and members of the Subcommittee for the opportunity to share with you some thoughts regarding this important topic. My name is Peter Nelson, and I am the Vice President of Agricultural Innovation at Memphis Bioworks Foundation, a nonprofit organization focused on assisting early-stage life science companies grow their businesses by supporting and funding entrepreneurs and building critical components missing in a region's entrepreneurial ecosystem. This work has included incubating and supporting agricultural ventures for over a decade and providing thought leadership in the sector. My entire career has been focused on creating new ways for farmers to connect with technology and value-added opportunities and this is my passion. In my role at Memphis Bioworks, I am fortunate to have the opportunity to serve as President of AgLaunch, a joint initiative with Tennessee Department of Agriculture.

By creating the AgLaunch partnership, we have matched a regional player in life science technology commercialization with an extensive food and agriculture network, ensuring AgLaunch's work is substantiated by farmers and provides benefit to both the urban and rural communities.

AgLaunch envisions a transformed regional agriculture and food economy centered around farmers, innovation, and equity. It was conceived as part of Tennessee Governor Bill Haslam's Rural Challenge in 2012 and specifically named in the 2016 Governor's Rural Task Force recommendations focused on economic development. Supported by a diverse group of partners including Tennessee Farm Bureau and land grant universities, AgLaunch's mission is to attract, create, and grow agtech startups, facilitate the development of new agriculture and food value-chains, and build collaborative farmer networks, with a commitment to intentional inclusion.

While AgLaunch is anchored in western Tennessee, the agricultural leadership in the state understands that the problems and opportunities in this area are simply too important to not consider the regional impact of AgLaunch's work. This includes a particular focus on Memphis and the Mid-South Mississippi River Delta region, a five-state area that includes counties in Arkansas, Kentucky, Mississippi, Missouri, and Tennessee.

The Memphis and Mid-South Mississippi River Delta region is characterized by its highly productive agricultural system, first-class logistics capabilities, and a large number of food and agricultural companies. This region is also a home to chronic poverty, population decline, health disparities, and limited opportunity. The global agricultural innovation revolution is offering the ability to rethink how Tennessee and its surrounding region organizes assets to create a leading innovation ecosystem for food and agriculture.

As this Subcommittee addressed in its last hearing on this topic in October 2017, there is increasing interest and investment in the development of new agricultural technologies and the creation of new startup companies to bring innovations to market. This interest is driven by the need to feed a growing population, changing

food consumption patterns, increased pressure on natural resources, and the dramatic reduction of the cost of enabling technologies such as genomic sequencing and big data.

Farmers have traditionally been at the forefront of developing & implementing new innovations and technologies. These early innovations addressed direct needs on the farm and created solutions that could work economically and efficiently. Over time, the role of the farmer in adopting new technologies for their farms has been one of “customer” rather than “partner.” Currently, there is a large amount of new technology, much of it unproven, that gets presented to the farmer, and an increasing disconnect between those creating new innovations and the farming community. As was stated in the October 2, 2017 Memorandum to the Members of this Committee, “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.”

It is this disconnect between those who are creating new innovations and farmers that is dramatically lowering the probability of success for new agricultural ventures, which is in turn giving investors pause and slowing down the rate of adoption of these new innovations on the farm. The “Farm Centric Innovation Model” championed by AgLaunch is changing the agricultural investment thesis into new ventures and ensuring that farmers are part of the development process much earlier.

AgLaunch has initiated a 3-phase startup program called AgLaunch365, which leverages the farm-centric philosophy developed to propel agtech firms. Phase I concentrates upon developing the company’s business model and initiates the customer discovery process. Phase II allows teams to complete their minimal viable product and prepare for spring field trial plans with designated farmer partners through the AgLaunch Farmer Network. Phase III provides the participating startups with direct access to AgLaunch’s network of innovative farmers to actually “ground-truth” those products or services.

The value proposition for the startup to participate in AgLaunch programming is access to technology-embracing and curious farmers through the AgLaunch Farmer Network, which allows the startup founders to acquire direct, unbiased feedback and incorporate those observations, ideas, or modifications into the development of their product. Participating farmers get access to new technology and an opportunity to participate in way in the growth of the new innovation. The AgLaunch approach provides better alignment between those innovative firms and their potential to become a commercial success.

Since the creation of the program, dozens of companies have received support some of which are featured on our website at: <http://aglaunch.com/aglaunch-portfolio>. All of the AgLaunch startups have received valuable insights and feedback from members of the Farmer Network and many are pursuing active partnerships with those producers.

A good example of the power of the AgLaunch Farmer Network is a startup company called AgVoice, which has a voice recognition technology for agriculture that simplifies crop scouting and other recordkeeping efforts and was validated through the AgLaunch Farmer Network. The validation process included answering simple questions like: “Will the technology work in the cab of a tractor or combine when it gets noisy?”, “Will the ear piece stay on your ear when you’re in the middle of scouting a hot cotton field?”, and “Will the lexicon be robust enough to record all the farm practices necessary and will the records be accurate?” The results of this real-world field trial generated data and farmer testimonials used to raise further investment and attract additional customers. The participating farmers were rewarded with opportunities for equity and distribution rights in the company, furthering engaging the farmer in the success of the startup.

The AgLaunch Farm Centric Innovation model and Farmer Network does not work without early stage capital sources that are aligned with AgLaunch’s approach. AgLaunch has worked to assemble several tools that can be leveraged and replicated in order to provide early-stage capital to agtech companies in the program. These include:

1. Working with Tennessee Department of Agriculture, AgLaunch is piloting a cost share program for farmers to get reimbursed for hard costs associated with on-farm trials of pre-commercial technology vetted and assisted through the AgLaunch program.
2. Supporting Memphis Bioworks’ venture capital firm, Innova Memphis with an AgTech fund specifically focused on early stage investments in rural-based innovative agricultural startups.
3. Encouraging the efforts in Tennessee of Launch Tennessee, a statewide entrepreneurial organization, and Life Science Tennessee to create an SBIR/STTR cost share program, as well as support applicants in the surrounding states that have similar programs.
4. Creating a network of other agricultural venture investors that have an interest in agricultural innovation and connecting them directly with farmers and the field trial network to better understand the AgLaunch pipeline.

AgLaunch programs are scalable to other regions, and key learnings are distributed through various initiatives to ensure that the Farm Centric Innovation Model has maximum impact.

The October 2, 2017 memorandum states that “agricultural regions are competing to be the next great innovation hub, which has spurred rural revitalization.” In many cases, agtech startups directly benefit from being located in regions closer to their customer base: the farmer. In so doing, they are building small businesses in rural areas and delivering innovation and technology solutions to a sector that needs it to remain competitive in a global marketplace. AgLaunch is positioning Tennessee and the surrounding region to be a leading innovation hub, while also sharing key learnings to other states and regions through various initiatives to

ensure that the Farm Centric Innovation Model has maximum impact towards changing the investment thesis for agtech and accelerated adoption rates of technology.

We believe in the role of a farmer as a partner in innovation, not just a first customer and this philosophy will change the current agricultural investment thesis. This will create more successful startups and bring forward solutions that more efficiently address real-world agricultural problems. Mr. Chairman, I would like to thank you again for inviting Memphis Bioworks Foundation to share with you the AgLaunch story and the work we have undertaken and look forward to addressing any questions that the committee members may have.

Statement of Michael D. Fernandez, Ph.D.
Senior Fellow
George Washington University Food Institute

Before the House Committee on Small Business
Subcommittee on Agriculture, Energy and Trade

Hearing on “Restoring Rural America: How Agritech is Revitalizing the
Heartland”

February 15, 2018

I would first like to thank Chairman Blum, Ranking Member Schneider and the members of the Committee for giving me the opportunity to testify on an important and timely topic: how technology can help revitalize rural America. My name is Michael Fernandez and I am a Senior Fellow with the Food Institute at George Washington University.

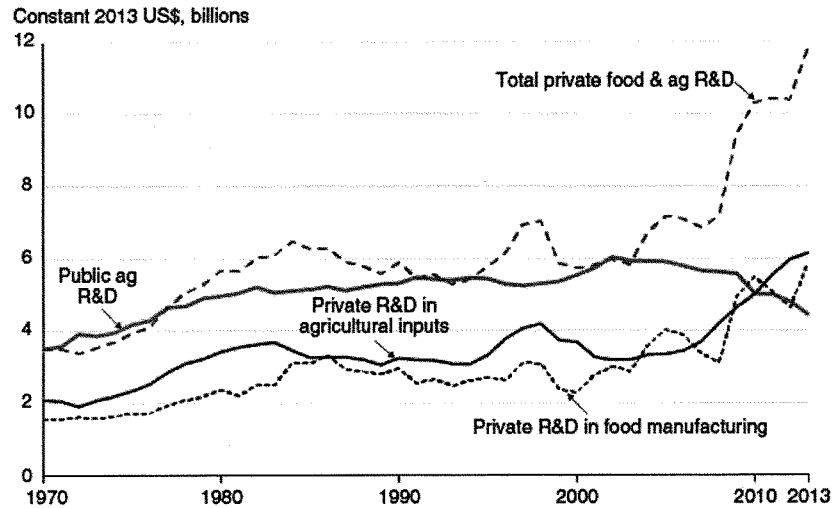
We live in an age of unprecedented technological advancement. I grew up at a time when the idea of a personal computer seemed like something out of science fiction. Today we all carry around devices that let us watch live as Chloe Kim flies through the air in Korea, or connect instantly with almost anyone on the planet, or buy almost any product with the touch of a finger and have it delivered to our door in 2 hours.

Agricultural technology is critical for the future of rural America, revolutionizing how our farmers, ranchers and foresters go about their business. Whether it's high tech, internet connected tractors used in precision farming or robotic milking machines or genetically engineered crops or “big data,” technology now touches every aspect of farming and ranching. But even while technology has flourished, many rural communities have been left behind. Members of this committee know very well, for example, that 40% of rural Americans do not have high speed internet access. As we begin a national discussion about infrastructure, we need to be asking whether we are doing enough to support our agricultural science and technology infrastructure and whether that new technology is helping to build vibrant rural communities.

One thing that isn't up for debate is that supporting agriculture R&D is a great investment – the Economic Research Service says the rate of return on food and ag research can be as high as 60%. And we have seen private sector money flow into ag R&D and new agrifood technology startups like never before. According to the ERS, between 2008 and 2013, private ag R&D funding jumped 64% in real, inflation adjusted dollars.

Unfortunately, during that same time period public investment, including federal and state spending, dropped by about 20%. Public funding now accounts for less than 25% of all food and ag R&D funding in the US, and is at a level below where it was in the 1980's.

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

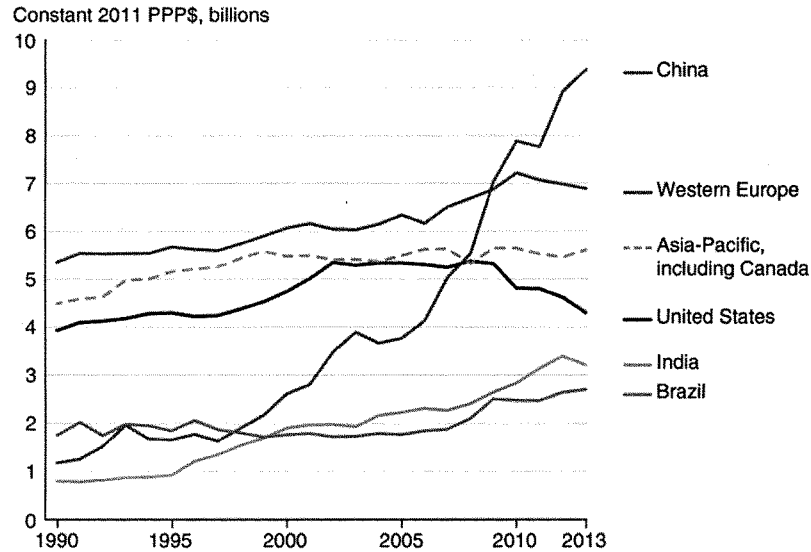


Annual spending on research is adjusted for inflation by a research price index constructed by ERS. R&D = research and development.
Source: USDA, Economic Research Service.

Private funding plays an important role, particularly in translating scientific breakthroughs into commercial products, but it is publicly funded research that has been the engine driving innovation. Public investment supports basic research that isn't driven by short short-term economic reward, and helps maintain the scientific talent pipeline that is critical for our future. The steady dwindling of this important part of the public infrastructure necessary to support vital, growing rural communities threatens our long term competitiveness.

The U.S. is, in fact, already falling behind our international competitors in terms of public support for ag research. China became the world's largest public supporter of ag research in 2008, and the Chinese government now invests about twice as much public funding in ag R&D as we do.

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.

Today we are on the cusp of a new revolution in agricultural technology: gene editing. Gene editing is a suite of tools, the most well-known of which is CRISPR Cas-9 (and usually just referred to as CRISPR), that allows scientists to make precise changes at specific locations within the target plant or animal genome.

And it is this precision that gives gene editing its power and what differentiates it from earlier forms of genetic engineering. In the first generation of genetic engineering technology, which has yielded the GMOs that are so ubiquitous in American farming, large sequences of DNA, usually from another organism, are inserted into the target genome to confer the desired trait. That insertion happens at a random location within the host genome, which give rise to one of the biggest concerns about first generation GMOs: that the random insertion can lead to unpredicted and unintentional consequences. This is also one of the reasons why current GMOs require such extensive risk assessments and safety testing, to ensure that the end product doesn't differ in any meaningful way from its conventional counterpart other than the desired new trait.

Gene editing works in an entirely different way. Derived from a kind of bacterial “immune system,” gene editing technology like CRISPR, allows scientists to target specific sequences within the host genome for changes. Those changes can include adding new genes, as we do with current GMOs, but also making targeted changes within the host genome itself. Scientists can make small changes at a specific location within the DNA sequence to knock out or alter the function of a given gene. Some have likened it to the “search and replace” function of a word processing program, where you can find the word you are looking for and change a few letters. There are questions about the level of specificity, including scientific reports that gene editing can result in “off-target” DNA changes outside the desired location, but it is this combination of relative specificity and the ability to make small changes within the target genome that gives gene editing the potential to be truly transformative.

Since the ability to use CRISPR in plants was first demonstrated in 2013, there has been a flood of gene editing research, with more than 50 scientific papers appearing in peer-reviewed journals and a number of companies seeking to develop new products using the technology.

DuPont Pioneer has used CRISPR technology to develop improved varieties of waxy corn, a type of corn that already is on the marketplace and that yields starch with unique properties for food and industrial purposes. As referenced earlier, U.S. researchers aren’t the only ones in the game: Chinese scientists have reported using gene editing to confer resistance to powdery mildew, a destructive fungal disease, in wheat. Scientists at Penn State have produced mushrooms that don’t brown when cut. Minnesota-based Calyxt has used a different form of gene editing to generate soybeans that create healthier oils, with levels of monounsaturated fats comparable to olive and canola oils. And new developments haven’t been limited to plants. Researchers at the biotech firm Recombinetics have used gene editing to create hornless cattle, potentially eliminating the need for the painful de-horning process.

Looking further into the future, exciting practical applications of CRISPR tools for sustainable agriculture can now be envisioned. Caribou Biosciences, the company set up by one of the original developers of the technology, has partnered with Pioneer-DuPont to work on drought resistant corn and wheat.

These are amazing technical achievements, but how will they contribute to revitalizing rural America? I’d like to offer four ways to think about this question:

Farmer bottom line First of all, and perhaps most obviously, these new technologies should contribute positively to farm income. One feature of gene editing technology is that it promises to be relatively easier and cheaper than earlier genetic engineering methods. That should, in theory, lead to lower cost products for farmers. The relatively low cost and ease of use of CRISPR tools are also spurring research in academia and in companies of all sizes, essentially democratizing crop-trait development. If up-front costs are indeed lower that could create more incentive for companies to develop applications for lower volume crops like fruits and vegetables, and therefore bring benefits to a wider array of farmers.

Ownership Second, we must pay attention to how ownership of this new technology plays out. We are already seeing conflicts over who owns the underlying intellectual property rights to CRISPR, and the biggest ag companies are inking licensing deals with competing developers. A promising cross-licensing deal on ag applications of CRISPR that was struck late last year may ease those concerns. But as we see even greater concentration in the agritech industry, driven by economies of scale, there is a risk that the technology will be locked up in the hands of only a few large players. There are companies, like Benson

Hill Biosystems that are looking to bring the power of gene editing to smaller companies, including work on a so-called “CRISPR 2.0” that could bypass intellectual property fights, but it is important that we keep an eye on how this progresses.

Scale neutral As our farming population ages and a new generation of farmers and ranchers takes over, we must think about incentives for technology that will meet their needs. These younger farmers are likely to be even more technologically savvy than their predecessors, and open to new approaches, but they are also likely to be operating at a smaller scale. Most studies suggest that adopters of first generation biotech products have seen economic benefits, but it is less clear that those benefits have accrued equally across farm sizes. What policy incentives do we need to be thinking about to make sure that new technology will meet the needs of small and medium scale operations?

Consumer acceptance Finally, the products of this new gene editing technology must be acceptable to consumers. The first generation of biotech products was geared more towards farmers, not end consumers. As American consumers are ever more focused on food – what’s in it, where it comes from, and how it is produced – we need to make sure that new products offer tangible benefits that consumers can embrace. We also need to be sure that consumers can have confidence in the underlying regulatory system that reviews these new products. A sound, credible regulation approach alone won’t guarantee acceptance, but it is a necessary foundation.

The products of gene editing will be different than the earlier GMOs, and we will need to tailor our regulatory approach accordingly. A robust, scientifically justifiable, and transparent system is absolutely critical to ensuring success at home and to accessing markets abroad. Scientists are rapidly developing new products and are starting to knock on regulators’ doors, but there is no clear answer for them. The Department of Agriculture has already told developers of some new gene edited products that they fall outside USDA’s regulatory authority. To be clear, USDA regulators have not made a determination of safety, but rather have said that existing regulations tailored for the first generation GMOs simply don’t apply. The Food and Drug Administration, on the other hand, has signaled its intention to use its rigorous, and often protracted, new animal drug approval process to evaluate animal products of gene editing.

The window to craft a clear, credible pathway to market is narrowing rapidly. Although it may be counter to our current trend towards deregulation, the history of biotech development shows us the importance of regulations. I would argue that the US biotechnology industry has been a success *because* of our regulatory system, not in spite of it. A system that allows products onto the marketplace without a clear and transparent evaluation of risks and benefits will not fly with today’s consumers, and risks killing this technology before it even starts to deliver on its real promises.