

**HIGH-TECH AGRICULTURE: SMALL FIRMS ON THE
FRONTIER OF AGRIBUSINESS**

HEARING

BEFORE THE

**SUBCOMMITTEE ON AGRICULTURE,
ENERGY, AND TRADE**

OF THE

**COMMITTEE ON SMALL BUSINESS
UNITED STATES**

HOUSE OF REPRESENTATIVES

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

HEARING HELD
OCTOBER 5, 2017



Small Business Committee Document Number 115-038
Available via the GPO Website: www.fdsys.gov

U.S. GOVERNMENT PUBLISHING OFFICE

WASHINGTON : 2018

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THURSDAY, OCTOBER 5, 2017

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

The Subcommittee met, pursuant to call, at 10:15 a.m., in Room 2360, Rayburn House Office Building, Hon. Rod Blum [chairman of the Subcommittee] presiding.

Present: Representatives Chabot, Blum, Comer, Bacon, Marshall, Lawson, and Schneider.

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

Crazy day voting on budget. So congressional members will be in and out throughout our hearing.

At our March Subcommittee hearing on family farms, we heard about many challenges America's small farmers are facing, including burdensome and uncertain regulations and excessive taxation. The Subcommittee is here today to examine how agtech entrepreneurs and farmers can work together in a way that can benefit both small businesses and small family farms.

Agtech or agritech is a broad term describing a diverse range of innovations and technologies, including agricultural bioscience, data-enabled agriculture, automation and robotics, supply chain and logistics, and alternative business models. These innovations in technologies have the ability to definitely increase farm productivity, reduce resource use, which is so important, and boost profits, which is also important. Additionally, agtech entrepreneurship activity may spur rural revitalization with agtech innovations in America's heartland and other agricultural areas attracting talent, dollars, and jobs to those regions.

We want all entrepreneurs from all walks of life to consider careers, businesses, and startups in agriculture. Private sector participation in agtech research and development has surged in recent years.

There are currently over 100 different vehicles to develop agtech entrepreneurs and small businesses. Many of these are funded by corporate and angel investors with trade associations, land grant universities, State and local chambers of commerce also getting involved to connect entrepreneurs and innovators with startup capital. However, the most important stakeholder in any discussion of agtech are the farmers themselves.

Small and family farmers cannot risk their time and resources for experimental innovations and technologies that may or may not work. But if risk is minimized, or even monetized, they can offer invaluable feedback to entrepreneurs about the technology and innovations that are most useful and most likely to increase profits. Think of farmers as a real life focus group.

Farmers themselves may be budding entrepreneurs developing new technology to improve their farms, but may need some help connecting with investors and mentors to bring their ideas to market. Our witnesses today will discuss how farmers and industry can work together to ensure that both benefit from the rapidly expanding innovations and technology today's entrepreneurs are continuing to develop. We will also hear about the challenges that startup companies face in raising capital and navigating the regulatory burdens to market.

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

My ranking member, Mr. Schneider, I understand is on his way over for his opening remarks. So I will yield to him when he gets here. In the meantime, I would like to introduce our witnesses.

Our first witness is Dr. Lisa Benson, director of Rural Development for the American Farm Bureau Federation, commonly known as Farm Bureau. The Farm Bureau recently initiated the Rural Entrepreneurship Challenge, which is the first national business competition focused exclusively on rural entrepreneurs working on food and agriculture businesses. The Farm Bureau has also published principles for companies to adopt in regard to the use of farm data. Thank you for being here today.

Our next witness is Mr. Kevin Bikes—Heikes, I mean. Rhymes with bikes, right? Freudian. I won't forget your name now—the chief operating officer and cofounder of IN10T—I got that one right, correct?—a digital agriculture small business in Kansas and St. Louis, Missouri. Among other services, IN10T operates farmertrials.com, an online platform that allows farmers to sign up for paid field trials with agtech companies facilitating mutually beneficial relationships. We appreciate your testimony and thank you for being here today.

And I understand Dr. Alice Robinson, the chief analytics officer of IN10T is here today also. Right there. Thank you for being here, appreciate it.

Our next witness is Dr. Mark Kester—did I get that one, right, Kester? Excellent—chief scientific officer of AgroSpheres, a biotech startup located in Charlottesville, Virginia. AgroSpheres started as a multidisciplinary student project in the Kester lab at the University of Virginia. After winning several prestigious competitions, it is now a real world agtech startup. AgroSpheres works closely with local vineyards to trial a system to degrade pesticides using enzymes. Most fascinating. Six other members of the AgroSpheres team are here, including the two student cofounders are with us today. Right here. The two student cofounders. Excellent. Welcome. And congratulations.

And right on queue, the ranking member, Brad Schneider. We are ready for your opening testimony. And you can also introduce Mr. Guthrie as well when you are finished with that. Sorry.

Mr. SCHNEIDER. No, that is okay. Thank you.

Good morning. Before we begin, I do want to take a moment to express my condolences to all those who lost loved ones earlier this week in Las Vegas, and send our prayers for recovery to those who were wounded. I want them to know that the American people are grieving with all of Las Vegas, all who were hurt and killed. And I am incredibly grateful for the extraordinary professionalism that we saw and the bravery of our law enforcement and first responders during that attack.

Bring it back to this hearing, I want to thank you all for being here and taking the time to share your thoughts, your perspectives, your insights with us about high-tech agriculture. I also want to thank Chairman Blum for holding this hearing today. I think it is very important to use this forum to highlight the technological needs of the agriculture industry.

The global population is expected to exceed 9 billion by 2050. While concerns about population growth are not new and warnings of increasing food pressures on global technology has been and will continue to be essential to reducing these concerns, addressing these risks. However, this challenge is exacerbated by a number of problems.

The most dramatic and urgent factor is climate change. Agriculture is highly dependent on a stable climate. As we have seen in recent weeks, there is no denying that our planet is experiencing more frequent and more damaging, more powerful natural disasters. We saw with Hurricane Harvey, Irma, Maria, and Jose, four in less than a single month. The people in Puerto Rico and the U.S. Virgin Islands continue to face scarcity of resources that threaten their lives. We have also seen this with increasing wildfires in the west and California's 5-year-long draught devastating our farms, ranches, and forests. Extreme weather continues to reverberate off our coast. 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 annually to combat them. However, technology can help us overcome the combined effects of growing demands for food and extreme weather and climate changes. Technology will hold the key to remaining competitive, and we should look to it as we consider ways to put food on the table and reduce environmental factors for our Nation's small farms.

Many experts claim that agriculture technology, or agtech, can reduce the amount of dependence on fossil fuels, fertilizers, water and land requirements without—and I will repeat, without hindering our economic growth. The time is now for the U.S. to show its leadership and invest in agtech. Doing so not only contributes to rural America, but also engages all aspects of our economy, encouraging job creation and innovation. America has always been a country of invention. We must harness that skill today and find the balance between government oversight and technological advancements without hindering business opportunities.

I look forward to today's discussion and to learning more about the challenges facing the agricultural community and the role tech-

nology can serve to help our producers thrive. I would like to, again, thank all of our witnesses for being here today and providing us your insight.

And, with that, I will turn to the introduction.

Chairman BLUM. And we have already done them. Mr. Guthrie—

Mr. SCHNEIDER. Okay. So sorry to make you wait.

But it is my honor and great pleasure to introduce Mr. Joe Guthrie. Mr. Guthrie is a senior business instructor in the Agricultural Technology Program within the College of Agriculture and Life Sciences at Virginia Tech. He taught courses on business communications and leadership since 2007, and brings over 25 years of agriculture business management experience to the classroom. Through this, he has helped educate a new class of innovators in the agriculture field with the skills and resources they need to succeed.

Mr. Guthrie holds a bachelor's degree from Virginia Tech in agricultural economics and a master's degree as a Fulbright Scholar from Massey University in New Zealand in agricultural economics and international trade. It is my pleasure to introduce Mr. Guthrie. Thank you for being here.

Chairman BLUM. Thank you, Mr. Schneider, and well done on the run.

Mr. SCHNEIDER. Thank you.

Chairman BLUM. I would just like to take a second to explain our opening statements and the timing lights that you have in front of you.

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

You, the witnesses, will each have 5 minutes to deliver your 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 the 5 minutes it will turn red. And we ask that you try, if possible, to adhere to that time limit. I know you are thinking green, yellow, red, something in Congress makes sense, correct?

And, with that, I recognize Dr. Benson for 5 minutes.

STATEMENTS OF LISA BENSON, PH.D., DIRECTOR, RURAL DEVELOPMENT, AMERICAN FARM BUREAU FEDERATION; KEVIN HEIKES, COFOUNDER AND CHIEF OPERATING OFFICER, IN10T; MARK KESTER, PH.D., CHIEF SCIENTIFIC OFFICER, AGROSPHERES, LLC; AND JOE GUTHRIE, SENIOR INSTRUCTOR, AGRICULTURAL TECHNOLOGY PROGRAM, COLLEGE OF AGRICULTURE AND LIFE SCIENCES, VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

STATEMENT OF LISA BENSON, PH.D.

Ms. BENSON. Thank you so much.

Good morning. I want to thank Subcommittee Chairman Blum and Ranking Member Schneider and members of the Subcommittee for inviting me to participate in today's hearing. My name is Dr. Lisa Benson, and I am the director of Rural Development at the American Farm Bureau Federation, which includes 50 State Farm

Bureaus, Puerto Rico Farm Bureau, and nearly 6 million members across the country.

In my role, I lead the Farm Bureau's Rural Entrepreneurship Initiative, which provides rural entrepreneurs with world-class business training, networks, and resources to help them succeed. My professional career has centered on helping beginning farmers, ranchers, and rural entrepreneurs grow their businesses, overcome obstacles, become more profitable, which is key, and sustain economic development in their rural communities.

Farm Bureau created the Rural Development program and the Rural Entrepreneurship program because our leadership personally witnessed the decline of the rural communities. Their children weren't returning home after college, many of the local businesses were closing, and the infrastructure was deteriorating in those communities. Farm Bureau wants to reverse this trend by engaging on policies and creating programs that extend beyond the farm gate. We chose to focus on an area that sustains economic growth, creates jobs, and improves the quality of life for rural Americans. We chose to focus on entrepreneurship.

As entrepreneurs grow their businesses, they hire their family, their neighbors, and their friends. Entrepreneurs tend to purchase goods and services from local businesses. So as they thrive and prosper, so too do those rural communities where they come from.

Farm Bureau wanted a program where the rubber meets the road and a program that highlights the success of businesses that are located in rural America. This led to the creation of the Rural Entrepreneurship Challenge and the Rural Entrepreneurship Initiative.

In 2014, we kicked off the challenge, which is the first national business competition that focuses exclusively on rural businesses and ag and food businesses. The competition helps us identify excellent rural entrepreneurs that have unique products and strong business skills. In the first year, we had 95 applications. Now, in our fourth year, we had 471 applications from 47 states and Puerto Rico.

Over time, we identified a trend in the competition. The entrepreneurs that had ag tech businesses dominated our winners circle. These ag tech winners included ScoutPro from Iowa that offers an app to help scout fields; Levrack from Nebraska that developed a storage device to help expand your storage in farm shops; and Vertical Harvest Hydroponics from Alaska, my home State, that created a growing system engineered to withstand arctic conditions.

Many of these ag tech entrepreneurs came from family farms or farming communities. They saw problems on their farms and then created solutions to address those.

A hurdle that many of these ag tech entrepreneurs expressed to us was trying to find enough capital to scale-up their production to reach economies of scale. They considered reaching out to investors, but were reluctant to give up equity in their businesses and also weren't sure what terms to expect in a deal. To address this challenge, we created the Agriculture Investment Summit, and it brings together rural entrepreneurs with venture capital funds and accelerator programs that target rural investments.

We brought together 35 rural entrepreneurs and 15 investors representing more than \$300 million in investment funds. Two of those entrepreneurs are in negotiations now with investors they met at the summit.

Through the Rural Entrepreneurship Initiative, Farm Bureau has supported more than 1,000 rural entrepreneurs from 37 States, including Hawaii and Alaska. We have provided more than \$500,000 in startup capital, mentorship, networking with investors, and publicity nationwide for those small businesses. Entrepreneurs have used those startup funds to refine their prototypes, to build greenhouses, hire staff, develop online marketplaces, and upgrade their production facilities.

At Farm Bureau, we believe that supporting rural entrepreneurs is critical to enhancing and strengthening rural communities. We continue to work with rural entrepreneurs and help them overcome their obstacles and help them achieve their dreams for their businesses.

Thank you for your time today, and I look forward to answering any questions you may have.

Chairman BLUM. Thank you, Doctor.

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

STATEMENT OF KEVIN HEIKES

Mr. HEIKES. Yes. Thank you.

Thank you Chairman Blum, Ranking Member Schneider, and members of the Subcommittee, for allowing me, on behalf of my partners, Dr. Alice Robinson and Randall Barker, to be here to talk about digital agriculture.

Growing up on my family's farm and ranch in Colorado, I had the pleasure of learning the art of ag. Over the last 20 years, I have had the opportunity to learn about the science and technology of the industry through various experience in different agtech companies.

IN10T is a small company. We were started with the simple belief that connecting farmers and businesses doing research grounded in data science was necessary. What makes our company unique is the founding leadership capabilities and our varying skill sets.

Our team fuses the art and science of agriculture together into one small business. By working with farmers and agribusiness companies, we combine the strength of both groups through the application of science, data analytics, computer science, engineering, and service to improve how digital agriculture works today.

IN10T is committed to ensuring farmer success and their engagement in the innovation process. We do this by guiding farmers through the IN10T product innovation process, while capturing their valuable perspectives. The most important thing that we have learned in this process is to keep talking to and keep listening to our farmer constituents.

Here is what one of our Illinois collaborators, Bill McDonnell, shared regarding our company and our process. As both a farmer and a crop consultant, IN10T'S trialing process is great. It focuses on gathering data in a true commercial production field environment. It is some of the best data that we can use as farmers be-

cause it is implemented using realistic production data and it comes from our own farms.

IN10T supports our clients or agribusinesses by ensuring a rigorous science is applied to all of our trials for both product performance and also customer sentiment. Agribusiness companies need realtime and real world information to compete and deliver farmer value in this digital and precision-driven world. Rather than more products, companies need better products in the right location or the right fields. Better products are a result of product feedback and also customer perception.

The digital and precision world has arrived. We can capture more data and we can move it faster than ever. With each pixel of data and each piece of equipment, we can gather valuable insights, but it has to be managed properly. With the increased digitization of agriculture, more and more opportunities come for other small businesses to deliver solutions that weren't necessarily available yesterday.

The number one question that we hear from farmers all the time is: How well did this work? How well did product X work on this field last year? IN10T establishes paid experiments linking business research with qualified farmers to capture this data, drive insights, and ultimately answer that question that farmers ask us. Since farmers are key to the IN10T vision, we needed a way to engage and recruit more farmers.

When IN10T began, there wasn't an initial platform in which farmers could indicate their interest in field trial opportunities. We determined there had to be a better way to engage with farmers interested in participating with field research opportunities, so we created FarmerTrials. FarmerTrials is a simple concept in which a company can connect with agribusinesses—and our company connects agribusinesses to farmers. We can and do believe that farmers should be paid for this valuable research that they do at their farm.

New technologies need to be evaluated on real farms to understand the value and utility. FarmerTrials is a place in which objective data and farmer feedback regarding new technologies can be used to drive faster and better innovation.

With regards to the agtech industry, there are more and more solutions being introduced to the market by startups throughout the U.S. This is significant because agtech is receiving the capital and resources for needed advancement. To supplement this, data science and full field trials are necessary to understand product performance and efficacy. We also need to drive user adoption at the farm level.

With respect to small business, we believe that small businesses work very well in agriculture. They must be part of the launching pad and also new products and services that are launched. Small business can be agile and move quickly and respond to the complexities that we see in agriculture today.

Additionally, some small businesses can engage in expanding rural communities by growing businesses, employment opportunities, and also by deploying technology resources.

On behalf of our small business, IN10T, thank you for allowing us to be here today to talk about agriculture, technology, and small business.

Chairman BLUM. Thank you, Mr. Heikes.

Dr. Kester, you are recognized for 5 minutes.

STATEMENT OF MARK KESTER, PH.D.

Mr. KESTER. Thank you very much.

Good morning, Chairman Blum, Ranking Member Schneider, and distinguished members of the Small Business Committee. I am Mark Kester, the chief scientific officer of AgroSpheres, a biotechnology company in Charlottesville, Virginia.

I would like to acknowledge six members of the AgroSpheres team behind me, the true student entrepreneurs behind this company who are with me today.

We thank you for calling attention to agriculture technology entrepreneurship and for inviting us to tell the story of AgroSpheres. We would like to share what we have learned from taking this company from a student-run project in my laboratory to a stand-alone, business where we are going to change the way agriculture embraces technology.

AgroSpheres is an ag biotechnology company based in Charlottesville, Virginia, working on, simply, nanotechnology-enabled, environmentally friendly biocontrols. Let's break it down. All we have done is created a "FedEx truck" that is designed to deliver on time, all the time, to the plant. Simple as that.

What we actually have done is utilized a bacteria and have engineered it to make a specific protein. And that protein is a biocontrol that let's plants thrive. Now, when the bacteria makes this protein, we also got the bacteria to divide. But this is where the intellectual property comes in. We got to divide the two cells, not 50/50, but 99 to 1. Ninety-nine percent of one of the cells has all the genetic material. The 1 percent is just a membrane expressing the protein, the biocontrol, no genetic material. So we made genetically modified organisms without the genetic materials.

And we did one other thing. We also got this 1 percent to actually express certain proteins on the outside that bind to plants. And just as the FedEx truck can deliver on time all the time, in the back of these trucks are packages. In our FedEx trucks there are packages, which are biocontrols. That is the AgroSpheres' product.

So how did we actually develop this? Really, really quickly. But in all seriousness, it is said that for new businesses, it is about the thirds. It is one-third the gee-whiz science, it is one-third the intellectual property, and it is one-third the team. That is the team behind me. They are student entrepreneurs. And, in fact, I am going to embarrass now Payam Pourtaheri, who actually graduated with pretty much the highest GPA in the engineering school of UVA. He applies to med school, doesn't get into med school. He gets into M.D.-Ph.D. programs. Not only will they give him an M.D., they will give him a Ph.D., and they will pay him for it. Highest honor in that realm. He gives up that huge honor and opportunity to stay with AgroSpheres. That is the passion, that is the entrepreneurship, that is the commitment that hopefully will grow and nurture

these new student-run businesses as we take them out of universities and take them to real world applications.

As we developed Agrospheres, we have learned to engage the farmer early in the process. And we did that. Around University of Virginia in Charlottesville, there are multiple vineyards and apple orchards. And we worked with the farmers directly. We said, what is your problem? And the problem for our solution was that they have to put pesticides on their plants, and they cannot harvest that plant until the pesticide degrades—that is called the pre-harvest interval. And that plant is susceptible to blight, temperature, wind, storms, or if the grapes get too ripe too early, you can't harvest. They are at risk. What we have done is we expressed a protein that degrades pesticides. So what Mother Nature does in 6 to 10 weeks, we can do in 2 hours. Wow.

And what we learned from the farmers, also, is what they really wanted was biocontrols, ways to make the plants thrive using our FedEx trucks. So by engaging the farmer early, we were able to refine our product; that was critical.

Since I have now a minute left—what are we asking for? What are our concerns? Where are the positives? Number one, accelerators and incubators. We have an accelerator incubator at UVA. It is called the Innovation Lab, i.Lab. This gave our students access to space, resources, legal, corporate, financial, and taught them how to be student entrepreneurs and then actually entrepreneurs in the community. That model of student entrepreneurialism should be strengthened.

Number two, we have to work closely with the association partnerships, the trade organizations, not only at the State level, but at the local Level. One of our early grants was from the Virginia Wine Board. Without their funding, we don't have a company today. That is the funding that gets you to the data, which gets you in front of the angel capitalists and venture capitalists and truly can turn you into a real company.

And, number three, SBIR grants, Federal SBIR grants. We are now seeing more targeted funding in the ag-space from DOD, DOE, National Science Foundation, as well as the USDA. What is really important is that we streamline how quickly we can evaluate these grants. When we put a grant in, it can take anywhere from 9 months to 18 months to find out if we are truly funded. And when we get a grant and we now want to take it to the next level for higher funding, we have to start all over again and take 9 to 18 months to find an answer. That is not a good way to keep a business thriving. So we want to suggest that we can make that process more expediential.

Thank you very much. I would like to thank the Committee members for giving me the time to tell you the AgroSpheres story.

Chairman BLUM. Thank you, Doctor. Absolutely fascinating.

Mr. Guthrie, you are recognized for 5 minutes.

STATEMENT OF JOE GUTHRIE

Mr. GUTHRIE. Thank you [off mic] on this very important topic and how agriculture is being changed by ever-advancing technology. I will talk to you both from a perspective of being a small business owner of a farm myself and an instructor in agriculture

who was teaching the next generation of farmers and small business owners, who will comprise most of the agriculture industry, and to help keep America at the forefront of feeding a hungry world. As Mr. Schneider pointed out, that we will need to feed 9 billion people by 2050.

Technology in agriculture has changed more in the past 100 years than it has, perhaps, in all of human history combined before that. As an example of that, my father, who was born in 1925, walked behind a horse that was pulling a plow, and 25—I am sorry. I didn't have the microphone on. I thought—oh, good enough. Well, I am using my teaching voice.—walked behind a horse that was pulling a plow. A quarter century later, he was driving a tractor with the power of 100 of those horses. By the time he handed the farm off to me, we weren't even plowing fields anymore, because we were using zero tillage techniques as a soil conservation measure. Just to show you how much agriculture has changed in a brief period of time.

What will the next 25, 50, or 100 years bring? There is no way for us to tell that any more than people 100 years ago could have foreseen the advances we have now. But there is no question that precision agriculture is an all-important driving force in crop production, and it appears that it will be even more important in the future.

Precision agriculture is a term used to describe several related technologies used together to decrease input cost and increase yields. Those technologies include soil and yield mapping with GPS, tractor guidance systems that allow for automated tractor operation in fields, and variable rate applications of fertilizer, chemicals, and seeds. Unmanned aircraft, or drones, are also often incorporated for many different applications as well into those systems.

A USDA study released last year found that precision agriculture was used on 30 to 50 percent of America's corn and soybean acres in a 2010 to 2012 timeframe in which the study was done. No question that those acres have increased substantially since then.

To give you an example of the use of precision agriculture and how it is transforming how we farm, I visited a dairy farm in central Virginia last year, where one of my students was doing an internship. And the farmer said, "Joe, come back in a year and you won't see me sitting on the seat of a tractor planting corn. Instead, I will be sitting at a desk, in front of a computer monitor, watching five different tractors, with no driver on them, in five different fields, pulling five different corn planters at the same time, all using precision agriculture." Each one of those planters, by the way, would be able to change the rate and variety of corn seed to match the precise condition of the soil the planter is driving over.

So the implications of this technology is, as you can tell, staggering, and so are the changes it might have on our industry. First, the technology, while designed to improve profits, has been found so far to be only marginally helpful in improving profitability because of the high cost of the technology itself.

Another consideration is that the precision agriculture and other advances will make more sense on larger farms. And so we would tend to think that we would see more larger farms adapt them more quickly and that we would see a trend towards more large

farms. And, indeed, we are seeing those trends. It is important to keep in mind, however, that even large farms in the U.S. are considered to be small firms. And, in fact, most are family-owned.

Another important implication of precision ag is a reduction in the number of people needed for farm labor. You can imagine in that example I gave, there is no one driving those five different tractors. So that reduction in the need for farm labor is one of the benefits of the technology, but it has serious implications for rural communities.

Another example of an innovation is so-called robotic dairy in which nobody actually milks the cows anymore. The cow walks into a stall. She is milked whenever she wants to by a robot. Again, we are seeing implications for that and what that might do to rural communities. And we are also seeing larger and larger dairies with fewer people on them, and, again, implications of that for our rural communities.

Given the time limitations, let me just give you an example of what we are doing at Virginia Tech. We started a precision agriculture class 3 years ago using material and technology that was donated to us from a manufacturer. In fact, manufacturers are coming to us all the time asking to donate to us so that students can learn on that material. And I would advise that, you know, if you haven't done so already in your land grant universities, to consider that as well.

Thank you very much.

Chairman BLUM. Thank you, Mr. Guthrie. Fascinating, fascinating testimony. Thank you very much.

I will recognize myself for 5 minutes now. I have too many questions and too little time. So I will throw them out to whoever would like to answer them.

First of all, I am a small entrepreneur myself. So I love small business because I am one of them. I was just sitting here thinking about the major corporations that are players in the ag industry like Deering Company, they are very big in my district; Case; Monsanto, lots of big names.

Are they involved at all in any ways with you all? Are they helping? Are they standing in your way? Do you see them as somebody that, once your technology catches on, that they would purchase your company? I would just like to hear about the interaction of these mega corporations.

Mr. GUTHRIE. Sure. And I pointed out with the technology that we are using in the classroom that is being donated to us from some of those major corporations, some of which you named there, we are also seeing not only big corporations, but smaller companies that are starting up and are developing and selling technologies, opportunities for college graduates in things such as sales, and, you know, a lot of different opportunities. And keep in mind, even though those are large companies, they have a local presence as well. And so those companies, you know, are hiring people, you know, at the local level, at the local dealership. And so we are seeing some benefits from it already in having more professional, college-graduated students in rural communities as a result of that.

Chairman BLUM. Is there encouragement from the mega corporations? Because, you know, I know situations where it is just the opposite, they try to squash competition sometimes.

Mr. KESTER. So let me just add to that. AgroSpheres already has a sponsored research agreement with a mid-size ag company. And for a company that is only 9 months old, that is pretty awesome. But we want to be a large business. So we have to partner with mid- to large-size ag to really get our product out there. So it is part of our business plan. These eventually, hopefully, will be our partners. We have to watch who we work with and how we work with them. But, at the end of the day, it has to be a partnership.

Ms. BENSON. Let me just say that John Deere is one of our sponsors for the challenge competition. So there are many of these larger companies that have venture capital wings, and they see innovation as rising the level of the water for everybody, all the ships rise. And so I think, for them, the idea of having new technology gives them the opportunity to see what is coming down the pike, and they may not be as nimble as some of these smaller companies. So there is an opportunity for the entrepreneur to either grow their own business or to think about selling that technology to a larger company that can ramp up production. So, for us, we see it as diversifying how that entrepreneur can grow.

Mr. HEIKES. And I would say that those are our clients. We are linking the multinational agribusinesses to farmers. So the point that you made is exactly right on. There needed to be a neutral platform, and that is the void that our company fills, is how do you provide a neutral platform where multiple companies can work with growers and different assets? And what we try to do is some farm research trials work better for some farmers and some work for different companies. Our job is to link those together.

And I would say when you talk about agility in small companies, some of the things that we are doing on the data science element, we are able to move faster, be more agile in our approach. And so I think small business and working with farmers and linking those agribusinesses is the niche that we are filling.

Chairman BLUM. Thank you. We have got a minute left.

How interested is venture capital in agriculture these days? I have read and I have heard that they are increasingly interested. The money out west, Silicone Valley, very interested in ag. But I would like to hear from you.

Ms. BENSON. Yes. Very interested. But, in my experience, they are still trying to figure out how to adjust to the different horizons that ag investments have. So people that are used to quick turn-arounds with software, able to get in and out within 3 years and have a 10 percent return, you don't see those kinds of returns and that horizon with a business investment.

But with the rural business investment companies coming through there are a brand new type of firms, what we are seeing is targeted investment in rural communities. So that has been a real, I think, boon in venture capital funds that are trying to go for ag tech and for rural investments.

Chairman BLUM. Good to hear. I am out of time.

And I would now like to recognize our ranking member, Mr. Schneider, for 5 minutes.

Mr. SCHNEIDER. Thank you. And, again, thanks, everyone, for your testimony.

I have one question off the panel. It is Pourtaheri, right? What did your parents say when you told them you weren't going to med school? That was a rhetorical question.

Mr. KESTER. He has a great answer.

Mr. POURTAHERI. I mean, at first, they were a little hesitant, but since I am doing what I love, they were happy I am doing what I love.

Mr. SCHNEIDER. You are lucky to have the parents you have. That is a great answer. Do what you love.

But I do want to touch on some of the things. And, Dr. Kester, you touched on a couple of things. You talked about accelerators and you talked about trade organizations and having access to connecting the entrepreneurs. And this is something we are working on here in Congress. In fact, we passed a bill earlier this year that I had the privilege of drafting and introducing in 2013 called the HALOS Act trying to allow those entrepreneurs to meet the investors. And we have something, Accelerate Our Startups Act, another bill introduced, exactly that. We would like to try to do more of that and look for ways to—and perhaps we can do in this Committee—to drive that into more agriculture and agtech where the opportunities in our rural communities are greater.

Can you touch a little bit on how you have seen those affect or expand a little on your comments with the incubators?

Mr. KESTER. Exactly. I think the key part is designing them, making them into boutique applications for the ag industry. There are many incubators, accelerators, trade organizations, et cetera, and they are really geared towards software development. I do a lot of pharmaceutical innovation. I have drugs in the clinic. That is where most innovation happens in terms of the incubators and accelerators. We need these research accelerators and incubators directly designed for ag. And we are seeing more of it. I mean, the outlook is very, very positive.

Mr. SCHNEIDER. I think I am going to shift to Mr. Guthrie. I think, you know, it is the glamour, if you will. But when you talk about ideas, and the term you used, Mr. Guthrie, precision agriculture, it kind of talks technology is about getting more precise and getting exactly what we want, whether it is in medical technology, in computers, or agriculture.

Can you expand a bit about exactly how precision agriculture technology is changing the techniques of agriculture? And you talked about zero tilling perhaps is one—

Mr. GUTHRIE. Sure. And so what we are finding is a more and more sophisticated agricultural producer in the world today, one that needs to be able to adjust and to adopt, ever-increasingly more complicated in advanced technologies. The entire point, though, Mr. Schneider, goes back to the most simple principle of economics, which is, you know, revenue minus cost equals profits.

Mr. SCHNEIDER. Right.

Mr. GUTHRIE. And the precision agriculture works on both sides of that side of the income statement in which it is both in-

creasing yields to help us to increase the revenue side, and the precision side of it that allows for the decrease in the amount of inputs is helping us to work on the expense side of it as well. But then we have to offset that with the cost of the technology itself. And so that is where we really are.

And I heard the word risk brought up earlier. And that certainly is something that is important to consider, particularly as you look at, you know, legislation here and the new farm bill that—you know, that has a lot to say about and a lot to do with farm risk, is, you know, the risks of this new technology. And Mr. Blum brought that up earlier. We can't have farmers that are, you know, spending a lot of money on technologies that are not going to work and are not going to be productive. And as these things, you know, come out and they are tried, only a certain number of them are going to be successful.

Mr. SCHNEIDER. I speak as an engineer, part of engineering is trial and error.

Mr. GUTHRIE. Sure.

Mr. SCHNEIDER. And part trial. You want to find the error quickly in the process rather than at the end of the process after spending a lot of money, and certainly you want to find it before trying to take it out to the broad market.

Mr. GUTHRIE. Sure.

Mr. SCHNEIDER. As you were doing your initial remarks, the diagram I drew in my notes: Lowering costs——

Mr. GUTHRIE. Right.

Mr. SCHNEIDER.—increasing yields——

Mr. GUTHRIE. Right.

Mr. SCHNEIDER.—but much higher capital investment——

Mr. GUTHRIE. Right.

Mr. SCHNEIDER.—which is going to increase the size of our farms. Larger farms with fewer people working those farms——

Mr. GUTHRIE. Yes.

Mr. SCHNEIDER.—changes the entire economics within our communities. And that is probably a conversation for another time.

Mr. GUTHRIE. Yes.

Mr. SCHNEIDER. I am almost out of time. I wanted to give Mr. Heikes and Dr. Benson a chance to touch on these issues. I apologize for not getting to you, but if you have just a quick remark.

Mr. HEIKES. Yeah, quick remark. Thank you for your interest in the accelerators and tech programs, because those are necessary. And I would say that as a small business, one of the things that we have identified is that you have to evaluate, when is the funding the right option. And I think one of the areas that we have touched on is building a small business is hard. But we have to always remember that we have to add value. And so when you start a business and you are building this, start with the value piece and then think about the investment. So we tell a lot of small companies that as they are getting started.

Mr. SCHNEIDER. And I came late, so I missed the introduction. Where in Colorado are you?

Mr. HEIKES. I grew up in southern Colorado, La Veta. But now our business is in Lenexa, Kansas, and St. Louis, Missouri.

Mr. SCHNEIDER. Okay.

Ms. BENSON. And I would just add when you talk about the changing dynamics when you have larger farms and more mechanization, how that impacts jobs within those rural communities. I would just say there is a diversity of businesses in ag or ag-related businesses that we are starting to see pop up. Craft beverage is a huge industry that is growing.

Mr. SCHNEIDER. Right.

Ms. BENSON. Ag tech is growing. Farm-to-table is, using apps and connecting consumers to their growers and to food in different ways.

So while we see a shift happening in maybe traditional farming, we also see new opportunities in the ag production line across the spectrum of different sectors. So we always are looking to encourage the new types of businesses as well as more traditional.

Mr. SCHNEIDER. Thank you. And I went too long. But I yield back. Thank you.

Chairman BLUM. Thank you, Mr. Schneider.

As you can see, votes have been called again. This is budget day. So welcome to Washington. It is a crazy time. I just would like—so we are going to conclude our hearing here.

But I just want to say that, do not interpret the lack of attendance today in this Committee meeting as a lack of interest on Capitol Hill in what you all do, because it could not be further from the truth. People are extremely interested here, congressional Members are, in clean water, pesticides, weather events, plants that can sustain themselves through draught conditions. It is a frequent topic, and I know particularly water quality and runoff is. So people are very interested here. It just happened to be you have gotten to be here on one of those days where we have many, many budgets that we need to vote on.

So, once again, I want to thank—I want to thank all the witnesses for their testimony.

And as we heard today from our panel, agtech investment is driving rural revitalization in cities, States, and regions using agtech entrepreneurs to bring jobs and dollars into our local communities. All stakeholders—and we heard that today over and over again—must work together to make sure that small farms, family farms, can benefit from the many exciting technologies and innovations America's brightest entrepreneurs, such as your students, are developing.

I ask unanimous consent that members have 5 legislative days to submit statements and supporting materials for the record. And I will encourage members to submit questions to the panel that you can respond to in writing, those members that weren't here.

And, without objection, our meeting is adjourned.

[Whereupon, at 10:59 a.m., the Subcommittee was adjourned.]

A P P E N D I X



**Statement of the
American Farm Bureau Federation**

**STATEMENT OF DR. LISA BENSON
ON BEHALF OF THE AMERICAN FARM BUREAU FEDERATION**

**HOUSE SMALL BUSINESS COMMITTEE
SUBCOMMITTEE ON AGRICULTURE, ENERGY AND TRADE**

**FOR THE HEARING ON
HIGH-TECH AGRICULTURE: SMALL FIRMS ON THE
FRONTIER OF AGRIBUSINESS**

OCTOBER 5, 2017

Good morning. I want to thank Subcommittee Chair Blum, Ranking Member Schneider and members of the Subcommittee for inviting me to participate in today's hearing. My name is Dr. Lisa Benson. I am the director of rural development at the American Farm Bureau Federation (Farm Bureau), which includes 50 state Farm Bureaus, Puerto Rico Farm Bureau and nearly 6 million members. In my role, I manage Farm Bureau's Rural Entrepreneurship Initiative, which provides rural entrepreneurs world class business training, networks and resources to help them succeed.

My passion has always been helping rural communities thrive. I was born in Fairbanks, Alaska and grew up in Anchorage. My family still lives in Anchorage so I have seen firsthand the challenges and opportunities facing entrepreneurs living in rural communities.

My professional career and research has centered on helping beginning farmers, ranchers and rural entrepreneurs grow their businesses, overcome obstacles, become more profitable and sustain economic development in their rural communities. My career began at the University of Florida, then at Virginia Tech and now at the Farm Bureau. I earned a doctorate in agricultural education and extension at Virginia Tech where my research focused on how beginning farmer programs contribute to rural economic development.

Rural communities across the United States face diverse challenges in terms of income, education and infrastructure. A USDA Economic Research Service report found that rural communities have fewer adults with college degrees than urban communities.¹ This lower educational attainment is linked to higher poverty and higher unemployment rates compared to urban communities. According to the Federal Communications Commission, 39 percent of rural Americans lack access to 25 Mbps/3 Mbps service, compared to only 4 percent of urban Americans.² Current and future generations of rural Americans will be left behind their fellow citizens if they are without affordable high-speed broadband service that enables them to tap into health care and educational services, government agencies, and new business opportunities.

Farm Bureau leadership personally witnessed the decline of their rural communities back home in their states. Their children weren't returning home after college. Local businesses were closing. Infrastructure was deteriorating. Health and education services were declining. Farm Bureau leadership wanted to reverse this trend by having Farm Bureau engage on policies and create programs that extend beyond the farm gate.

Farm Bureau chose to focus on programs to enhance entrepreneurship. Entrepreneurship can be a tool to sustain economic growth, create local jobs and improve the quality of life for rural Americans. When rural entrepreneurs succeed, rural communities thrive and prosper. As entrepreneurs grow their businesses they

¹ USDA Economic Research Service. (April 2017). USDA Rural Education at a Glance, 2017 Edition. Economic Information Bulletin 171. <https://www.ers.usda.gov/publications/pub-details/?pubid=83077>.

² Federal Communications Commission. (January 2016). 2016 Broadband Progress Report. <https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2016-broadband-progress-report>.

create jobs for their family, friends and neighbors. Entrepreneurs tend to purchase goods and services from other local businesses, which increases the prosperity for the entire rural community. Farm Bureau wanted a program where the 'rubber meets the road' and a program that highlights the successful business opportunities located in rural America. This focus led to the creation of the Rural Entrepreneurship Initiative. For more information on the Rural Entrepreneurship Initiative, visit our website at StrongRuralAmerica.com.

In 2014, Farm Bureau kicked off the Rural Entrepreneurship Challenge, the first national business competition focused exclusively on rural entrepreneurs with food and agriculture businesses. The competition identifies rural entrepreneurs with unique products and strong business skills. In the first year, there were 95 applications submitted. Now, in its fourth year there were 471 applications submitted from 47 states and Puerto Rico. The Challenge has also expanded into separate categories to highlight the diverse and emerging trends in food and agriculture. We offer awards for the best startup in the following categories: agricultural technology, craft beverage, agritourism, farm-to-table, farm and local product.

Over time, we identified a trend in the Challenge competition. Entrepreneurs with agricultural technology businesses dominated the winners circle. Winners included ScoutPro, Inc. from Iowa that offers an app to help scout fields, Farm Specific Technology from Tennessee that developed a roller crimper to help break down cover crops, Levrack from Nebraska with an expandable storage device for farm shops and Vertical Harvest Hydroponics from Alaska that created a growing system engineered to withstand arctic conditions. Many of these ag tech entrepreneurs came from family farms or farming communities rather than Silicon Valley. These entrepreneurs saw problems on their farms and created solutions to solve them.

A hurdle many of these ag tech entrepreneurs faced was trying to access enough capital to scale up their production to reach economies of scale. Some of these entrepreneurs considered reaching out to investors but they were reluctant to give up equity in their businesses and were not sure what type of terms to expect in a deal.

To address this challenge, Farm Bureau created the Agriculture Investment Summit that connects rural entrepreneurs with investors from venture capital funds and accelerator programs. We targeted investors from Rural Business Investment Companies and accelerator programs focused on rural and ag tech investments. We brought together 35 rural entrepreneurs and 25 experts and investors representing more than \$300 Million in investment funds. Investors participating in the Summit represented the following funds: Midwest Growth Partners, Innova, CVF Capital Partners and the Kirchner Group. We also had managers from the following accelerator programs: Techstars, Village Capital and The Yield Lab.

The Summit provided Venture Capital 101 training to entrepreneurs on topics such as the right time to take on investors and

how to protect your intellectual property as you meet with investors. Entrepreneurs shared their experiences with investors and investors talked about what they looked for in companies. Rural entrepreneurs had the opportunity to pitch their businesses to investors and engage in a question and answer period. After the Summit, investors remarked that they found the entrepreneurs thoughtful, passionate and down-to-earth. Entrepreneurs said they received top caliber training and enjoyed networking with other entrepreneurs and investors. Two entrepreneurs are now in negotiations with investors they met at the Summit.

Through the Rural Entrepreneurship Initiative, Farm Bureau has supported more than 1,000 rural entrepreneurs from 37 states, including Hawaii and Alaska. We have provided more than \$500,000 in startup capital, mentorship, networking with investors and publicity. Entrepreneurs have used the startup funds to refine their prototypes, build greenhouses, hire staff, create online marketplaces and upgrade their production facilities.

We continue to work with the entrepreneurs that participated in the Challenge to learn what obstacles they face and help them overcome barriers. Entrepreneurs told us they wanted to learn more about federal programs they could access, grant opportunities, and how to connect with investors. We developed an online, monthly newsletter called Ag Spark to provide ongoing support for rural entrepreneurs. The newsletter provides entrepreneur case studies, expert interviews and a calendar of upcoming opportunities. We promoted the USDA Small Business Innovation Research grant with articles from a previous recipient and grant reviewer. We also publicize USDA's Value Added Producer Grant program and Rural Energy for America Loan and Grant program. We have more than 1,600 newsletter subscribers and that number grows each month.

American Farm Bureau also works closely with our state Farm Bureaus to cross-promote programs for entrepreneurs and beginning farmers. We work with the Iowa Farm Bureau to promote their Renew Rural Iowa program, a program that supports small business development in Iowa. This year, we are working with North Carolina Farm Bureau to launch the North Carolina Rural Entrepreneurship Challenge to highlight exceptional rural entrepreneurs in their state.

At Farm Bureau, we believe that supporting rural entrepreneurs is critical to enhancing and strengthening rural communities. Through the Rural Entrepreneurship Initiative, we have educated more than 1,000 rural entrepreneurs and provided resources to make their food and agriculture businesses more profitable. Our Challenge competition and Investment Summit connect entrepreneurs to startup capital and investors who can help them take their businesses to the next level. We continue to work with rural entrepreneurs to help them overcome obstacles and achieve their dreams for their businesses. Thank you for your time today. I look forward to answering any questions you may have.

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Testimony of

Kevin Heikes

Co-Founder and Chief Operating Officer

IN10T



With regards to

High Tech Agriculture: Small Firms on the Frontier of Agribusiness

Submitted to

The Committee on Small Business Subcommittee on Agriculture,
Energy, and Trade. Rod Blum, Chairman

Thursday, October 5, 2017

Introduction

Thank you, Chairman Blum, Ranking Member Schneider, and members of the Subcommittee, for allowing me to testify today on behalf of IN10T and my partners Randall Barker and Dr. Alice Robinson regarding High Tech Agriculture: Small Firms on the Frontier of Agribusiness. More importantly, thank you for allowing me to share the story on how our small business is working with farmers to shape the future of digital agriculture.

Growing up in production agriculture, I had the pleasure of learning the “art” of farming through my family’s farm/ranch in Southern Colorado, which is still in operation today. Over the last 20 years, I have had the opportunity to learn about the “science and technology” of the industry through my experiences in various AgTech companies and ventures. I have learned that successful innovation requires an understanding of the “art” in agriculture combined with a vision for “science” solutions that can advance the agricultural industry.

I am passionate about agriculture and technology. Like many, who have grown up on a farm, I learned how to be an entrepreneur. It is my pleasure to discuss how building a small business linking farmers and agri-businesses is critical to future on-farm innovations.

IN10T is a small company that was started with the simple belief that connecting farmers and businesses doing research grounded in data science was a needed service. What makes our company unique is the founding leadership team with varying capabilities.

- **Randall Barker:** Former Monsanto executive who leads our agri-business development and company strategy. Randy has 25+ years’ experience in innovation, agronomy, marketing, and customer relations.
- **Kevin Heikes:** Early team member of multiple ag-startups with focus on product, implementing systems, farmer relationships, and developing listening models.
- **Dr Alice Robinson:** Research scientist specializing in multiple environmental subject areas integrated with data science, analytics, modeling, experimental design, and data strategy.

We believe it takes a team who understands agri-business and is willing to partner with farmers to test and validate new technologies and products in order to bridge the innovation gap. In essence, our team fuses the “art” and “science” of agriculture in a small business. This has led to a big vision for a small team. Our vision is to be considered by farmers and agricultural innovators to be the best digital agriculture company in the world. IN10T is committed to advancing agriculture by improving farmers profitability, productivity, and sustainability using the latest data-driven technologies.

Why We Started IN10T

IN10T is a digital agriculture company founded in 2016 focused on solving farmer adoption challenges in agriculture. While we create data science solutions for the agriculture industry, our company believes that we must be “intentional” with respect to data. So intentional, in fact, that we chose our company name to signify the importance.

By working with farmers and agribusiness companies, we combine the strength of both groups through the application of science, data analytics, computer science, engineering, and service to improve how digital agriculture works.

Farmers

IN10T is committed to ensuring farmer success and engagement in the innovation process. We do this by guiding farmers through the IN10T product innovation process, while capturing their valuable perspective on how to improve field experience. We work with farmers to collect and manage the data within their current systems in a manner they approve. The most important thing we have learned in the process is to keep talking with and listening to our farmer constituents.

“As both a farmer and a crop consultant IN10T’s trialing process is great. It focuses on gathering data in a true commercial production field environment. This is some of the best data we can use as farmers because it is implemented using realistic production practices and comes from our own fields.” **Bill McDonnell, Farmer and Founder of McDonnell Ag Solutions. Ottawa, IL**

Agricultural Business Innovators

IN10T supports our clients by ensuring rigorous science is applied to our trials for both product performance and grower perceptions in order to deliver reliable results. We continually iterate to deliver better and more reliable answers for farmers and businesses by improving our solutions, partnering, licensing, or acquiring the necessary technologies to execute trials. We are collaborative and will pursue the answers that improve agriculture, innovation, and ag-tech in any manner that is results oriented and is of the highest integrity.

A unique but important element to our company culture is that co-founders (Kevin Heikes and Randall Barker) were both raised on production operations. We understand how the agricultural supply chain functions, and the day to day challenges farmers face. More importantly, we understand the values of farmers and hard work that makes up the agricultural ecosystem. This, combined with a focus on quality data and science headed by Dr. Alice Robinson, drives out

ingenuity in finding new ways to solve problems and approach the challenges in the AgTech landscape. As we build our small firm on the frontier of AgTech, we are reminded that small businesses can truly have an impact so long as we focus on quality and value by putting farmers and customers first.

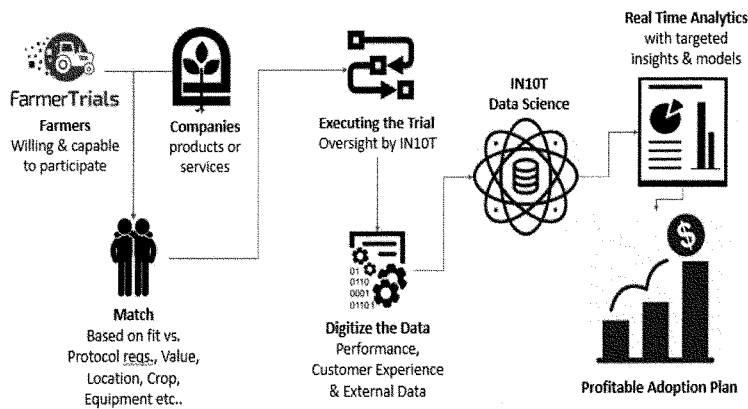
Digital Agriculture and Data

The digital and precision world has arrived – we can capture more data, and move it faster than ever. Each pixel of data from each piece of equipment can be valuable when it is managed properly. From these pixels, IN10T believes that every farmer has a digital footprint; that with this increased digitization of agriculture comes increased opportunities for other small businesses to deliver solutions that didn't exist yesterday.

The number one question we receive from farmers is, "How well did 'x' work on my farm last year?" Thanks to advances in on-farm technology, data science, connectivity, and remote sensing, it is possible for a wide network of farmers to actively participate in finding answers to their questions, and get paid for meaningful research through farmer trials.

IN10T establishes paid experiments linking business research with a qualified farmer customer base, capturing data that drives insights on business-critical questions. Farmers can choose which field trials that work best for their farm operations. IN10T collaborates closely with farmers, ensuring understanding of the data, and converting data into invaluable, applicable insights.

IN10T Digital Agriculture Process



Farmers at the Center of Innovation

As noted in our IN10T process, farmers are a key component of the IN10T vision, thus we required a way to engage and recruit farmers. When IN10T was founded, the existence of a neutral platform in which farmers could indicate interest in field trial opportunities was lacking. IN10T determined there had to be a better way to engage with farmers interested in participating in field research opportunities. IN10T launched FarmerTrials, a platform for farmers to find field trials in their area that they were interested in participating in.

FarmerTrials Platform

FarmerTrials is a simple concept in which our company connects farmers to agri-businesses. We believe farmers can and should be paid to execute valuable research on their farms. As we listened to farmers, we heard that payment is not about revenue generation, but more about valuable time spent in the innovation cycle. Since farmers are continually trying new things, we tell them, "The worst thing that can happen is that you get paid for a field trial; the best thing that could happen is that you rapidly grow your knowledge about your farm to drive profits and join a community of like-minded farmers!"

Agri-business companies need real-time and real-world information to compete and deliver farmer value in a digital and precision-driven world. Rather than more products, these companies need better products in the right locations. Better products are a result of product feedback and customer perception.

New technologies need to be evaluated on real farms to understand value and utility. FarmerTrials is a place in which objective data and farmer feedback regarding new technologies can be generated to drive better innovation.

Observations

AgTech

Increasingly more solutions are being introduced to the market by startups throughout the US. This is significant because agriculture and food production are receiving the necessary capital and resource allocation required for long-term growth. However, resource availability remains

limited and hesitant at the farm level. Data science solutions and full field trials are necessary to understand product performance and efficacy, in addition to driving user interest and adoption.

Collaborations

IN10T believes in partnership and collaborations. We were recently awarded The JumpStart grant which is a partnership with the Kansas Department of Commerce and Kansas Department Agriculture to encourage and support agricultural entrepreneurship.

“The agricultural technology and entrepreneurship industry offers huge potential for growth, with unlimited possibilities. To foster this potential will require ongoing input and discussion among key partners as a long-term strategy for growth is developed to guide the industry. Many current resources that encourage business growth could be directed toward agricultural technology entrepreneurs.” **The Kansas Agricultural Growth Strategy project - Kansas Department of Agriculture**

These opportunities afford small businesses the ability to invest in strategic initiatives. Furthermore, it increases information sharing between small business and government.

Small Business

Small businesses work well within the Agriculture industry and must be part of the launching pad for new products and offerings. Due to the personalized service, trust, and accountability small businesses provide, partnerships with farmers can be established and sustained long-term. These effective relationships result in the increasing adoption of products and services by continually delivering valuable results. Our economy wins by taking advantage of our greatest assets: farmers and innovative AgTech companies. Ensuring the industry finds success faster is our objective and we are confident this will help our US farmers and the overall ag economy. Small business can be agile and move quickly to respond to the complexities of agriculture. Additionally, small business can engage and expand rural communities by growing businesses, employment and opportunities, by deploying technology and agricultural resources in these areas.

On behalf of our small business, IN10T, we thank you for allowing us to share our thoughts regarding agriculture, technology, and small business in agriculture.

Good morning Chairman Blum, Ranking Member Schneider, and distinguished Members of the Small Business Committee. I am Mark Kester, the Chief Scientific Officer of AgroSpheres, a biotechnology company located in Charlottesville, Virginia. I would like to also acknowledge six members of the AgroSpheres team who are here with me today. We thank you for calling attention to Agriculture Technology entrepreneurship and for inviting us here to tell the story of AgroSpheres. We would like to share what we have learned during the process of taking our company from a student project in my lab at The University of Virginia to a real-world company that just closed a seed round of funding. AgroSpheres Inc, is an AgBiotech company based in Charlottesville, VA working on nanotechnology enabled environmentally friendly biocontrols.

AgroSpheres is a true success story. In a very short time, we have taken a concept and turned it into a reality. When UVa students, Ameer Shakeel and Payam Pourtaheri conceptualized the technology, they realized that they had come across something special. They had a “solution” but needed to find a problem. Ameer and Payam initially wanted to target the pharmaceutical space with their nano “solution”. I advised them that the runway was too long to develop a pharmaceutical application and that there was “lower hanging fruit”. They took this advice and adapted the technology to make a pesticide-degrading spray to address the problem of residual pesticide contamination.

Being from a region in Virginia rich in viticulture, we reached out to our local vineyards to understand how pesticide contamination was affecting our community. After visiting many sites, it was clear that the problem of residual pesticide contamination limited the capability of farmers to harvest premium quality products and posed a health risk to workers during the harvesting process. Farmers saw such great value in our technology that multiple vineyards and one apple orchard even agreed to allow us to run small-scale field trials and generate our first field-trial data for our technology. The willingness for small farms in our community to work with us was key to the early stages of our success.

As we transitioned from a laboratory concept company to a company now in the marketplace looking for commercialization partners, we began to learn more about what we had developed. We learned that the market place and farmers were more interested in products that grant crop protection in a more environmentally friendly manner. With this new market information, we went back to the lab and developed a three-stage approach to safer crop protection. First, we would make synthetic pesticides protected and targeted, reducing the amount sprayed, drift, and run-off. Second, we would look for partners that have currently developed biocontrols that are lacking field delivery mechanisms. Lastly, we would develop our own, next-generation biocontrols for crop protection to take to market independently.

While exploring different uses for our technology, we continued to build on our initial assumption of the platform’s versatility. We have developed a platform that has the ability to encapsulate synthetic chemicals, encapsulate or express biocontrols, and form a

natural adhesiveness to plants for a more targeted delivery. We are most excited about the biopesticide industry because we are a one-stop shop that can create the biocontrols, encapsulate and protect the biocontrols, and engineer proteins on the outside of our capsule to target the intended plants. Our products are crated through bacterial engineering and produced through the cheap and scalable process of bacterial fermentation. Most importantly, the AgroSpheres product delivers the biocontrol without any genetic material.

I also would like to highlight some of the successes that we have had along the way as we have morphed a concept into an agricultural biotechnology company. Our first milestone was licensing our pesticide-degrading technology from the University of Virginia. This meant that we now had value as a standalone company. Next, we started pitching investors and after a few months closed our seed round of financing. Then we used our newly acquired funds to purchase equipment and outfit our new lab in our home in Charlottesville. Lastly, we signed our first corporate research contract where a company is funding us to encapsulate one of their synthetic biocontrol chemicals. Our next steps are continuing to produce data validating our technology, find a partner in biocontrols for Agriculture, and hopefully, receive some SBIR funding!

We have many factors that have contributed to our success but would like to highlight a few:

- Creating a team of young motivated entrepreneurs with diverse backgrounds allows us to attack problems from many different angles. We have various science backgrounds, business backgrounds, and a faculty entrepreneur. Our young entrepreneurs changed career paths from going to medical or graduate school to pursue AgroSpheres.
- Engaging farmers and crop protection companies early to define and modify the product and initial company vision based on market need. Potential customers were much more generous with their time, information and resources than we initially thought. Without this initial generosity, we would not have been able to confirm our platform's versatility.
- Entrepreneurial competitions provided us the much-needed gap financing between technological development and equity funding. This non-dilutive funding gave us the ability to pay expenses and explore the technology and different end markets before approaching investors with inadequate information. When we needed money for an experiment, to pay a lawyer, or to run a field trial, we would look for a competition that we thought that we could enter and win.

In closing, I want to leave the committee with a couple of final thoughts that could help early-stage AgTech companies going forward.

- Public funding for company incubators or accelerators. At the University of Virginia, we have an iLab incubator that is funded by the University of Virginia and its donors. This program was immensely helpful to our development, providing office space, entrepreneurial mentorship, and contacts.

- Strengthening Federal, State and most importantly local grant opportunities for commercial ag research and development. If we had the ability to receive short-term funding to bridge the gap between technology conception and equity funding, we would have devoted more time to the rapid development of the technology and less time to the competitions that were a necessity for survival.

- We have applied for a couple of SBIR grants regarding different commercialization opportunities, but as startups move quickly and adapt to real time market feedback, it would be helpful if the evaluation timeline was expedited and shortened. This would allow us to incorporate this funding into our future planning.

In closing, I would like to thank you again for inviting AgroSpheres here today to share our experiences. I look forward to answering any questions you might have.

High Tech Agriculture: Small Firms on the Frontier of Agribusiness

Testimony presented to the House Committee on Small Business, Subcommittee on Agriculture, Energy, and Trade

Presented by Joseph W. Guthrie, Senior Instructor, Agricultural Technology Program, Virginia Tech, Blacksburg, Virginia

Ladies and gentlemen of the committee, I am honored and delighted to speak with you today about agriculture and how the many small business owners who comprise most of our nation's agricultural production are finding challenges and opportunities in the adoption of ever-advancing technology. I will also present information to you about how those of us who are teaching agriculture in higher education are preparing the next generation of agricultural producers to successfully incorporate new technology into their farm businesses.

Agriculture has been at the center of my life's work since I was a boy growing up on a beef cattle and dairy farm in the New River Valley of Southwestern Virginia. It is a farm that my family has owned for six generations since 1795, and one that I will pass along to my children to continue a legacy of a small family business that is helping to feed a hungry world. And that task will become increasingly important and challenging as the world's farmers will need to feed over 9 billion people by the year 2050.

For the past eleven years, I have also taught courses in agricultural business management in the Agricultural Technology Program in the College of Agriculture and Life Sciences at Virginia Tech, which is Virginia's Land Grant University. So I can speak to you today both as a small business owner of a farm and as someone who is helping to train tomorrow's farmers, agricultural supply business managers, farm equipment dealers, and others who will keep America at the forefront of agricultural production.

It is no exaggeration to say that technology in agriculture has changed more in the past 100 years than it had in any 100 years prior, and perhaps more than in all of human history combined. As an example of that, when my father, who was born in 1925, was growing up on our family farm, he walked behind a horse that was pulling a plow, just as every generation before him had done. A quarter century later, he was driving a tractor with more power than 100 of those horses. By the time he handed the farm off to me, we had stopped plowing altogether because we had begun using zero tillage planting as a soil conservation practice.

So, what is happening now and what will continue in the future with advancements in agricultural technology? Just as it was impossible for people in the early 20th Century to foresee the advancements that awaited them, so it is difficult for us to say what advances in agriculture might be in the next 25, 50, or 100 years. But what we can see is what some recent advancements have been and where the industry appears to be headed with them.

There is no question that precision agriculture is an all-important driving force in crop production now and appears that it will

be even more important in the future as it is more widely adopted, as the technology will likely become more affordable, and as it continues to improve over time. Precision agriculture is a term used to describe several related technologies that are often used together to decrease input costs and increase yields. Those technologies include soil and yield mapping to great precision using GPS, tractor guidance systems that allows for automated tractor operation in fields, and variable rate application of fertilizer, chemicals, and seeds. Unmanned aircraft, or drones, are also often incorporated into precision agriculture to provide imaging of fields that enhance decision-making on irrigation and application of chemicals and fertilizers.

A USDA study (USDA ERS Report Number 217) released October 2016 found that precision agriculture was used on 30-50% of US corn and soybean acres in 2010-2012. There is no doubt that the percentage has risen significantly since then.

Let me give an example of the use of precision agriculture and how it is transforming how we farm. I visited a dairy farm in central Virginia a year ago where one of my students was working as an intern during the summer. The farm owner said, "Joe, come back in two years and I won't be sitting on a tractor planting corn. I'll be sitting at a desk watching a monitor of 5 un-manned tractors in 5 fields pulling 5 corn planters." Each of those planters are able to change the rate and the variety of corn seed to match the precise conditions of the soil the planter is driving over.

The implications of this technology to enhance production is, as you can tell, staggering. So are the changes it might have on the agricultural industry. First, the technology, while designed to improve profits by providing savings in input costs and increases in yields, is very expensive. The USDA study found only a small increase in farm profitability among farms that had adopted precision agriculture during the time of the study. Hopefully, profitability will increase as the technology becomes more affordable over time.

Another consideration is that precision agriculture and other technological advancements make more sense on larger farms where their fixed costs can be spread out over more acreage. That would indicate that we might expect larger farms to adopt the technology first and that we might see a trend of fewer but larger farms. And, indeed we are seeing those trends. It is important to keep in mind, however, that even large farms in the US are still considered small firms. Most, in fact nearly all, are family owned.

Another implication of precision agriculture and other technologies in agriculture is a reduction in the number of people needed to farm labor. As you can imagine from the example of the dairy farmer, he won't be hiring anyone to drive those 5 tractors. The reduction in the need for farm labor and labor costs is one of the benefits of the technology, but it has serious implications for rural communities.

Another example of a labor-saving technology that is becoming increasingly popular in agriculture is the so-called robotic dairy. Using this technology, no one at one of these dairy farms actually

milks the cows any more. Instead, the cow is trained to walk into a stall whenever she wants to be milked, and she is fed some grain from an automated feeder while a computerized robotic milking machine attaches to her and milks her. It's truly amazing to see in practice. It costs about a half million dollars.

That leads me to another example of the staggering changes we are seeing in agriculture, specifically in the dairy industry. A colleague of mine from Virginia Tech took her Dairy Management class to visit 4 Virginia dairy farms that milked a total of 5,000 cows. A generation ago, given the size of the typical Virginia dairy herd, she would have needed to have visited 50 dairy farms to see that number of cows, and even more to see the equivalent amount of milk produced, since the average cow produces much more milk now than a cow of 20 or 30 years ago. Again, the use of technology favors larger farms that spread out fixed costs, so we are seeing fewer and larger dairy farms with increased production per cow.

These changes associated with technology and increased economies of scale increase production, which makes agricultural products more plentiful and less expensive. Therefore, they ultimately benefit consumers, perhaps more than they actually benefit the farmers who use them.

Given time limitations, I have discussed only a little bit about only a few of the changes in technology we are seeing in agriculture. Others would include the use of genetically modified crops such as Round-Up Ready corn, new technology in chemicals and particularly in herbicides, and the increasing use of drones for a number of applications.

We on the faculty of the Agricultural Technology Program at Virginia Tech, like faculties of colleges of agriculture around the nation, are endeavoring to keep up in teaching courses that incorporate new technology as we train the next generation of agricultural producers and suppliers, most of whom will own, manage, or work for small businesses. An example is a new course that we added to our curriculum three years ago specific to teaching precision agriculture. We were able to do this with a grant of the precision agriculture equipment from a manufacturer. So, the students are learning on the equipment that they may use some day or may already have at their home farm. Public/private partnerships such as this one can be greatly beneficial to both the students and to the technology manufacturer, and I would encourage your states' Land-Grant universities to pursue a similar partnership if they have not done so already.

Given the brief time I have been asked to speak, I will stop there in what is a very large and broad topic, but one I am glad your committee has seen fit to put onto its agenda to learn more about. To the extent I am able, I will now try to answer any questions you may have or top provide your answers later if I need to do more research before I can answer accurately.

Thank you.

Questions for the Record

Committee on Small Business

Subcommittee on Agriculture, Energy, and Trade

“High-Tech Agriculture: Small Firms on the Frontier of Agribusiness”

Lisa Benson

Rep. Al Lawson**Question 1:**

Can you please explain the important role of 1890 institutions in helping to expand agri-tech and how these universities can assist in the development of this industry?

The field of agricultural technology is critical to helping U.S. farmers and ranchers produce enough food to feed a growing global population. Land grant institutions provide key training to the next generation of entrepreneurs who will create agricultural technology innovations to help us produce healthy, safe food using less land, water and inputs. The role of 1890 land grant institutions will become even more important as the U.S. population shifts from a majority of non-Hispanic whites to a more diverse population with a minority-majority.¹ The 1890 institutions serve an important role equipping diverse students to enter into the field of agricultural technology. The 1890 institutions and other HBCUs (Historically Black Colleges and Universities) provide much needed career exploration and STEAM training (science, technology, engineering, agriculture and mathematics) to ensure our country has a robust, skilled and diverse workforce to address the mounting challenges facing agriculture. Career exploration programs include Tuskegee University’s AgriTREK Summer Institute and AgDiscovery Summer Program² that introduces high school students to potential career tracks through a two-week residential program. Florida A&M offers AgTech Century 21³, a summer enrichment program to help middle and high school students learn more about careers in agricultural science. Some initiatives focus on entrepreneurship and the commercialization of agricultural inventions. The HBCU Innovation and Entrepreneurship Collaborative⁴ fosters innovation, commercialization and entrepreneurship at college campuses across various disciplines including agriculture, science, engineering and technology.

¹ U.S. Census Bureau (2015). Projections of the Size and Composition of the U.S. Population: 2014 to 2060. <https://www.census.gov/content/dam/Census/library/publications/2015/demo/p25-1143.pdf>

² Tuskegee University (2017). AgriTREK/SciTREK and AgDiscovery Summer Programs for High School Students. <https://www.tuskegee.edu/programs-courses/colleges-schools/caens/conferences-workshops/agritrekscitrek>

³ Florida A&M (2017). AgTech Century 21 Summer Enrichment Program. <http://www.famu.edu/cesta/main/index.cfm/cooperative-extension-program/agriculture/herd-health/agtech-century-21-summer-enrichment-program/>

⁴ Association of Public & Land-Grant Universities (na). HBCU Innovation and Entrepreneurship Collaborative. <http://www.aplu.org/projects-and-initiatives/access-and-diversity/hbcu-innovation-commercialization-and-entrepreneurship/index.html>

Question 2:

Can you discuss what improvements can be made to improve the agri-tech industry, particularly as it relates to protecting the environment and food production?

We are facing the challenge of producing food for a growing global population with an ever dwindling supply of farmland and water. Ag technologies are being developed to produce food more intensively, using less water, farmland and inputs. Through the Farm Bureau Rural Entrepreneurship Challenge⁵ we have identified and promoted a number of technologies developed by rural entrepreneurs that help produce food with less farmland, water and inputs. Albert Wilde from Croydon, Utah, developed an all-natural plant food from sheep wool that reduces the need for watering by 25%. Albert's business is Wild Valley Farms⁶. Alex Adams, an entrepreneur from Knoxville, Tennessee, developed a technology called GeoAir⁷ that uses drones to detect mold in corn so farmers can conduct targeted spraying and reduce overall crop protection chemical applications. To learn more about agricultural technology businesses across the country, visit our Entrepreneur Showcase available here: <https://app.reviewr.com/s1/showcase//RUral2018>

Question 3:

I just launched a hunger initiative called the "Let's Feed America" initiative where I am advocating for various hunger initiatives to eradicate food deserts in my district and to provide food aid to low and moderate income residents along with senior citizens and the disabled populations. How can agri-tech be used to help eradicate hunger in food deserts?

Food deserts are created when residents living in a designated area have limited access to healthy, reasonably-priced food. Agricultural technologies, innovations and systems can be used to address food deserts by 1) increasing the availability of healthy foods for residents living in remote or low income areas, and 2) providing foods at a price point that is affordable for low and moderate income residents. Through the Farm Bureau Rural Entrepreneurship Challenge we have identified a number of agricultural technology businesses that address the challenges of food deserts. Linda Janes and Dan Perpich of Anchorage, Alaska, created Vertical Harvest Hydroponics⁸, a hydroponics farm built in a shipping container that can withstand arctic conditions. The containers are shipped throughout Alaska to provide fresh vegetables to communities living in remote rural villages and towns. Local residents learn how to farm using the containers, In South Carolina, Lindsey Barrow

⁵ Farm Bureau Rural Entrepreneurship Initiative (2017). Rural Entrepreneurship Challenge. <http://www.strongruralamerica.com/challenge/>

⁶ 2018 Farm Bureau Rural Entrepreneurship Challenge (2017). Wild Valley Farms. <https://app.reviewr.com/s1/pitch?subid=2618319&evtid=2499238>

⁷ 2018 Farm Bureau Rural Entrepreneurship Challenge (2017). GeoAir. <https://app.reviewr.com/s1/pitch?subid=2815350&evtid=2499238>

⁸ Vertical Harvest Hydroponics (2017). What We Do. <http://verticalharvesthydroponics.com/about/>

Jr. created the Lowcountry Street Grocery⁹. The Lowcountry Street Grocery is a community-supported mobile farmers' market that delivers local, farm-fresh food and nutrition education to communities surrounding Charleston. Lindsey takes a portion of the revenue from the stops the mobile market makes to pay for additional visits to low-income/low-access communities to ensure that residents in these areas receive access to healthy food. Visit our Entrepreneur Showcase to see more ag technology businesses that are helping increase access to healthy, affordable food: <https://app.reviewr.com/s1/showcase//Rural2018>

⁹Lowcountry Street Grocery (2017). About: An Innovative and Unique Approach to Doing Good Business. <http://www.lowcountrystreetgrocery.com/about-us/>

Questions for the Record

Committee on Small Business

Subcommittee on Agriculture, Energy, and Trade

“High-Tech Agriculture: Small Firms on the Frontier of Agribusiness”

Thank you again for the opportunity to be in DC for this experience. Here are our responses to the questions provided:

Question 1: Can you please explain the important role of 1890 institutions in helping to expand Agri-tech and how these universities can assist in the development of this industry?

One way to increase AgTech adoption is continued hands-on experiences through the land-grant system. For example, Internships provide opportunities for young people to experiment and pursue careers in agriculture while helping agribusinesses.

With the AgTech industry change happening at such a rapid pace, we need more partnerships between education and the private sector. There are many benefits to completing an internship for the student, the business, and the university.

Question 2: Can you discuss what improvements can be made to improve the Agri-tech industry, particularly as it relates to protecting the environment and food production?

IN10T believes in the importance of continued access to environmental data. In addition to access, continuing to increase the quality of environmental data is essential. An example environmental data set is the SSURGO database which contains information about soil as collected by the National Cooperative Soil Survey. Other examples are the satellite imagery and radar information that is published daily.

Secondly, IN10T believes we need more testing and validation of products and practices at the farm level. New technologies need to be evaluated on real farms to understand value and utility. FarmerTrials is a place in which objective data and farmer feedback regarding new technologies can be generated to drive better innovation. A neutral platform displaying research and innovation projects is a needed tool for tomorrow's farmer.

Question 3: I just launched a hunger initiative called the “Let’s Feed America” initiative where I am advocating for various hunger initiatives to eradicate food deserts in my district and to provide food aid to low and moderate income residents along with senior citizens and the disabled population. How can agri-tech be used to help eradicate hunger in food deserts?

Data is already helping us measure and improve many elements of today's agriculture. In the proposed initiative, there appears an opportunity to apply data science to the currently available data.

This analysis could evolve to a model with predictive/potential opportunities thus supporting the future eradication of hunger.

Thank you,

Kevin Heikes/IN10T

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Questions for the Record
Committee on Small Business
Subcommittee on Agriculture, Energy, and Trade
“High-Tech Agriculture: Small Firms on the Frontier of Agri-
business”

Rep. Al Lawson

Question 1:

Can you please explain the important role of 1890 institutions in helping to expand Agri-tech and how these universities can assist in the development of this industry?

My University, the University of Virginia works closely with 1890 Land Grant Institutions including Virginia State and North Carolina A&T. In particular, the nanoSTAR Institute at University of Virginia, which I direct, works closely with the North Carolina/Virginia Minority Alliance to place undergraduate students from these schools into our Summer Undergraduate Research Program. As discussed in my testimony, all schools of higher education should be committed to a culture of entrepreneurialism for their undergraduates. These students should be encouraged to participate in team-projects that prepare them for the new opportunities offered by the scientific “revolution” in synthetic biology and agricultural technology.

Question 2:

Can you discuss what improvements can be made to improve the Agri-tech industry, particularly as it relates to protecting the environment and food production?

As discussed in my testimony, one of the companies I have founded, Agrospheres, is using the science of synthetic biology to engineer non-GMO delivery platforms to degrade pesticides directly on plant surfaces. Agrospheres, developed as a student entrepreneurial project, is now a University “spin-out: company that has won several prestigious National competitions including the United States Patent and Trademark Office Collegiate Inventors Competition. To successfully compete and grow as a company, Agrospheres has taken advantage of incubator facilities in the Charlottesville area as well as grant funding from local, State and National Sources. Further support for these resources, particularly enhanced SBIR grant funding in the Ag space, from NSF, USDA, DOE and DOD, are essential to the development of these new companies that will change the world.

Question 3:

I just launched a hunger initiative called the “Let’s Feed America” initiative where I am advocating for various hunger initiatives to eradicate food deserts in my district and to provide food aid to low and moderate income residents along with senior citizens and the disabled population. How can agri-tech be used to help eradicate hunger in food deserts?

There are now numerous examples of companies developed through Academic/Industrial partnerships that are making agricultural products safer and more cost-effective. This directly transfers to a healthier economy for farmers but also to fresher and more plentiful products in urban settings. Ag-tech provides the “solutions” to feed urban food deserts and quite possibly the world.

Respectfully,

Mark Kester

Director, nanoSTAR Institute, University of Virginia

Questions for the Record

Committee on Small Business

Subcommittee on Agriculture, Energy, and Trade

“High-Tech Agriculture: Small Firms on the Frontier of Agribusiness”

Joe Guthrie

Question 1:

Can you please explain the important role of 1890 institutions in helping to expand Agri-tech and how these universities can assist in the development of this industry?

The 19 colleges and universities that comprise the Council of 1890s Institutions are integral and vital components of the land-grant missions that provide invaluable new knowledge of agriculture to the people in their states and to the nation. These historically black colleges and universities—such as Florida A&M in Rep. Lawson’s state and Virginia State University in my home state—have the same 3-part mission of all land-grant universities: education, research, and extension. In each of the states with one of the 1890 Institution, that institution partners with another university—such as the University of Florida or Virginia Tech—to fulfill the land-grant mission. Agriculture has been a central focus of the land-grant mission since the passage of the Morrill Land-Grant Act and the establishment of universities around the nation that it provided for.

Today, the land-grants are continuing to provide leadership in the burgeoning new agricultural technologies. Importantly, the land-grants are fulfilling that leadership role in all 3 aspects of their mission. They are educating students, such as through the new course in Precision Agriculture in the Agricultural Technology Program at Virginia Tech that I discussed in my testimony. They are providing research in many aspects of agriculture, both on-campus and at agricultural research and experimentation centers. And they are extending that knowledge to farmers through the Cooperative Extension Service.

There has never been a time in which it was more important to get new information quickly to agricultural producers and suppliers than it is right now. The states with 1890 Institutions are fortunate to have two sets of campuses, faculties, and students with a combined extension component to fulfill that need. As an example, in Virginia, the work in agricultural research and extension is divided up with Virginia Tech and Virginia State University partnering in some sectors, and each taking areas of specialization in other sectors. In Virginia, we are particularly fortunate to have these two institutions in two geographically distinct parts of the state. Virginia Tech’s campus is in the ridge and valley region of the Southwestern part of the state, which is primarily a forage and livestock producing area and lends itself well to research in those sectors. Virginia State University is located in Petersburg, in Vir-

ginia's coastal plain region, where row crop farming predominates. The two institutions partner in having about a dozen other research stations around the state. Virginia State has also taken the lead in several initiatives that work well in its area such as aquaculture. To the extent that other states with 1890 Institutions can find similar ways of having their land-grants partnering with specializations, we have found in Virginia that it can certainly create synergies and efficiencies and be beneficial to stakeholders.

I am a person with a love of history and the story it tells us of who we are today, so I'd just like to add a note about the history of the Morrill Land-Grant Act and two other great acts of Congress and the Lincoln Administration that have proved to be of incalculable value to the nation and have made American agriculture the most productive and efficient in the world.

First, the Morrill Land-Grant Act provided for a grant of land in each state from the federal government to provide either the site or the funding for a public institution of higher education with areas of focus on agriculture, mechanics (what we now call engineering), and military science. It was originally passed during the Lincoln administration in 1862 and was expanded to include colleges for African-Americans in 1890.

Another of those great pieces of legislation was the one which created the United States Department of Agriculture in 1862. Lincoln called it "the people's department." From its humble beginnings where its most prominent mission was to distribute seeds to farmers, it now works to "assure food safety, protect natural resources, foster rural communities, and end hunger in the United States and internationally" according to its website.

The third great work of Congress and the Lincoln Administration of 1862 was the Homestead Act. It provided for settlement on the vast and rich farmlands west of the Mississippi. Settlers were given title to land for free if they settled on it and farmed it. The act was expanded in 1866 to include African-Americans. More than 1,600,000 homesteaders settled on over 270 million acres, which is about 10% of the total area of the United States. As a result, today's American agriculture is largely comprised of family farms where ownership is passed down through generations of landowners who tend the land as their own and protect it for their heirs. No other system provides as well for productivity or sustainability.

I cite these great acts of Congress from 1862 to give examples of how legislation can provide great benefits to the nation with the hope that this Congress will be as inspired and as gratefully remembered for the works it passes.

Question 2:

Can you discuss what improvements can be made to improve the Agri-tech industry, particularly as it relates to protecting the environment and food production?

Among the advantages of many of the new innovations in technology in agriculture is that they can have positive effects on environmental sustainability. For example, enhancements in seeds and

chemicals have led to reduced soil erosion by reducing or eliminating tillage. Precision agriculture more accurately and efficiently applies fertilizers which helps reduce run-off. Precision ag can also reduce the number of trips over the field that a farmer would need to make during the growing season, and that saves diesel fuel and other input costs. So, while these technologies are designed to reduce input costs, they have an indirect benefit of environmental stewardship in doing so. We can only presume that further improvements in precision ag and other new technologies in agriculture in the future would tend to have the same effects.

In addition to reducing inputs, precision ag and other new technologies are designed to improve yields. For example, modern corn planters can select from a number of varieties of seeds as the planter covers a field and select, to a high degree of accuracy, a particular seed that will maximize production in a specific part of the field. That selection is based upon precise satellite mapping and records of previous yields that measure the field down to the square meter. As yields per acre improve we can produce more food to feed more people on the same acreage.

Ultimately, sustainability in American agriculture is linked to profitability of millions of small farms, mostly family farms, across the nation. Our farmers can only stay on the land and make it productive while providing for long-term environmental stewardship if the farm business is profitable enough to allow for investments to go back into the farm. New technologies should improve profitability by reducing input costs and increasing yields, and they generally do. However, the technology must increase profits enough to pay for itself. So far for precision agriculture, that profit has only been nominal because of the cost of the technology, as I pointed out in my testimony. The hope is that the cost of the precision ag technology will go down over time, as the cost of technology generally tends to do.

Question 3:

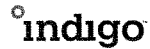
I just launched a hunger initiative called the “Let’s Feed America” initiative where I am advocating for various hunger initiatives to eradicate food deserts in my district and to provide food aid to low and moderate income residents along with senior citizens and the disabled population. How can agri-tech be used to help eradicate hunger in food deserts?

I applaud the Congressman’s efforts in these initiatives to enhance nutrition for all Americans in general and for the more economically disadvantaged people in his district in Florida in particular. I hope it helps to raise our consciousness of the issues associated with the lack of adequate nutrition faced by many Americans. Food deserts are a problem in many places across the United States, but in our urban centers in particular. I share the Congressman’s hope that we will find applications for new agricultural technologies in providing for food production in areas that are currently food deserts.

One challenge that we will face in achieving the use of enhanced agricultural technologies in eliminating food deserts is the

scalability of the technology. As I pointed out in my testimony, precision agriculture technology tends to be used on large farms because only the larger farms are able to afford the technology since they can spread the cost outlay for the technology out over enough acres to make it worthwhile. The hope is that the technology will become less expensive over time, as most technologies tend to become, and then they will be used more generally in medium sized and small farms. That's important because most of the efforts in eliminating food deserts focus on smaller scale operations and start-ups with limited acreage. That could help us to raise more food, not necessarily in the urban centers, but perhaps close enough in outlying areas to make small farms there viable, productive, and profitable enough to specialize in marketing to consumers in the urban centers with fresh produce through outlets such as farmer's markets and produce stands.

Because of the limited acreage available in urban areas, we would also tend to look to intensive, high value returns from acreage in the urban centers themselves. Greenhouses are one way to capture that high value per acre. I'll point out an example of such an intensive operation that has been successful as an agricultural producer, a youth training center, and a community outreach program. It is a hydroponics operation called Pulaski Grow in my home county, Pulaski County, Virginia. Their website is www.pulaskigrow.org. Pulaski Grow uses greenhouses to grow both plants and fish in a symbiotic relationship called hydroponics. Hydroponics allows for the production of both plants and fish on a large enough scale to be economically viable in only a very small area. A similar project could be done on a couple of vacant lots or perhaps, on a smaller scale, even on a roof top. While such an operation could be viable as a for-profit venture for an entrepreneur, Pulaski Grow has chosen to be a philanthropic non-profit and focus on using the operation as a youth training center which employs disadvantaged youth in the area to help them acquire hands-on skills and important life lessons in working at a business. Such an operation could be replicated almost anywhere because of the use of greenhouses. Outputs can include both farm-raised fish, which can be a very affordable protein source for a local urban population, and organically-grown herbs. Pulaski Grow receives a modest annual grant from Pulaski County's Board of Supervisors, of which I am a member. The grant is specifically used to help enhance the youth training aspect of the venture. I want the Congressman and all the other members of the committee to consider themselves to have an open invitation to visit and tour the facility. Their staff can contact me to make the arrangements.



**Testimony submitted by
Paul T. Dacier, Executive Vice President & General Counsel, Indigo Ag, Inc.
October 10, 2017
to the House Committee on Small Business, Subcommittee on Agriculture, Energy, and Trade
for the hearing on High Tech Agriculture: Small Firms on the Frontier of Agribusiness.**

Mr. Chairman, members of the Sub-Committee, thank you for allowing me to submit testimony for your hearing on High Tech Agriculture.

My name is Paul T. Dacier, Executive Vice President & General Counsel of Indigo Ag, Inc.

Indigo is a company dedicated to harnessing nature to help farmers sustainably feed the planet. The company utilizes beneficial microbes residing within plant tissues to improve crop health and productivity. Indigo's 2017 portfolio is focused on water use efficiency and yield in cotton, wheat, rice, corn, and soybeans.

The company is headquartered in Boston, Massachusetts, with commercial and customer service based in Memphis, Tennessee.

In mid-2017, we opened international offices in Buenos Aires, Argentina, and Sydney, Australia.

As stated by Indigo's President & CEO David Perry, we believe that we have the opportunity to create a fundamentally different kind of agriculture company — one that is focused on a different set of values. We believe that a better agriculture starts with 3 principles:

1. If we are to provide sufficient healthy food for everyone on the planet, farmers must first be profitable. The business of farming needs to be economically attractive, bringing in new farmers, in order to sustain and expand the farming community.
2. Agriculture must conserve natural resources; it has to use water wisely and reduce the runoff of nitrogen and other chemicals into our water supply.
3. Agriculture needs to match the needs of consumers. Consumers are changing the way they think about food. They want to know more about how it's produced and where it comes from. For growers, this creates an opportunity — an opportunity to differentiate their products, growing them in a way that consumers find valuable and are willing to pay more for. This gets growers out of the business of producing a pure commodity, and into the business of producing a value-added product.

Indigo intends to enable the future of agriculture

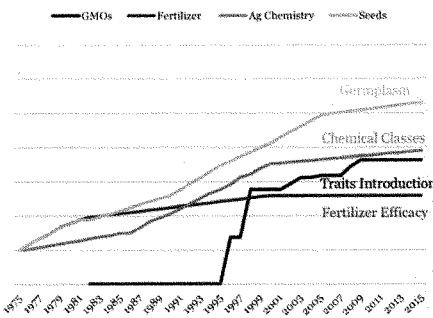
- by leading the development of sustainable agricultural technologies based on the plant microbiome,
- by offering a business model to growers that improves farmer profitability and sustainability, and
- by directly connecting consumer preferences with farming practices.

Today, we're not getting much in the way of agricultural innovation. Over the last fifty years, agricultural productivity has been driven primarily by the increased use of four things: synthetic fertilizer, agricultural



chemicals, plant breeding and hybridization, and, more recently, genetically modified traits (GMOs). Six companies now sell the majority of these technologies, and these companies are consolidating even further. What's already an oligopoly is now getting more concentrated and more powerful, despite innovation in those four technologies plateauing over the past fifteen years.

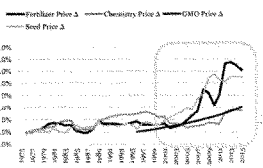
The rate of innovation has plateaued over the last 10 - 15 years



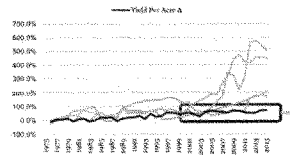
Source: Chart reflects cumulative impact of technology introductions by innovation since 1975. Scale based on Company knowledge and industry research.

Since around 2000, we've seen no significant innovation in fertilizer, just one new class of agricultural chemicals in the United States, and only incremental benefits on top of GMO traits developed in the 90s. Plant breeding ("germplasm" in the figure above) has continued to provide benefits, but the lion's share of those are realized only in corn.

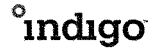
Input prices are up 400% in the same period...



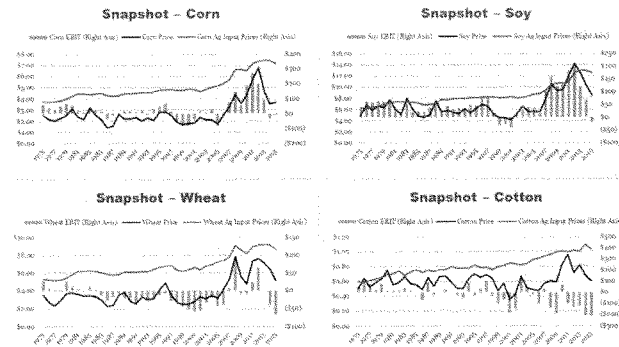
...while yields have remained flat



Source: Chart reflects % change since 1975 for soy input costs and yield per acre. Chart based on USDA data, Company knowledge, and industry research.



Despite this plateau in innovation, however, there's been a dramatic increase in price. Over the same forty-year timeline, there's been about a 400% increase in the costs of these technologies. Most of this has happened over the past fifteen years, and has been driven primarily by the costs of seeds and fertilizer. It's important to note that while costs have increased significantly, yields have remained relatively flat. Not surprisingly, the result of this is that farmer profitability is suffering.



Source: Chart based on USDA data, Company knowledge, and industry research.

Here we see the largest four crops in the United States. In each of those crops, we've graphed the input price (red), the commodity price (blue), and the gray bars, which represent farmer profitability (or lack thereof). There are a few remarkable takeaways here. Historically, profitability rose and fell with commodity price. Recently, we've seen spikes in commodity price, where both profitability and input prices soared. While commodity prices have since come down, they are still at historically high levels. Nevertheless, farmers today are largely unprofitable due primarily to high input prices.

Despite all of the agricultural innovations of the last forty years, farmers today are economically no better off than they were in 1975. This is largely the result of having such consolidated suppliers. With so few big ag companies and so many farmers, no farmer has enough power to negotiate price. Money is flowing from farms to those big input providers. Indigo is focused on reversing that flow of money — putting it back into farmers' pockets and into their local communities.

As David has stated, we believe that there is a better way to farm. It transforms grower profitability by reducing weather risk, increasing yields, decreasing input costs, and increasing crop prices. If we're successful in the way that we think we can be, we improve the economics of farming substantially, giving growers increased market power, premiums at harvest, and data-based agronomic information.

Efforts to make farming healthier and more sustainable often ask farmers to make an untenable choice: to maximize the use of the technologies that they need to reach profitability, or to make economic sacrifices in order to farm in a way that is consistent with consumer preferences. Indigo plans to eliminate that tension by



- a) providing microbes and data based agronomic insights that increase crop productivity,
- b) using microbes to gradually replace half of the synthetic fertilizer and up to 90% of the chemical insecticides and fungicides used today, and
- c) providing a premium market for crops that are grown using these new approaches.

Indigo has its origins in the microorganisms that have evolved in conjunction with plants over millions of years to optimize crop health and maximize productivity. Inspired by insights from the human microbiome, Indigo began with the hypothesis that naturally occurring microbes living inside a plant—known as “endophytes”—are vital to its health. By using sophisticated sequencing techniques and tapping the knowledge of collaborators, Indigo has assembled a world-class database of genomic information from these microbes, resulting in innovative, nature-derived products that complement a plant’s natural processes to improve crop health while increasing yield.

We add these naturally-occurring microbes to crops in the form of a seed coating. These products complement a plant’s natural processes to improve resilience across various stages of plant development, while also boosting crop yields.

Indigo focuses on microbes that exist within the plant to help defend against environmental stresses and maximize yield. Thus, our long-term vision imagines a better agriculture industry, one in which chemistry, fertilizers, land, and water are used conservatively and efficiently. We seek to help crops achieve maximum productivity in a manner that allows farmers both to steward the land and produce food in a way that aligns with consumer preferences.

Our products are not genetically engineered — they are based on plant microbes that have existed for millennia in nature *independent of* human influence. Indigo microbes reside within the plant and reinforce its health throughout the season by improving its stress tolerance, nutrient intake, and water use efficiency.

For farmers, the productivity gains enabled by Indigo science and technology will help improve grower profitability and expand our capacity to feed a growing population amid increasingly challenging weather conditions.

Together with growers, we have the potential to not only impact an industry, but to fulfill a larger vision of a world where nutritious food is transparently sourced and resources are conserved for future generations.

On behalf of my colleagues and partners in farms across the United States, thank you for allowing me to submit testimony.

Our Experience With Rural Entrepreneurship

I am glad your paths crossed with Dr. Lisa Benson from the American Farm Bureau Federation. She is very dedicated to rural business development, is genuine, and tack sharp.

My name is Martin Bremmer and I am the president of Windcall Manufacturing, Inc. in rural Venango, Nebraska (the southwest corner where Nebraska, Kansas, and Colorado meet). Our company manufactures a small handheld grain combine. Its purpose is to allow grain growers to harvest a small amount of grain to test the sample for water content. The percentage of water is how farmers determine if a field or crop is ready to harvest. If the grain is too wet the farmer is charged a “drying” fee and if the grain is too dry the farmer will lose money from “shrinkage” when the grain is sold. The GrainGoat, a patented machine, is the only one of its kind in the world due to the complex nature of threshing grain in such a tiny machine. You can learn more at www.graingoat.com.

Dr. Benson asked me, and several other who participated in the Farm Bureau Rural Entrepreneurship Challenge last year (2016), to describe the “challenges and opportunities” facing rural entrepreneurs.

Despite being 100 miles from the nearest town with a Home Depot or a good sushi restaurant, we are, for the most part, satisfied with shipping access to plastics and metal fabricators. We are accessible to all freight companies, FedEx, and UPS. So acquiring our raw components and drop shipping our finished product is relatively uneventful.

We are challenged with the distance to our plastics and metal fabricators during product development, however, simply because they are four to six hours away by interstate. Face-to-face meetings are usually necessary when new CAD drawings are being discussed and implemented into “one-up” prototype parts prior to larger purchase orders. This step is critical in discovering errors in manufactured parts before large orders are requested.

This hurdle could be eliminated with reliable high speed internet access in rural parts of the U.S. While most cities enjoy internet speeds of 20 to 100 mbps of speed, here in rural Nebraska, Kansas, and Colorado we either have dial up speed or we must pay \$60-\$100 per month for 3-8 mbps. This means we cannot hold reliable video conferences and a simple webinar usually cuts in and out. Cell phone companies do not equip their cell towers with high speed equipment due to the low population in rural areas. This past summer our only internet provider in this area announced they were closing, which would have left us without internet completely until an ISP from 200 miles away purchased the business and has continued to offer our area with basic internet access. This is our greatest challenge, currently as a rural entrepreneur.

I echo the four points brought up by Dr. Hofecker (Demeter, Inc.) in his email on this subject (Access to tech, entrepreneurial train-

ing, peer communities, and access to capital). Most rural entrepreneurs do not intentionally set their trajectory to become an entrepreneur, rather, they take skills from their careers and start a second career developing their own businesses. They are very often lacking in the training necessary to understand the process to grow a start-up to a successful level.

If I could add anything to these points it would be emphasizing access to capital through all stages of a start-up. Seed money for prototyping, funds for product development, and finally commercialization all require varying amounts of money at very specific milestones. If the business owner cannot accurately plot this timeline and secure the funding before it is needed the business will fail. Training in this matter is equal in importance to oxygen!

I feel so blessed that here in Nebraska we have been supported by an enthusiastic network of Angel Investors, and a Dept. of Economic Development who value rural business growth. Outside of Nebraska, our hard work has caught the eye of USDA and their Small Business Innovative Research program (SBIR). We thank them for awarding us both a Phase I & Phase II grant allowing us to reach the threshold of commercialization. With that assistance we will market our product not only to farmers and custom harvesters but also to seed breeders such as Bayer and ADM, university researchers, and in the next few years to overseas markets. If any of these groups or agencies had not assisted our business, our goals could not be attained.

If you have additional questions or would like further details of our experience with starting a manufacturing business in rural Nebraska, please let me know.

Thank you for being interested in this very important element of the U.S. agricultural economy. Ripples from the ag economy travel to every corner of the country.

Have a great fall,
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