BIG DATA AND AGRICULTURE: INNOVATION AND IMPLICATIONS

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BEFORE THE

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HOUSE OF REPRESENTATIVES

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*__Editor's note:__ John Deere was invited to testify but declined.

BIG DATA AND AGRICULTURE: INNOVATION AND IMPLICATIONS

WEDNESDAY, OCTOBER 28, 2015

HOUSE OF REPRESENTATIVES,
COMMITTEE ON AGRICULTURE,
Washington, D.C.

The Committee met, pursuant to call, at 10:00 a.m., in Room 1300 of the Longworth House Office Building, Hon. K. Michael Conaway [Chairman of the Committee] presiding.

Members present: Representatives Conaway, Neugebauer, Lucas, King, Gibbs, Austin Scott of Georgia, Crawford, DesJarlais, Gibson, Hartzler, Benishek, Denham, Davis, Yoho, Allen, Bost, Rouzer, Abraham, Moolenaar, Newhouse, Kelly, Peterson, David Scott of Georgia, Costa, Walz, McGovern, DelBene, Vela, Lujan Grisham, Kuster, Nolan, Bustos, Kirkpatrick, Aguilar, Plaskett, Graham, and Ashford.

Staff present: Bart Fischer, Callie McAdams, Haley Graves, Jackie Barber, Matt Schertz, Mollie Wilken, Skylar Sowder, John Konya, Anne Simmons, Evan Jurkovich, Keith Jones, Mike Stranz, Nicole Scott, and Carly Reedholm.

OPENING STATEMENT OF HON. K. MICHAEL CONAWAY, A REPRESENTATIVE IN CONGRESS FROM TEXAS

The CHAIRMAN. Good morning. I call the hearing to order.

Before we start the hearing, I would like to recognize Frank Lucas for some conversation about the tragedy in Stillwater. Frank?

OPENING STATEMENT OF HON. FRANK D. LUCAS, A REPRESENTATIVE IN CONGRESS FROM OKLAHOMA

Mr. LUCAS. Thank you, Mr. Chairman. Before we begin the hearing this morning, I want to take a couple of moments to reflect on the tragic events that unfolded at my alma mater, Oklahoma State University, this past weekend. As most of you know, a car plowed through a crowd of spectators at the homecoming parade Saturday morning.

Our homecoming parade at Oklahoma State is like the biggest high school homecoming you have ever seen in your life. Enthusiasm, mass amounts of alums and supporters, and all those little kids up and down the line.

Part of the group that was injured, and ultimately four of them lost their lives, two of those folks who did not survive the crash were Dr. Marvin Stone and his wife, Bonnie; both long-time employees of Oklahoma State. And it is fitting that we are having this

hearing today on big data because Dr. Stone, a Regent's Professor of Biosystems and Agricultural Engineering in Oklahoma State, was a pioneer in the field. He was integral in developing new precision ag technology, such as the GreenSeeker technology, that helped pave the way for much of the innovation we see in the industry today. And while he retired in 2006 after 24 years of service at Oklahoma State, he remained very active in his profession and, ironically, was honored just this spring in this very room for his innovations in agriculture.

The Division of Agricultural Sciences and Natural Resources at Oklahoma State will be honoring the Stones with a vigil on campus in Stillwater tonight, and I would ask that you keep all of those who were impacted by this terrible tragedy in your thoughts and prayers in the days ahead as funerals take place, as the survivors who are in critical condition still continue to mend themselves.

And, Mr. Chairman, I would very respectfully ask, if the Committee could join me in a moment of silence for all those good folks lost.

The CHAIRMAN. Thank you. Please now, join us for a moment of silence.

Dear Heavenly Father, we thank you for the multitude of blessings you have bestowed upon us, including the blessing of peace that passes understanding. We ask for healing and comfort on those injured in the tragedy at Oklahoma State this past weekend, comfort for the grieving, and healing for those that need to be healed. Please be with that whole community and help them deal with this senseless tragedy. We also ask for wisdom, knowledge, and guidance that we might govern these great people, that we have big decisions to make this week. We ask for that wisdom and discernment that we may make those that honor you, and that our service will further your kingdom here on our Earth. Be with us this morning as we have this hearing. We ask these things in Jesus' name. Amen.

Good morning everyone. This hearing of the Committee on Agriculture on big data and agriculture: the innovation and implications to come, will to order.

Information technology is profoundly impacting every aspect of our lives. In so many ways, this is a good thing, but, as anyone who has had their identity stolen can tell you, it is not without its downsides.

The same, of course, is true in the case of production agriculture. As we have learned in previous hearings, foreign countries do a lot to give their producers a leg-up over their competitors. By way of example, along with lower worker, consumer, and environmental standards, we have witnessed other countries manipulate their currencies, set up state trading enterprises, use subsidies, tariffs, and other non-tariff barriers to gain the upper hand in this competition. But, we too have some distinct advantages going for us. Some, like our infrastructure, are tangible, easy to see, while others, like a strong rule of law and a great entrepreneurial spirit, are usually just taken for granted. But every now and again, a game-changer comes along, and we in America have had an excellent track record of inventing them and using them early to our great advantage.

This record has helped keep America's farmers and ranchers out in front of the pack.

The United States has led the way in several major agricultural game changers, including the moldboard plow, the cotton gin, refrigeration, and the Green Revolution.

Not long ago, we celebrated the addition of Norman Borlaug's statute to the Capitol. Of course, Dr. Borlaug's Green Revolution was a huge game-changer, introducing innovations that have saved billions of lives. Thanks to Dr. Borlaug, we are well positioned to be able to feed the nine billion people who will soon inhabit our planet, and we will meet this challenge using far fewer natural resources and inputs.

Today, many believe that information technology, or big data as it has been called, is the next big game-changer for agriculture. Thanks to significant investments in precision agriculture technology by those companies represented here today, as well as countless others, producers now have more information about their farms at their fingertips than ever before.

Big data, has what seems like boundless potential to improve the efficiency, profitability, and competitiveness of our nation's farmers and ranchers, while conserving natural resources and benefiting the environment.

In fact, the benefits of big data have already been paying off, as we will hear about today. But, at least one of the reasons why potential benefits have not yet been fully realized is because farmers and ranchers are getting lots of information from lots of different places. Getting all of this information into one place where it can be easily accessed and used is critically important. I am very pleased that Billy Tiller, who is from my part of the country, is here today to talk about this impediment, and how he and other farmers are working to find farmer-friendly solutions in overcoming it.

Beyond practical considerations, however, is the important question of how to protect producer privacy and private property rights.

Thankfully, the law protects the privacy of most producer information that USDA gathers, but, of course, it does not cover information gathered by private entities. This has enormous implications that can, among other things, affect the commodities market, land values, and how farm policies operate, and it could potentially expose producers to frivolous and costly environmental litigation.

My hope is that the Committee and our exceptional panel of witnesses will fully explore these and, perhaps, other relevant issues.

In closing, I want to go back to what I think is a central point, and that is the fact that this data is the farmer's information, and as such, the farmer should own or, at bare minimum, control information about his operation.

If we can achieve this important principle, I think we go a long way in ensuring that American agriculture harnesses the power of big data.

[The prepared statement of Mr. Conaway follows:]

PREPARED STATEMENT OF HON. K. MICHAEL CONAWAY, A REPRESENTATIVE IN CONGRESS FROM TEXAS

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The same, of course, is true in the case of production agriculture.

As we have learned in previous hearings, foreign countries do a lot to give their producers a leg-up over their competitors. As a few examples, along with lower worker, consumer, and environmental standards, we have witnessed other countries manipulate their currencies, set up state trading enterprises, use subsidies, tariffs, and other non-tariff barriers in order to gain the upper hand.

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If we can achieve this important principle, I think we go a long way in ensuring that American agriculture harnesses the power of big data.

I would now recognize the Ranking Member, Mr. Peterson, for any comments he wishes to make.

The CHAIRMAN. With that, I will recognize the Ranking Member for any comments that he would like to make.

OPENING STATEMENT OF HON. COLLIN C. PETERSON, A REPRESENTATIVE IN CONGRESS FROM MINNESOTA

Mr. PETERSON. Thank you, Mr. Chairman. And I welcome the witnesses to the Committee today, and I am looking forward to your testimony.

There are a lot of interesting things happening with big data and agriculture, and they all have the potential to provide huge benefits, not just to farmers but to consumers, and to the economy as a whole.

Adopting new technologies can make farming more efficient, enabling farmers to make wise use of inputs and help to keep their costs low. Technology can also help connect farmers with local businesses and consumers, opening up potential new business opportunities. Of course, there are concerns about these advances, particularly when it comes to privacy, and this is something we are going to have to keep an eye on. But I am encouraged that our commodity groups and agriculture technology providers have started a productive dialogue, and I hope that that relationship continues, and that we can learn more about these efforts during today's testimony.

One final point, we need to take a look at what is happening with rural broadband. All of this technology is great, but it is not going to do anybody any good if we don't have reliable broadband. We made a lot of progress but there are still huge parts of the country that don't have reliable service, and in spite of all of the money that we have spent trying to get broadband into unserved areas, people continue to overbuild existing systems and spend the money in places that, in my opinion, they shouldn't. Somehow or another, we need to take this Universal Service Fund away from telephones and put it into broadband, and do what we did back in the 1930s where we got it to every house. And somehow or another, we have to figure out how to do this.

So anyway, I think that there is a lot of interesting points for us to discuss today, and I thank our witnesses for appearing before this Committee. And yield back.

The CHAIRMAN. I thank the gentleman.

The chair would request that other Members submit their opening statements for the record so the witnesses may begin their testimony to ensure that there is ample time for questions.

I now recognize Mrs. Hartzler to introduce our first witness.

Mrs. HARTZLER. Thank you, Mr. Chairman. I am very honored to be able to introduce our first witness, my friend and Missouri Farm Bureau President, Blake Hurst. Mr. Hurst, or Blake, farms in northwest Missouri. He has a 2 acre greenhouse with his wife, Julie, and daughter and two sons. But he is also more than just a farmer and a leader of the Farm Bureau in the state, he is also a very accomplished writer, and his articles—he has a gift of humor as well as getting his point across. And he has been featured in *Wall Street Journal, Weekly Standard, Reader's Digest,* Missouri Farm Bureau's *Show Me Magazine,* and many more publications. And he is certainly a leader among the American Farm Bureau Federation, and on issues relating to farmer data. He was one of our main pivotal voices last summer on my farm tour where we had a session dealing with big data. So I very much appreciate him and the honor to be able to introduce him today. Thank you for being here.

The CHAIRMAN. Thank you. We also have Mr. Billy Tiller, the Director of Business Development, Co-Founder of Grower Information Services Cooperative in Lubbock, Texas. Dr. Michael Stern, Presi-

dent, Chief Operating Officer, The Climate Corporation and Vice President, Monsanto, San Francisco, California. Mr. Matt Rushing, who is the Vice President, Product Line, Advanced Technology Solutions, AGCO, Duluth, Georgia. And Mr. Shannon Ferrell, Associate Professor and Faculty Teaching Fellow, Agricultural Law Department of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma.

Mr. Ferrell, I express our condolences on the death of your brother this past week, and our prayers for you and your family as you go through those circumstances. Thank you for being here this morning.

Mr. Hurst, would you care to begin? Five minutes.

STATEMENT OF BLAKE HURST, PRESIDENT, MISSOURI FARM BUREAU; MEMBER, BOARD OF DIRECTORS, AMERICAN FARM BUREAU FEDERATION, TARKIO, MO

Mr. HURST. Thank you, Congresswoman Hartzler, for the warm welcome. Thank you, Chairman Conaway and Ranking Member Peterson, for holding this hearing.

I am honored to represent Missouri Farm Bureau and the American Farm Bureau Federation, and share our members' views on big data. Included in my written testimony is an article I wrote a couple of years ago on the topic.

Big data will lead to as much change in agriculture as the Green Revolution or biotechnology. Farmers have had access to precision technology for a number of years, but significant strides have been made in data collection and analytics. As a result, farmers using the technology are reporting higher yields, fewer inputs, more efficiency, less strain on the environment, and higher profits. Yet many are also expressing concerns about privacy, security, portability, and transparency in how their data is used, and who exactly has access.

The questions about the new technology can be grouped into the following categories. Transparency: What information is being collected? Will the ATP, or ag technical provider, notify me, the farmer, if its policies and/or procedures change? With whom does the ATP share the information? Who else can obtain my data? Can I delete my data from a database? Can I easily switch among providers, which is a huge question? Am I the gatekeeper to data access? Of course, who is liable if there is a data breach? And is there value to this data to my farm, and can I capture some of that data, can I be paid for the data?

In early 2014, the Farm Bureau invited six farm and commodity groups and six ag technology providers to meet to see if we could find a solution to the farmers' concern. We worked several months to develop 13 principles of data privacy and security, which are included in my written testimony.

Farmers prefer this teamwork approach over regulatory or a legislative fix because we believe the market will provide the process to address problems if farmers have an equal footing with agribusinesses. If we rely on the government to make changes, the undue overhead may well irreversibly deter innovation.

However, while we are not advocating for government involvement in regulating big data, our farmers are extremely interested

in having the government being a data-driven partner so they can more easily use electronic technologies to access and utilize USDA programs such as having a one-stop sign-up for programs across multiple agencies like the Farm Service Agency, Natural Resources Conservation Service, Risk Management Agency. Through technology, the government can enable progress and efficiency. USDA needs better data technology and the authority and resources to use them to drive value for farmers' data. If we can accomplish that, we will jointly drive innovation, reduce economic burden on farmers, and reduce costs for USDA.

You will note that we started this process with 12 participants, and we have moved on from the beginning, we have had 35 different organizations sign on to our agreement. The first thing we did was set up a transparency evaluator. We agreed it would be useful to help farmers understand the documents they signed with ATPs and ag service providers, and to do so without hiring a lawyer. Consequently, we developed a transparency evaluator. I would describe it as a combination of a *Consumer Reports* review and a Good Housekeeping seal of approval.

Before signing contracts, farmers should understand what will become of the data collected from their operation, including whether it is accessible to a Freedom of Information Act request, whether it is accessible to government agencies without permission, and whether it could be used to speculate in the commodities market. Farmers need to be able to determine if the benefits and relationship outweigh the privacy and security risks.

We have also done work on ag data repositories. Today, most experts believe that 80 percent of the data we collect never leaves the tractor or combine, or is never entered into a database. A data repository will be developed so it is akin to a bank where one is free to deposit and withdraw data at will, a place where farmers can store their data for later use.

While AFBF has not endorsed any ag data repository, we are working with some which are being developed so that producers have an opportunity to store their data in an open, neutral network. And we hope that one or more data repositories follow the principles in our data privacy and security document.

We have had some skepticism from farmers about data repositories. The biggest concerns are security, providing agribusiness companies with one more avenue to sell to and increase their costs. I believe the farmer data has value, and by simply offering it to a repository we may not be able to capture that value. And if data is stored in an individual company database it is often difficult and often impossible to move to a different provider.

In summary, the increasingly important role of precision agriculture and big data offer significant opportunities for farmers and ranchers. However, we must do everything we can to ensure producers own and control their data, can transparently ascertain what happens to the data, and have the ability to store the data in a safe and secure location.

Thank you.

[The prepared statement of Mr. Hurst follows:]

PREPARED STATEMENT OF BLAKE HURST, PRESIDENT, MISSOURI FARM BUREAU; MEMBER, BOARD OF DIRECTORS, AMERICAN FARM BUREAU FEDERATION, TARKIO, MO

Chairman Conaway and Ranking Member Peterson, thank you for the opportunity to testify today on the fast-paced expansion of innovation in "big data," its implications and its use in production agriculture. I would like to begin my testimony by sharing an article I wrote nearly 2 years ago on this topic.

> Big data will make farming more environmentally responsible and easier to regulate, but will lessen the sense of place cherished by the local food movement.
>
> Nothing is more important in agriculture than place. What is successful on one kind of soil in one kind of climate won't necessarily work in another place with a different soil or different weather patterns. Farmers have always gained the knowledge necessary to understand a place through hard-won and rarely transferable experience. What farmer Brown knows about his land might travel down the road a few miles, but it is less applicable on a similar farm in a different part of the country. This idea of place is what drives the local food movement. Wineries brag about the perfection of the marriage between their varietals and soil. On our farm, every acre that I've farmed for 35 years and that my father has farmed for 65 years has a story. We know which weeds grow where, when the wet spots will appear, and we all remember that time the combine caught on fire down by the hackberry tree. Farmers' personal relationship to place, one of the salient facts that distinguish agriculture, is about to change.
>
> Most combines traveling across fields in the Midwest this fall had a GPS receiver located in the front of the cab. Although agriculture has been experimenting with this technology for a decade or so, only now is the industry starting to consider all the uses of this transformative technology. For several years, farmers have had the ability to map yields with global positioning data. Using that information, firms can design "prescriptions" for the farmer, who uses the "scrips" to apply seed and fertilizer in varying amounts across the field. Where the yield maps show soil with a lower yield potential, the prescription calls for fewer seeds and less fertilizer. This use of an individual farmer's data to design a different program for each square meter in a field spanning hundreds of acres could replace a farmer's decades of experience with satellites and algorithms. What we have gained in efficiency and by avoiding the overuse of scarce and potentially environmentally damaging inputs, we may be losing in the connections of the farm family to the ancestral place. Precision technology will allow managers to cover more acres more accurately and will likely lead to increasing size and consolidation of farms. While Michael Pollan, Mark Bittman, and Alice Waters continue to argue that we need to turn back the clock on technology in agriculture, much of the world is moving in a quite different direction.
>
> Advice for individual fields is only the beginning of the uses for this technology. Agricultural equipment firms have run pilot programs where data is uploaded every several hours to the cloud, where it can be used . . . well, we don't really know all the ways it can be used. If 1,000 machines randomly spread across the Corn Belt were recording yield data on the second day of harvest, that information would be extremely valuable to traders dealing in agricultural futures. Traders have traditionally relied on private surveys and U.S. Department of Agriculture yield data. These yield estimates are neither timely nor necessarily accurate. But now, real-time yield data is available to whoever controls those databases. The company involved says it will never share the data. Farmers may want access to that data, however, and they may not be averse to selling the information to the XYZ hedge fund either, if the price is right—but that's only possible if farmers retain ownership and control of the data.
>
> One of the most important issues around "big data" goes directly to property rights. As Christopher Caldwell points out in the *Claremont Review of Books,* just because Facebook, MasterCard, or Google keeps track of what I searched for or where I buy lunch, it is not altogether clear why they should assume ownership of that data. For many of us, the convenience and enjoyment we receive for free from Facebook or Google may well be worth the loss of privacy.
>
> The value relationship between farmers and the companies that collect their data is considerably different. The risks to privacy that the farmer endures, such as his pesticide or GMO usage that may be accepted practice but not politically popular, are considerably greater than the fact that Amazon knows I have a weakness for thrillers and murder mysteries. Not only that, but the individual farmer's data has considerably more value than the average consumer's data. Many farms are fairly large businesses, spending hundreds of thousands on fertilizer and seed and producing millions of dollars of crops. It's not difficult

to imagine a smart phone ad arriving within seconds of a farmer encountering weed or insect damage while he's harvesting his crop. Farmers' information is valuable to the companies sponsoring ads, so farmers should be compensated when their data is sold. Farmers need to protect their data and make sure they bargain wisely as they share data with suppliers and companies who desire access to their information.

Farmers look forward to the ability to improve their yields and efficiency by comparing their results to neighboring producers. If my neighbor is receiving better results because of superior seed selection or because he times applications of inputs differently, then I'd really like to have that information. But this knowledge can have other results. If investors have data from all across the country, the access to better information could correct any market imperfections in the market for farmland. What has been a dispersed and unorganized market will likely be more accurate and rational with the advent of agricultural "big data." Knowledge of soil types, weather patterns, and productivity has been limited to close neighbors, but now access to data maps will replace the value of local knowledge. Owners of the database will have a decided advantage when it comes to pricing agricultural inputs, whether seed or farmland.

Farmers are rightly concerned about data privacy. Even if an individual operator does everything to the best of his ability, following all the applicable rules, regulations, and best management practices, there is still concern that the EPA or one of the numerous environmental organizations that bedevil agriculture might gain access to individual farm data through subpoenas or an overall-clad Edward Snowden. This concern about privacy will likely slow the adoption of the technology. The data will be invaluable to regulators and to parties in future litigation and it may also help protect farmers from accusations of wrongdoing. Of course, some farmers will never be comfortable sharing any kind of farm information with strangers.

Amazon made headlines with the news that it is beginning to experiment with the use of drones for delivery of purchases to customers. We're a long ways from Amazon CEO Jeff Bezos's ideas about the delivery vehicle of the future, but it is fun to think about what it might mean for agriculture. Nothing is more irritating to farmers than having to stop harvesting and travel dozens of miles for parts for their machines. With real-time monitoring of machine data and drone delivery, the local implement dealer may spot a bearing that is outside of the recommended temperature range, recognize an impending part failure, and dispatch a drone rescue mission before the actual operator of the machine realizes he is in trouble. That's unbelievably efficient, but more than a little spooky. Although delivery by buzzing FedEx drones may be a part of the distant future, drones will certainly be part of the data revolution in agriculture in the here and now. Though the industry complained loudly when they discovered that the EPA was using aerial surveillance to monitor livestock firms, the advantages of cheap and ubiquitous drones to monitor crop conditions and forecast yields will be too valuable to ignore.

Big data on farming will also likely affect the private-public partnership that brings us subsidized crop insurance. In the present system, insurance rates are set to maximize enrollment in the subsidized program, because encouraging participation by producers is seen as a public good. Insurance rates in marginal areas are lower than they would be if prices reflected only actuarial risk. But with access to the data about individual farms, insurance companies will be able to identify the least risky, most productive farms, which will likely buy less costly private insurance. This will end the ability of the present crop insurance programs to spread risk and will increase costs for farmers in more marginal areas, if the government doesn't increase subsidies further.

If a farmer can manage one machine guiding itself across a field by satellite, applying inputs and measuring outputs, reporting by-the-minute data on yields, oil temperature, and a gazillion other data points, what is to stop that same farmer from managing dozens of machines on farms the size of New Hampshire? Tyler Cowen argues that we're about to see an even wider disparity in incomes between the ten to 15 percent of the population that can relate well to computers and the vast majority of us who will deliver services to the computer-savvy class. Farming may be one of the first industries to explore the validity of Cowen's thesis. All of us involved in agriculture will soon have to decide whether we want to occupy the nostalgic niche providing artisanal beets and heritage pork to Cowen's ten percent, or whether we'll roll the dice on surviving the transition to a data-driven agriculture. Farming will be more efficient, more environmentally responsible, and easier to regulate and measure. But it won't be the same.

I wanted you to have this article before we begin to share what Farm Bureau and other farm and commodity groups have been working on the past couple of years because it encapsulates the opportunities and challenges we all face—not just farmers and ranchers, but the agriculture technology providers (ATP) and other segments of the agricultural production and marketing chain. It is extremely likely that the big data movement and the innovative technologies and analytics it yields will lead to at least as much change in agriculture as did the Green Revolution and the adoption of biotechnology. Farmers using the technology are reporting higher yields, fewer inputs, more efficiency and, importantly, higher profits.

Yet, many are also expressing concerns about privacy, security, portability and transparency in how their data is used and who, exactly, has access. While the questions about the new technology are numerous, they can be grouped into the following categories:

Transparency

- What information is being collected?
- Will the ATP notify me (the farmer) if its policies and/or procedures change?
- With whom does the ATP share the information?
- Who else can obtain my data?

Control

- What control does the farmer have over the information that is collected?
- Can I delete my data from an ATP's database?
- Can I easily switch among providers (and take my data with me)?

Security

- Am I the gatekeeper to data access?
- Who is liable if there is a data breach?

Value

- What is the value of this data to the farm?
- Can I get paid for my data?

Principles of Data Privacy and Security

In early 2014, the American Farm Bureau Federation (AFBF) initiated a working group by inviting six farm and commodity groups and six ATPs to discuss these issues and see if we could coalesce around some concepts and solutions to our members' challenges and concerns. The participants included:

- American Farm Bureau Federation;
- American Soybean Association;
- Beck's Hybrid Seed;
- Dow AgroScience;
- Dupont Pioneer;
- John Deere;
- Monsanto;
- National Association of Wheat Growers;
- National Corn Growers Association;
- National Cotton Council;
- National Farmers Union;
- Raven; and
- USA Rice.

This group worked several months to develop 13 principles on privacy and security. I served as one of AFBF's four representatives on that group. We had significant discussion and frank debate on the issues. But more importantly, we had several "learning moments" that occurred simply from spending time with each other as the ATPs learned more about farmers' concerns and we gained insight into the ATPs' ability or inability to address each and all of those concerns. *I would emphasize a critical point: farmers prefer this teamwork, "business-to-business" approach over a regulatory or legislative "fix" because we believe the market will provide the process to address problems if farmers have an equal footing with agribusinesses. If we rely on the government to make changes, the undue overhead might irreversibly deter innovation.*

However, while we are not advocating for government involvement in regulating big data, our farmers are extremely interested in having the government be a data-driven partner so that they can more easily use electronic technologies to access and utilize USDA programs, such as having a one-stop sign-up for programs across multiple agencies rather than having to report to their crop insurance agent, the Farm Service Agency, Natural Resources Conservation Service, *etc.* Through technology, the government can enable progress and efficiency. USDA needs better data technologies and the authority and resources to use them to drive value for farmers' data. If we can accomplish that, we will jointly drive innovation, reduce economic burden on farmers, reduce administrative costs for USDA agencies and improve services. Everyone wins.

You will note that we started this process with 12 participants. As we had intended from the beginning, when we completed our work on the principles document, it was shared with other groups to gauge their interest and see if they wanted to sign on indicating their support as well . . . Today, 35 groups have endorsed the principles. The latest document is attached for your further review.

This was an extremely valuable process that allowed various segments to better understand the "other side's views," work through differences and reach a workable conclusion. Beyond the principles document, the 35 groups have committed to ongoing engagement and dialogue regarding this rapidly developing technology.

Transparency Evaluator (TE)

One of the first things that several of the participants agreed would be useful was a way to help farmers understand the formal agreements and/or contracts they sign to engage ATPs and/or ag service providers—and to do so without a legal background or hiring a lawyer to understand the details. This group made the decision to develop a Transparency Evaluator. In its simplest form, I would describe it as a combination of a *Consumer Reports* review and a Good Housekeeping Seal of Approval.

This was a priority because many farmers are interested in using some form of data collection and storage, but virtually all are unaware of how their data is used after it leaves their farm—their immediate control, if you will.

Farmers often sign a terms and conditions contract with companies that collect their data, a contract that typically exceeds 30 pages in length; some are even longer. It is virtually impossible to find the specific provision you may be interested in, such as "will the ATP share my data" in such a lengthy document and even more difficult if a farmer is trying to compare policies between companies or service providers.

One of the driving motivations for the AFBF Board regarding the decision to engage in big data discussions was that use of this technology, in all its iterations, is a choice that belongs to each individual farmer. With that in mind, we determined our best course would be to encourage farmers, before signing a big data contract, to make sure they understand what will become of the data collected from their operations, including such important issues as:

- Who controls their data;
- Who can access it;
- Whether the aggregated or individual data can be shared or sold;
- The ways a company intends to use the farmer's data;
- Whether it will be kept in a place that could make it accessible to others via a Freedom of Information Act request;
- Whether farmers can get his data out of the system;
- Whether it is accessible to government agencies such as the Environmental Protection Agency;
- Whether or not it could be used by ATPs to speculate in the commodities market; and
- What happens to the data if the company is sold, acquired, or dissolves.

In short, farmers need to be able to determine whether the benefits outweigh the privacy and security risks associated with usage. By providing a tool to answer these questions, Farm Bureau can help farmers make informed decisions.

Twenty farm and commodity organizations, ag service providers and ATPs have joined forces and provided financing to collaborate in the development of a TE. The TE will provide farmers with an easy-to-use mechanism to allow them to compare and contrast specific issues within the contracts presented to them by ATPs. The groups are:

- AGCO;

- AgConnections;
- American Farm Bureau Federation;
- American Soybean Association;
- CNH (Case New Holland);
- CropIMS;
- Dow AgroSciences;
- Dupont Pioneer;
- Farm Dog;
- Farmobile;
- Granular;
- GISC (Grower Information Services Cooperative);
- Growmark;
- Independent Data Management;
- John Deere;
- Monsanto;
- National Association of Wheat Growers;
- National Corn Growers Association;
- National Farmers Union; and
- National Sorghum Producers.

While we are still in the development phase, the TE group has coalesced around a TE tool that will be simple and easy for farmers and ATPs to use. A key component in the development is, to the extent possible, match the questions/information available in the TE with the provisions endorsed in the Privacy and Security Principles.

Farmers need a method to quickly understand the often-complicated privacy policies, terms and conditions and other documents that come with signing up for new precision agricultural services. Likewise, ATPs and ag service providers need an easily recognizable way to demonstrate to farmers that they mean what they say—that their marketing and promotional materials are consistent with the legal terms of the contract. The TE is being developed around a simple scorecard format to allow, for example, a farmer whose primary focus may be transparency concerns, to easily review that area of the TE and, if desired, click on a link to obtain more information from a particular ATP.

The TE will provide answers to ten questions that provide the farmer with basic information about ownership, control and use of the data generated on his or her farm. These would be "yes" or "no" questions, with a link to the specific language in the actual contract to back up the answer if the farmer wishes to look at the specific contract language. While we have not yet finalized the questions, it is likely to include wording such as, "Will the ATP obtain my consent before selling my data to persons or companies not parties to the agreement?" and, "Can I delete my data upon contract termination?" Other questions could be about ownership, contract termination or portability.

Products that have been through the transparency scorecard analysis and approved by the TE administrator would be eligible to use an annual TE seal, denoting compliance with the process. This is something that could be used on the ATP's product websites or in marketing materials, giving a farmer a quick method to determine how the privacy policy and other contract documents for the product relate to the data principles.

While the original purpose of the TE was simple transparency of contracts, the members of the TE have discussed whether there should be a requirement for some level of adherence to the Privacy and Security Principles for Farm Data in exchange for awarding the seal of approval.

The current process calls for the ATPs to be responsible for the initial completion of the transparency scorecard. ATPs would complete the transparency scorecard by answering the questions and providing hotlinks to their privacy policies and other contracts containing the answers to each of the ten questions. The ATPs would submit the forms upon completion via electronic means to the TE administrator, who would then undertake a legal review of the responses to verify their accuracy.

This type of ATP self-certification at the beginning of the process has two advantages: it requires the ATP to engage in the process and, in the long term, we hope the scorecard will shape the privacy policies and other legal documents the ATPs attempt to certify.

After submittal, the TE administrator's review would determine the completeness and accuracy of the transparency scorecard responses. Assuming that all answers are correct and links are functional, the TE administrator would notify the ATP that certification is appropriate and the seal is granted. If problems arise during the review of the ATP's scorecard responses, there will be opportunities for resubmission and an appeals process.

Our goal is to have the TE operational next spring.

Ag Data Repositories

Another big data issue on which Farm Bureau is focusing is the development of an ag data repository. Today, most experts believe that 80 percent of a farmer's data is not removed from devices on the tractor or other machinery and that it is deleted before being transferred to storage in a database, effectively rendering it inaccessible and not usable.

A data repository akin to a bank should be developed where an individual is free to deposit or withdraw funds at will. Farmers could use such a repository to store their data for later use, and also provide a means to share their data with a trusted service provider, an ATP, a university for research purposes, business partners or any others if they want. The repository should be able to aggregate, secure, store, clean and distribute production data with whomever the producer requests it be shared.

While AFBF has not endorsed any particular ag data repository at this time, we are working with those who are developing them to share our thoughts on what type of system would work best so that producers have an opportunity to store their data in a secure, controlled and easily accessible location. To this end, it is also our hope to ensure one or more data repositories are developed and operated in a manner that, like the TE, adheres to the principles contained in the Data Privacy and Security document to the greatest extent possible.

Some businesses already operate successful databases, but a generous portion of our members have expressed skepticism about allowing their data to be stored in those databases. The following are some of their biggest concerns:

(1) Concerns about data security and privacy.

(2) Providing agribusiness companies with their data gives those companies another reason to target market to a producer and potentially increase their cost of doing business.

(3) A belief that farmer data has value, and that by simply offering it to a data service, they forgo opportunities to realize this value. (At this time, very few companies have offered to share any of the value they derive from a farmer's data with the farmer.)

(4) If data is stored in an individual company database, it is often difficult, if not impossible, to move-transport-producer data from that "data silo" to another repository if a farmer decides to change equipment dealers, seed dealers, *etc.*

Obviously, if historical data cannot be easily moved, the farmer is disadvantaged and innovation suffers.

We are encouraging all ag data repositories in place or being developed to:

(1) store and protect agricultural production data;

(2) allow farmers to control their data and be responsible for granting data access to others;

(3) per farmer agreement, to aggregate data in order for it to be useful to outside parties interested in analytics;

(4) standardize and transfer aggregated data to agribusinesses to create value;

(5) provide farmers with unrestricted access to their data;

(6) ensure and improve the participation of farmers in the creation and pricing of new products and services;

(7) increase the value of agricultural data at the farm level and improve the livelihood of farmers by capitalizing on this new asset—much as farmers capitalize on other key assets such as land, water, fertilizer and seed; and

(8) clean and certify the data to ensure a level of data quality so that actionable information is available and poor decisions are not made due to poor data—either now or in future years.

If these ideas are incorporated in a data repository, farmers will have more leverage with agribusinesses desiring to use their data than they do on their own. In addition, it will allow farmers to focus on farming—and ATPs, ag service providers,

universities, *etc.,* to focus on their core businesses while lowering costs to support their data-related needs, products and services.

If data repositories are properly developed, they will give farmers the ability to better manage and control their data, convert it into new products and services, increase their buying and selling power and capture more of their data's overall value. In short, it should enable farmers and their business partners to significantly expand their return on investments by unlocking the power of ag data.

In summary, the increasingly important role of prescription agriculture and big data offers significant opportunities for farmers and ranchers to increase productivity and efficiencies. However, we must do everything we can to ensure that producers own and control their data, can transparently and easily ascertain what happens to their data, and have the ability to store the data in a safe and secure location so it can best be used to improve efficiency and productivity.

ATTACHMENT

Privacy and Security Principles for Farm Data

October 22, 2015

The recent evolution of precision agriculture and farm data is providing farmers with tools, which can help to increase productivity and profitability.

As that technology continues to evolve, the undersigned organizations and companies believe the following data principles should be adopted by each Agriculture Technology Provider (ATP).

It is imperative that an ATP's principles, policies and practices be consistent with each company's contracts with farmers. The undersigned organizations are committed to ongoing engagement and dialogue regarding this rapidly developing technology.

Education: Grower education is valuable to ensure clarity between all parties and stakeholders. Grower organizations and industry should work to develop programs, which help to create educated customers who understand their rights and responsibilities. ATPs should strive to draft contracts using simple, easy to understand language.

Ownership: We believe farmers own information generated on their farming operations. However, it is the responsibility of the farmer to agree upon data use and sharing with the other stakeholders with an economic interest, such as the tenant, landowner, cooperative, owner of the precision agriculture system hardware, and/or ATP etc. The farmer contracting with the ATP is responsible for ensuring that only the data they own or have permission to use is included in the account with the ATP.

Collection, Access and Control: An ATP's collection, access and use of farm data should be granted only with the affirmative and explicit consent of the farmer. This will be by contract agreements, whether signed or digital.

Notice: Farmers must be notified that their data is being collected and about how the farm data will be disclosed and used. This notice must be provided in an easily located and readily accessible format.

Transparency and Consistency: ATPs shall notify farmers about the purposes for which they collect and use farm data. They should provide information about how farmers can contact the ATP with any inquiries or complaints, the types of third parties to which they disclose the data and the choices the ATP offers for limiting its use and disclosure.

An ATP's principles, policies and practices should be transparent and fully consistent with the terms and conditions in their legal contracts. An ATP will not change the customer's contract without his or her agreement.

Choice: ATPs should explain the effects and abilities of a farmer's decision to opt in, opt out or disable the availability of services and features offered by the ATP. If multiple options are offered, farmers should be able to choose some, all, or none of the options offered. ATPs should provide farmers with a clear understanding of what services and features may or may not be enabled when they make certain choices.

Portability: Within the context of the agreement and retention policy, farmers should be able to retrieve their data for storage or use in other systems, with the exception of the data that has been made anonymous or aggregated and is no longer specifically identifiable. Non-anonymized or non-aggregated data should be easy for farmers to receive their data back at their discretion.

Terms and Definitions: Farmers should know with whom they are contracting if the ATP contract involves sharing with third parties, partners, business partners, ATP partners, or affiliates. ATPs should clearly explain the following definitions in

a consistent manner in all of their respective agreements: (1) farm data; (2) third party; (3) partner; (4) business partner; (5) ATP partners; (6) affiliate; (7) data account holder; (8) original customer data. If these definitions are not used, ATPs should define each alternative term in the contract and privacy policy. ATPs should strive to use clear language for their terms, conditions and agreements.

Disclosure, Use and Sale Limitation: An ATP will not sell and/or disclose non-aggregated farm data to a third party without first securing a legally binding commitment to be bound by the same terms and conditions as the ATP has with the farmer. Farmers must be notified if such a sale is going to take place and have the option to opt out or have their data removed prior to that sale. An ATP will not share or disclose original farm data with a third party in any manner that is inconsistent with the contract with the farmer. If the agreement with the third party is not the same as the agreement with the ATP, farmers must be presented with the third party's terms for agreement or rejection.

Data Retention and Availability: Each ATP should provide for the removal, secure destruction and return of original farm data from the farmer's account upon the request of the farmer or after a pre-agreed period of time. The ATP should include a requirement that farmers have access to the data that an ATP holds during that data retention period. ATPs should document personally identifiable data retention and availability policies and disposal procedures, and specify requirements of data under policies and procedures.

Contract Termination: Farmers should be allowed to discontinue a service or halt the collection of data at any time subject to appropriate ongoing obligations. Procedures for termination of services should be clearly defined in the contract.

Unlawful or Anti-Competitive Activities: ATPs should not use the data for unlawful or anti-competitive activities, such as a prohibition on the use of farm data by the ATP to speculate in commodity markets.

Liability & Security Safeguards: The ATP should clearly define terms of liability. Farm data should be protected with reasonable security safeguards against risks such as loss or unauthorized access, destruction, use, modification or disclosure. Polices for notification and response in the event of a breach should be established.

The undersigned organizations for the Privacy and Security Principles of Farm Data as of January 23, 2015.

AGCO
Ag Connections, Inc.
AgSense
AgWorks
Ag Leader Technology
American Farm Bureau Federation
American Soybean Association
Beck's Hybrids
CNH Industrial
Crop IMS
CropMetrics
Dow AgroSciences LLC
DuPont Pioneer
Farm Dog
Farmobile LLC
Granular
Grower Information Services Cooperative
GROWMARK, Inc.
Independent Data Management LLC
John Deere
Mapshots, Inc.
National Association of Wheat Growers
National Barley Growers Association
National Corn Growers Association
National Cotton Council
National Farmers Union
National Sorghum Producers
North American Equipment Dealers Association
OnFarm
Raven Industries
Syngenta
The Climate Corporation—a division of Monsanto
USA Rice
Valley Irrigation

ZedX Inc.

The CHAIRMAN. Thank you, Mr. Hurst.

Mr. Tiller.

STATEMENT OF BILLY TILLER, DIRECTOR OF BUSINESS DEVELOPMENT AND CO-FOUNDER, GROWER INFORMATION SERVICES COOPERATIVE, LUBBOCK, TX

Mr. TILLER. It is a pleasure to be here today, Chairman Conaway, Ranking Member Peterson, and Members of the Committee.

My name is Billy Tiller. I am actually a cotton and grain farmer from Texas, and even though I work with and helped found Grower Information Services Cooperative, that is how I would characterize myself. In fact, today, the weather is not right in Texas, and hasn't been the last week or so, but as I leave it cleared up, so my guys are quickly in the fields and I am not there. So my mind is drifting a little back to the farm in Texas.

But what I want to talk about today is the fact, we are here on big data, and let me sort of tell you what happened.

Back in 2010, really it was a few farmers working together and we were talking about just the simple thing that it was difficult to move our data around. An example would be, we had crop insurance and we are trying to move our production data to our crop agent, and it wasn't a simple task. I mean I would have to go over, had reams of paper that I am hand-delivering to crop insurance agents that they are re-keying into systems, and I actually had brought that data from a system where it was in a sequel server database. So my point is I was moving it, and actually it was difficult to move. So we were trying to actually streamline that process.

Along the way of working with that, we started to identify some problems, and some problems I really hadn't started out thinking about, and those were problems of my own operation, which is about 6,000 acres. It is not one of the largest operations, and yet I was having difficulty with integration. And what I mean by that, I had many different systems that I was operating on the farm, and it was very difficult for me to integrate any of this data together to actually get—I wasn't thinking big data, I am just trying to get an analytical view of my own operation. And so what happened, I had a very incomplete data set because I had all these silos of data. In fact, on page 5 of the report, the testimony I gave you, I have a slide there and I would like to add one more silo there, one I forgot that I was thinking about yesterday is just paperwork. I have all this paper. We are digitizing a lot of it in my office today, but it is a silo of data that is missing there. But it is very hard to integrate and make good decisions when you can't bring all the data together.

And so what was going on in 2010 and what is going on today are the exact same problems. It hasn't gotten fixed. And we have been working diligently around the problem. And what we did to actually try to fix the problem in our own sense, we formed a cooperative called Growers Information Services Cooperative. Much like the repositories that Blake was talking about, we are attempting to store data, and we have really just got our system up and run-

ning where we can do that, it has been a long process, and where we can store data centrally, begin to look at a view that is across platforms, not create all the tools for the market, but let the market create those tools, but let us store them in a central location.

The other thing that the cooperative brought was we wanted to geospatially reference this information. Now, there is a land layer that lies at Farm Service Agency that they created, and really is an unbelievable task they went about to create the Common Land Unit. It is what we run our farm programs against, and also the same land layers used now with the approved insurance providers to operate our crop insurance. So we have map-based reporting, and we went down that road. It is a great geospatial way to reference things. It is a standard that we needed in agriculture, and so we chose that map to bear a standard.

Now, as I move forward, that is the reasons we did it, along with now we can see big data and we share revenue as growers together around the safety and privacy around data. What about data privacy. Let me say this. There is machine data out there, and this is very disconcerting to me, that when I buy a machine, I might not always own the data that might come off my machine. I can't hardly believe that I paid money for this. It would be like you buying your Kodak camera back in the day and then realizing that Kodak might want the pictures off the camera. It doesn't make sense to me, and I don't think it makes sense to you either. You should own the data if you bought the controller.

And so there are those things around data ownership. Also I would like to say that the landscape is changing. I mean quickly changing. And what I mean by that is, think about how quickly we went from smartphones to where we are talking about the cloud, and that has just been in the last 2 or 3 years.

So as I talk to you today, Members of the Committee, I want to complement what has gone on in the prior farm bills. And in 2008, Section 1619 set out to protect us as farmers around the geospatial information on our farm, and I would ask you all to continue in that. I would ask that you continue to safeguard that information. I think it should be allowed to be accessed by the farmer, and that is what we are working to actually use that. We use that information at GiSC because we step into the shoes of the grower, and we have an MOU with USDA where we have been working diligently to decide how can you get real-time data into farmers' hands. And USDA needs help there, we need help there, so there is a great partnership going on between the two of us, and I can see that work continuing to move forward into the future.

So I would summarize by saying please continue your work around privacy, understanding also that we don't need bumper rails, and you all know that. We want innovation, but somebody has to protect us, and we would like FSA to continue to update the Common Land Unit layer and do those things around that.

So anyway, I have a lot more at the end of my testimony, but four points I would like you—you can read those, but thank you for the time here.

[The prepared statement of Mr. Tiller follows:]

PREPARED STATEMENT OF BILLY TILLER, DIRECTOR OF BUSINESS DEVELOPMENT AND CO-FOUNDER, GROWER INFORMATION SERVICES COOPERATIVE, LUBBOCK, TX

Good morning. My name is Billy Tiller, and I am a 4th generation family farmer in Lamb and Bailey Counties of Texas. For those of you who like geography like me, we are about a 1 hour drive northwest of Lubbock, Texas near a very little town called Bula, just south of a bigger little town called Sudan. It is a great area. We grow non-irrigated crops—mainly cotton, grain sorghum, and sunflowers. I have also run cattle, have presided over the operations at a local bank, and for the past 5 years now, I have been working around innovations in, and analyzing the implications of "Big Data in Agriculture"—the topic of your hearing today. Let me say that I am very honored to be with you.

I am here today as a Co-Founder and the current Director of Business Development for Grower Information Services Cooperative (GiSC—*www.GiSC.coop*). GISC is a farmer-owned and farmer-led cooperative that is built around the idea that information—the data—generated from the farming operation has tremendous value, and farmers should be put in the best position possible to harvest this value. In a sentence, GISC seeks to accomplish grower data ownership by giving the grower better tools to index, store, protect, share and thereby use their data.

This idea that information and even raw data generated from the farm can be a valuable commodity is not necessarily new, but the pace of technology and innovation sweeping through the sector keeps this reality and world of possibilities ever changing. GISC's timing has been very fortunate. In the testimony that follows, I will explain why we came to the conclusion that growers need a cooperative to handle data, the services we are providing today, and the challenges we see for the future.

Brief History of GiSC

The concept of GiSC began in 2010, as discussion between myself and the other co-founder Monty Edwards. Monty was a very progressive and dynamic young crop insurance agent who also happened to be a fifth generation farmer and good friend. As we struggled with the immense paperwork involved in FSA and Crop Insurance, he and I began developing a way to move information more efficiently between my farm and certain farm service providers. During this exercise we realized the problem in agriculture was not so much the need for more technology, but the need for integration of current and future technologies to provide me an "end-to-end" view of my farm's operations.

We concluded that "big data" would only benefit the family operation if we as farmers had a means to organize the data. We also concluded that farmers could only find value in the developing agricultural data market if they had a means to aggregate their data and this needed to be done with a trusted entity. Therefore, in the early days of GiSC, we settled on two areas of focus:

1. Develop a secure data platform which could integrate and store data from the myriad of technologies adopted by the ag community. This same platform would also need to allow growers to share data with others while providing them sole control over the parameters of data sharing.
2. Formally launch GiSC to be a friend of the farmer/rancher and begin to create a plan for data governance with the grower's interest in mind, including the premise that the grower owns all the data that originates on his operation or his operation's activities.

We all know the last 100 years of history have been marked by some major revolutions in agriculture. The mechanical revolution brought my father and his father innovations that changed the very fabric of civilization. This same ever-improving mechanization has brought me climate controlled cabs, more (mechanical) horsepower, and much improved safety mechanisms, all of which have improved life on the farm. My father always said, "Son, you are living in the golden age of farming."

We have since witnessed giant leaps in scientific and agronomic innovations: from hybrid seeds, to better fertilizers, herbicides, pesticides, and fungicides. In the last 20 years, we have seen the another wave of scientific revolution involving biotechnology. All of these innovations have made farming more productive and have made the farmer a better steward of the land, as we have reduced the use of water, fuel, herbicides and pesticides. These scientific innovations continue today as further advances in biotechnology are pushing the upper boundaries of yield and stretching perceived water limitations through advances in genetics.

I value all these experiences tremendously. I value them for the tremendous impact they have had for humanity. I also value them because they have shaped my

thoughts about how to make sure that future innovations are in the best interest of agriculture producers.

As I testify here today, I believe another revolution in agriculture is occurring now—and that is the Information Revolution. It is built on precision agriculture, which involves the integration of computing power, satellites, and software that is increasingly being utilized to bring the American farmer into a "brave new world" of automation and operational analysis. It involves GPS guidance systems, recording operational activity in fields, and programmed applications customizable at the field and subfield levels. Indeed, we are accelerating toward a time when the producer will utilize all available sources of information, deciphered intelligently to operate more efficiently and decisively. This is the "big data" opportunity within agriculture.

So the Information Revolution is happening. This is very exciting. But there are some problems and hurdles to overcome.

We at GiSC think precision agriculture as we know it today has one fundamental drawback. It creates what is really an overwhelming amount of data that is difficult to assimilate, especially without tools to integrate and synchronize data created by various sources. So the data-poor environment of agriculture's past is now data-rich, but we lack any real effective way to handle all the information that is being funneled into the agricultural producers' management systems.

Too much information is almost impossible to manage, especially since the individual producer's data is an island. The farmer can get his hands on more information about his farming operation than at any other time in history, but that information is currently for his eyes only. The farmer is at a loss as to how to accomplish the task of sharing his information with another party.

The information age has brought not only information from internal sources that are at the producer's disposal, but also information from many outside sources. He receives data and information from the Farm Service Agency, crop insurance agents, accountants, chemical vendors, spray pilots, fertilizer dealers, cotton gins, marketing pools, grain elevators, equipment dealers, crop consultants, real estate brokers, *etc.* The list goes on and on.

Now look at the grower's data dilemma: not only does the grower have his own island of incompatible and unassimilated data, but there are also third party data islands. The grower needs both to provide data and receive data from those parties. This is the core reason GiSC was formed—to be the solution that bridges these islands, integrating and assimilating the grower's disparate data and providing digital connections with those that provide services to his operation.

GiSC Today

As noted, GiSC is a data cooperative owned by growers. It was founded on the notion that growers need an easy way to securely store and access their information, and to share that information with those who serve and support them. GiSC, in every sense, is "Built by Growers, For Growers"™.

The cooperative was birthed as an idea in 2010, but formally chartered in late 2012. Today we have 1,300 members in 37 states and are growing daily. The map below illustrates GiSC's footprint.

GiSC Footprint

*States with Members in Light Gray.

Beyond 1,300 growers in membership, we estimate that we have had direct personal communications with over 10,000 growers. These conversations indicated that 99.9% of those growers think forming GiSC was a good idea. Some thought it was such a good idea, they joined immediately. Even more exciting, most that did not join immediately left us with the impression that they would join soon after we deployed our platform technology, AgXchange™. This platform for growers has just been deployed and is available to all growers who are members of GiSC.

The point is that GiSC is gaining real traction, and in 2015, we have begun to transition the operations from mostly volunteer work by the early founders, to employees that spend every day answering growers' questions concerning data, systems, and privacy. In the summer of 2015, GiSC announced the hiring or Mr. Jason Ward to be the first Executive Director of GiSC. Mr. Ward brings 2 decades of experience in marketing and agricultural cooperative management, and will lead the staff in service to the grower members as the AgXchange™ platform is deployed.

Upon joining GiSC, Mr. Ward summed up our current mission well, stating, "Information is the new, and emerging, cash crop for agriculture and I believe the grower should be at the forefront of that movement. The first step for every grower is to make sure he or she is taking an active role in owning and controlling his or her data."

This mission is being carried out through three primary objectives:

(1) Establish the precedent that growers should own and control the information and data related to their production agriculture operations.

(2) Offer growers a private and secure cloud-based platform called AgXchange™ (*www.AgXchange.com*), where they can store all of the information related to a their operation, and provide their trusted third parties a communication channel for exchanging data, digital documents, and information. AgXchange™, will have the functionality to organize a grower's information geographically by a map of a grower's farm or land units. Central to GiSC's mission, the grower will be in control—the grower will dictate who may send data to the grower's data repository or access the data in the repository and may limit the access granted to his or her repository.

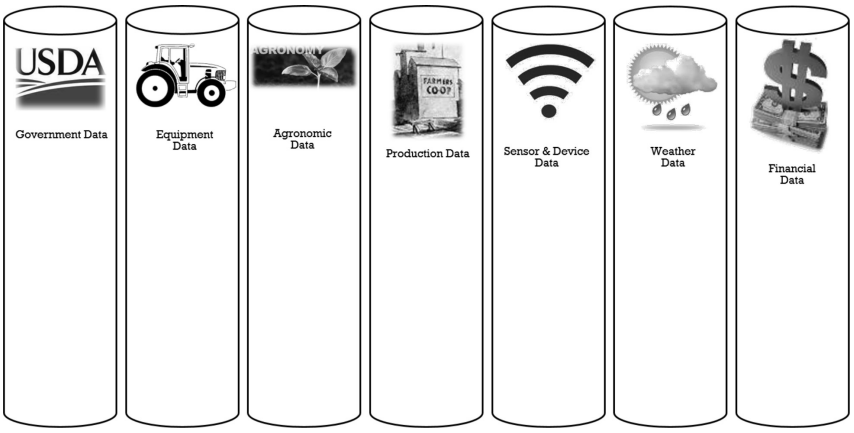
(3) Return value back to the grower members of GiSC. As the network of information and connections increases in AgXchange™, the value of that network increases. GiSC, will deliver patronage dividends back to its grower members from profits generated.

The Importance of Indexing Data and the CLU

I operate a farm that produces reams of data from many sources. In fact, I am producing and processing more data than at any other time in my history, because

it is so easy with devices such as my smartphone. Many only consider my Precision Ag data as the data that runs the farm, but it is much more encompassing. Here is view of my farm data in various silos outside of GISC:

Types of Farm Data



Much of the information I have today is cloud-based precision agriculture data, but much of my data is still in paper form or a digital form of paper such as a pdf file. I must be able to utilize both.

How can we index this data in a way that helps GiSC provide a big data picture for agriculture? The sensible answer is this: tie it back to the land; use a map; geospatially reference as much data as possible. Farmers have always kept track of things by farms or land units. The land unit operates much like a factory, where all manufacturing is taking place during the growing season for a geographic location. Accordingly, we needed to reference any data we could back to the land unit. All of the components of AgXchange™ hinge on this most basic unit.

Many operational maps that growers use, including precision ag maps, were researched, as the organizational backbone for geospatial referenced data. The conclusion of this research was that one map was head and shoulders above the rest for operating as that backbone: the Farm Service Agency (FSA) Common Land Unit (CLU) map layer. All U.S. farms registered with FSA have been geospatially defined as a unit or units, known as Common Land Unit(s). I state this matter of fact, but this was a monumental undertaking. FSA employees from across the U.S., in a coordinated effort, drew the boundary lines for the CLUs. This was perhaps one of the greatest feats ever accomplished by FSA without much public knowledge. FSA manages and keeps this CLU updated for its use to administer farm programs and increasingly for RMA to index crop insurance to the same land unit.

As stated above, GiSC and its member farmers saw the CLU maps as the solution to index all data. However, the CLU maps and data are still not readily available even to the farmers it is meant to serve.

The 2008 Farm Bill restricted public access to the CLU layer when connected to any personally identifiable information. We at GiSC strongly agree with limiting public access to grower's farm data, and I personally appreciate the steps taken by Congress in this prior farm bill to protect me. The 2008 Farm Bill also provided a needed exception, allowing the grower to request his CLU data from FSA. This was good for the grower in principle, but there is no simple method for growers to access their CLU data, much less an affordable and easy-to-use GIS system to view or use the CLU map layer.

GiSC has worked diligently with FSA since 2012 to understand what would be needed by FSA to share the CLU and other farmer information with a grower, and GiSC has developed a strong relationship with FSA and its staff during the process. FSA has thoughtfully worked to find ways to move this process forward, while also being very careful to protect producer privacy. Through a Memorandum of Understanding between GiSC and FSA, we are now receiving some producers' CLU information on behalf of the growers, with their consent. We expect this capability to continue to expand as we work through the legal and technical issues with FSA.

The farmer's CLU land layer, integrated into GiSC's platform, makes for a very user friendly system. This is the start of how GiSC can help farmers manage their

many silos of data and index it in a way that can make the data useful. It provides a meaningful way to display the information for the grower and those with which he or she wishes to share data within our system. We expect that FSA will make even greater strides in 2016 for delivery of real time data to their customers, and this will, in turn, benefit GiSC's membership as GiSC is able to deliver more data and data analytics to its farmer members.

Finally, I would also be remiss if I did not thank this Committee for including some very important provision in the 2014 Farm Bill to provide resources for and generally promote the electronic exchange of data between farmers and the USDA.

The Importance of Aggregating and the AgXchange™ Platform

The map-based CLU layer alone does not provide a farmer with avenues to interact; therefore, a system needs to be in in place to utilize it. Providing such a system was the inspiration for AgXchange™, and continues to be one of the fundamental value propositions of the AgXchange™ platform.

AgXchange Platform View

As stated earlier, we at GiSC determined there was a need in the industry for a grower-controlled platform that would be open to all service and technology providers to participate. This would provide a neutral technology tool, allowing growers to easily collect data from all of the proprietary systems and disparate clouds, organize and translate it into something meaningful. The CLU layer is the organizing point that makes geo-referencing possible, but it is the AgXchange™ that empowers growers to be better decision makers, and enables service and technology providers to give us better products and services.

GiSC is attempting to move the industry in the direction of enabling growers to have an end-to-end view of their operations just like an Enterprise Resource Planning (ERP) platform in other industries. But what has been lacking is a technology neutral middleman that can solve the industry's data acquisition and integration

problem. GiSC and its partners aim to fill that gap and be the aggregator of agricultural data, whether it is from John Deere equipment, Case IH equipment, or any other precision data technology provider.

Last Word to Farmers in this New World of Big Data

Farmers need a data aggregator and data integrator to help them reap all the benefits of big data and its implications to agriculture. We cannot just sit on the sidelines and wonder how it will all turn out, trusting that the tremendous for-profit agriculture technology providers will use our information only for our good rather than returns to their own share-holders. We need to be proactive by joining forces with groups such as GiSC, to give farmers a voice.

Growers must have access to data they own and they must devise applications and paths to bring the data back to their barn. We must remain vigilant as growers with the agreements that are currently being utilized by some vendors that take the rights to our data and our future data if we use the software or hardware of that particular vendor. We also need to realize that some of these agreements give these companies the right to a worldwide license to use our data in any way they please and in most cases for free.

To this point, it is important that all farmers know the important work that has been done—thanks in large part to the leadership of the American Farm Bureau, to bring all parties—grower groups and technology providers—to the table to hammer out a set of principles that should govern contracts in this area. This was and is an important piece of work for growers everywhere.

Subsequent to the agreement on Principles for Data Privacy, GiSC is currently involved in an initiative alongside commodity groups and Agricultural Technology Providers (ATPs) to develop an easy to understand metric that informs producers what they are agreeing to when they sign or click to accept data terms and use conditions from ATPs. We feel it is imperative that producers know upfront who has access to and can share their data so they can make informed decisions about the products and services they deploy on their operation.

Finally, I would just say to all growers everywhere that you will be impacted by the Information Revolution, whether you choose to participate or not. Information is powerful, and we do not want to be at the mercy of others, nor should we be information-poor as growers. The farmer must remain the premier fount of knowledge and information about his farm.

Last Word to the U.S. House Committee on Agriculture

As the Committee continues to weigh innovations and implications of big data in agriculture, GiSC would encourage you to keep some important principles in mind.

First, please be aware of the critical importance of the provisions of the 2008 Farm Bill which protect producer privacy around any geospatial data. While we support efforts to make it easier for a producer to attain his or her CLU and related farm-level data, we do not believe there is a legitimate public purpose to be gained in sharing such information with others who might ask. We appreciate that you understand that there is a right to privacy in our farm locations and our CLUs.

Second, we believe it is important to keep USDA in the middle of maintaining the standards for agricultural data and the most up-to-date statistics available to maintain transparency and sanctity in the markets. Objective and standardized measures and sets of data create a level playing field and thus benefit all participants in the marketplace. GiSC believes in this principle, and it is why we are indexing our data around the CLU.

Third, while USDA's role in the quality and standards for data is important, we believe the marketplace should be the source of new innovations in the world of big data. There are worlds of opportunity, and there needs to be profit drivers that continue to fuel the research and development needed that will continue this information revolution. Maintaining strong independent family farms is also key to keeping balance in this marketplace. To this end, we hope that you will continue listen to the commodity and grower organizations that have the grower's interest at heart.

Finally, I would ask that you continue to look for ways to automate the process of data delivery from USDA to the growers. GiSC is a willing partner in the task, and we will continue to work hand in glove with USDA to try and understand how to keep the grower in the driver's seat of this new digital world of big data.

Thank you for the opportunity to tell you about the work of GiSC and our efforts on behalf of the American farmer. Thank you for all the hard work you do on behalf agriculture and for the best interest of this great nation.

The CHAIRMAN. Thank you, Mr. Tiller.

Mr. Stern—or, Dr. Stern, excuse me, 5 minutes.

STATEMENT OF MICHAEL K. STERN, PH.D., PRESIDENT AND CHIEF OPERATING OFFICER, THE CLIMATE CORPORATION; VICE PRESIDENT, MONSANTO, SAN FRANCISCO, CA

Dr. STERN. Thank you Chairman Conaway, Ranking Member Peterson, and Members of the Committee, for inviting me to participate in today's hearing.

Your interest in the use of grower data and farm data analysis comes at an exciting time as agricultural data technology is being made available to farmers in ways it has never been done before. We are on the cusp of a digital revolution in production agriculture driven by the digitization of farm information that will drive a new wave of agricultural innovation and productivity.

The mission of The Climate Corporation is to help all the world's farmers sustainably increase productivity through the use of digital tools. Accordingly, The Climate Corporation looks at the actions farmers take every day, and the roughly 40 big decisions that farmers make every year on their farm. For example, what type of seeds to plant, where and when to plant those seeds, what is the optimal seeding population, and when and how much fertilizer should be applied, just to mention a few. The use of data can provide important, fact-driven information and insights to farmers to enable them to maximize yield, optimize their use of resources, and save money. What you might refer to as farmer data, or precision agriculture, is what I think about as digital agriculture; by using data science and software engineering, we transform data into insights for growers to help them make more informed decisions about what is happening in each part of each field. Our proprietary Climate FieldView Platform™ uses real-time and historic crop and weather data to deliver customized insights that help farmers make important agronomic decisions with confidence.

So how do we actually do this? By combining publicly and privately available information on weather, soil, and land with agronomic practices and farm equipment information provided by our farmer customers, we build complex models to analyze all of this data and provide insights for farmers to help them make real-time decisions that will result in greater efficiencies and increased productivity. All of this means that we are analyzing a vast amount of data for the farmer to help distill that information into usable insights. For example, we have developed our Nitrogen Advisor to monitor the movement of nitrogen-based fertilizers through the field from fall application to spring planting and beyond. This digital tool will provide insights to help farmers determine whether they have sufficient fertility in the field during the growing season to meet their yield objectives. Our Field Health Advisor uses satellite imagery to provide high contrast digital maps that help farmers spot trends and potential problems in their fields before they impact yield. The end result is to provide growers with more data-driven information to more sustainably increase the productivity of their operations.

As a company that will utilize our farmer customer data in the course of developing these transformational digital tools, we take our commitment to safeguarding that data very seriously. In June of 2014, The Climate Corporation published our data privacy policy

which is customer-focused, transparent, and makes it clear what we will and won't do with farmer data.

Our policy states that the company will make it easy for farmers to control who can access the data they provide and for what purpose. We will only use a farmer's data to deliver and improve the services for which they are subscribing. We will ensure safeguards are in place to protect farmer information from outside parties. We will not sell customer-provided data to third parties. The farmer owns this data. And finally, we will enable farmers to easily remove that data from our systems if they choose to no longer do business with us.

In addition, about a year ago, we endorsed a set of principles for data privacy that we and other industry participants developed with the American Farm Bureau. We are proud of the work that was accomplished, and we are pleased that our collaboration with grower organizations and other companies continues as we create a system to verify for our customers that we are meeting the standards we have endorsed.

The promise of digital agriculture is to help American farmers and farmers around the world to more sustainably convert natural resources into food. It is why we are in business. We believe that the digital ag revolution and The Climate Corporation's unique technologies will drive innovation to help achieve these important goals.

Thank you for the opportunity to share my thoughts with you this morning.

[The prepared statement of Dr. Stern follows:]

PREPARED STATEMENT OF MICHAEL K. STERN, PH.D., PRESIDENT AND CHIEF OPERATING OFFICER, THE CLIMATE CORPORATION; VICE PRESIDENT, MONSANTO, SAN FRANCISCO, CA

Thank you Chairman Conaway, Ranking Member Peterson, and Members of the Committee for inviting me to participate in today's hearing. Your interest in the use of grower data and farm data analysis comes at an exciting time as agricultural data technology is being made available to farmers in a way that's never been done before. We are on the cusp of a digital revolution in production agriculture, driven by the digitization of farm information, that will drive a new wave of agricultural innovation and productivity.

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What you might refer to as farmer data, or precision agriculture, is what I think about as digital agriculture—by using data science and software engineering we transform data into insights for growers to help them make more informed decisions about what's happening in each part of each field. Our proprietary Climate FieldView Platform™ uses real-time and historical crop and weather data to deliver customized insights that help farmers make important agronomic decisions with confidence. This information can be visualized in the cab of their tractor or in their fields to support the complex and important decisions they make throughout the season.

How do we do actually do this?

By combining publicly and privately available information on weather, soil, and land with agronomic practices and farm equipment information provided by our farmer customers, we build complex models to analyze all of this data and provide insights for farmers to help them make real time decisions that will result in great-

er efficiencies and increased productivity. All of this means that we are analyzing a vast amount of data for the farmer to help distill that information into usable insights. For example, we have developed our Nitrogen Advisor to monitor the movement on nitrogen based fertilizers through the field from fall application to spring planting and beyond. This digital tool will provide insights to help farmers determine whether they have sufficient fertility in the field during the growing season to meet their yield objectives. Our Field Health Advisor uses satellite imagery to provide high contrast digital maps that help farmers spot trends and potential problems in their fields before they impact yield. The end result is to provide growers with more data driven information to more sustainably increase the productivity of their operations.

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Our policy states that the company will make it easy for farmers to control who can access the data they provide and for what purpose. We will only use a farmer's data to deliver and improve the services for which they are subscribing. We will ensure safeguards are in place to protect farmer information from outside parties. We will not sell customer-provided data to third parties and finally we will enable farmers to easily remove that data from our systems if they choose to no longer do business with us.

In addition, about a year ago, we endorsed a set of principles for data privacy that we and other industry participants developed with the American Farm Bureau. The purpose of this set of principles is to further assure farmers that The Climate Corporation takes their privacy and security concerns as seriously as they do. These principles give farmers a framework on how to assess privacy policies as they consider doing business with data companies. We are proud of the work that was accomplished here, and we are pleased that our collaboration with grower organizations continues as we create a system to verify to our customers that we are meeting the standards we have endorsed.

The promise of digital agriculture is to help American farmers and farmers around the world to more sustainably convert natural resources into food. It's why we are in this business. We believe that the digital ag revolution and The Climate Corporation's unique technologies will drive innovation to help achieve these important goals. Thank you for the opportunity to share my thoughts with you today.

Mr. NEUGEBAUER [presiding.] Mr. Rushing, you are recognized for 5 minutes.

STATEMENT OF MATT RUSHING, VICE PRESIDENT, ADVANCED TECHNOLOGY SOLUTIONS (ATS) PRODUCT LINE, AGCO CORPORATION, DULUTH, GA

Mr. RUSHING. Chairman Conaway, Ranking Member Peterson, and Members of the Committee, thank you for the opportunity to testify on behalf of AGCO Corporation.

AGCO supports more productive farming across every phase of the crop cycle, through a full line of equipment, precision farming technologies, and services. Nearly 700 of our 3,100 dealers are located here in the United States, and support AGCO's vision to deliver high-tech solutions for professional farmers feeding the world.

We are at a hinge point in global agriculture. Growers must increase food production, as you know, between now and 2050 by 60 to 70 percent in order to feed the growing population. We must do all this with less.

Precision farming technologies are focused on inputs and environmental impacts, while optimizing the farm operation and lowering growers' input costs, improving overall efficiency, and maintaining stewardship of the land.

Advanced sensors and sensor fusion continue to enable better data acquisition, better insights into input deployment and yield,

cloud computing, and wireless connectivity allows for more efficient analysis and more granular management of land, machines, and inputs.

These technologies create a tremendous amount of data that is not always fully utilized by growers. We submit to the Committee that smart connected farm equipment and growers' ability to effectively manage and use this data is at the forefront of the next farming revolution. Machinery that collects it, farm managers and agronomists who can analyze it, and on and off-board technologies that transfer it, read it, and put it into action will be the next tools farmers use to unlock the value of their data.

So harnessing this data has the potential to be the next big driver for farm productivity gains, similar to the transition we saw 100 years ago when we moved from horses to machinery. With these developments must come shared standards for accessing, processing, and ownership of this data. Expansion of rural broadband, which was mentioned earlier, Internet access, which enables farm equipment connectivity is very critical. Progression towards and adherence to industry-wide farm data formats and quality standards enables growers to effectively work with agriculture service providers to increase farm efficiency. Ownership is another key piece of this farm data discussion.

AGCO and many other leaders in the industry assert that the farmer owns and should have control and responsibility for the data generated by his or her operation. Aside from the technical barriers, farmers must perceive the value of big data in their operations. Like any other industry going through a big data conversion or revolution, stakeholders must see to believe. Adoption of precision farming tools and services is driving the realization that data benefits and has a return on investment. Agricultural equipment and service providers must continue to demonstrate the value of data, and make it tangible across a wide variety of operations that exist. Data on its own is not valuable.

Given these challenges, it is up to us as leaders in the industry to develop and advocate for technology that achieves a secure and standardized and adaptable environment. Before we can do all that, we must demystify this area of big data. We must educate the industry and growers themselves on what farm data is and how it can effectively be used. AGCO's focus is on helping growers make sense of their data, and in keeping it private so they can use it how they want to maximize its potential. We are implementing strategic focuses around the world on developing equipment that is accurately recording the data parameters required for farm managers to engage in analytics and enable better decision-making, while ensuring the smart equipment can implement management plans derived from the data.

To respect the grower's data privacy choices, we have also chosen to transmit the data in two ways, through two pipelines; one machine data, and one for more sensitive agronomic data. We call this strategic initiative Fuse®, AGCO's open approach to precision agriculture that optimizes the farm.

AGCO applauds the Committee for highlighting this important topic. It is an exciting time to be part of the agricultural industry. New technology and innovations and ways to utilize data are pro-

pelling growers' productivity and efficiency. We are experiencing an unprecedented level of cooperation among farmer advocacy groups, industry associations, biotech companies, equipment manufacturers, and technology providers, all coming together to help growers utilize the data to better feed the world.

We look forward to your continued support. Thank you.

[The prepared statement of Mr. Rushing follows:]

PREPARED STATEMENT OF MATT RUSHING, VICE PRESIDENT, ADVANCED TECHNOLOGY SOLUTIONS (ATS) PRODUCT LINE, AGCO CORPORATION, DULUTH, GA

Mr. Chairman and Members of the Committee: thank you for the opportunity to testify today on behalf of AGCO Corporation. My goal here is to offer you some perspective into the area of agricultural data: what it is, the potential it holds for helping growers increase productivity, some challenges the industry faces and, most importantly, the exciting opportunity before us if we help our nation's growers leverage their data effectively.

Founded in 1990 with worldwide headquarters just north of Atlanta, GA, AGCO is a global leader in the design, manufacture and distribution of agriculture equipment in over 140 countries. We support more productive farming across every phase of the crop cycle through a full line of equipment, precision technologies and services. Nearly 700 of our 3,100 dealers are based in the U.S. AGCO's vision is to deliver high tech solutions for professional farmers feeding the world. This means everything we do supports growers in their efforts to feed the rising population.

I. Precision Farming and the Role of Data

Farmers face a number of challenges that modern agriculture helps meet, while also creating some unprecedented dilemmas. We are at a hinge point in the global agriculture industry. Our customers—growers—must increase food production 60–70% between 2005 and 2050 (United Nations Food and Agriculture Organization Report: *http://www.fao.org/docrep/016/ap106e/ap106e.pdf*) in order to feed the global population; they must do more with less. AGCO is driving one of the next phases of evolution for the modern farm through the advent of technology-enabled services to help farmers optimize and fine-tune their operations like never before. Most precision farming technologies that have been widely adopted today focus on minimizing waste of fuel, water, chemicals, seeds, fertilizers or time, and reducing soil and water pollution. (Using the right amount of water is critical in light of growing demand and damaging droughts.) Thus, the use of data in farming optimizes across several aspects of the farm operation, lowering growers' costs, improving overall efficiency and improving stewardship of the land.

These technologies have also created tremendous amounts of data that has so far not been fully utilized by most growers. The data will be leveraged to drive decisions on selecting the best crop varieties for each individual zone in a field. Fertilization and crop protection plans best suited for those plants in those specific field conditions are combined with recommendations for the optimal timing of each field operation. Machinery that collects it, farm managers and agronomists who analyze it, and on- and off-board technologies that transfer it, read it and put it into action will be the next tools farmers use to unlock the value in their data.

Harnessing this data has the potential to be the next big driver in productivity gains, similar to the transition more than 100 years ago from horses to tractors, and later from mechanical to electronic machines. Improved sensors and sensor fusion enable better data acquisition and better insights into input deployment. Cloud computing and wireless connectivity allows for more efficient analysis and more granular management of land, machines and inputs. AGCO submits to this Committee that smart, connected machines and growers' ability to effectively manage and use farm data is at the forefront of the next farming revolution.

II. Challenges to Effective Use of Agricultural Data

With such change must come shared standards for accessing, processing and ownership of this data. In terms of access, expansion of rural broadband/Internet access which enables farm equipment connectivity is critical to the continued progression of evolving farming practices which lead to increased food, fuel and fiber production. In terms of processing, adherence to industry-wide farm data formats and quality standards enables growers to efficiently work with the agriculture service providers (ASPs) to increase farm efficiency. Today, farm data is highly varied and follows different and often proprietary formats which dramatically limit growers' ability to

work with their data. Key agriculture industry associations and initiatives, of which AGCO and others testifying here today are proud to be a part, are working hard to get the "small data" right in order to improve data portability and interoperability, streamlining farmers' ability to utilize it. Ownership is another key piece of this farm data discussion. AGCO and many of the other key players in the industry assert that the farmer owns and should have control and responsibility for the data generated by his or her operation.

Aside from technical barriers, farmers must perceive the value of 'big data' in their operations. Like in other industries going through a similar 'big data revolution,' stakeholders must see to believe. Adoption of precision farming tools and services is driving the realization of data benefits and return on investment. Agricultural equipment and service providers must continue to demonstrate the value of data—make it tangible across the wide variety of operations that exist.

Given these challenges, it is up to us leaders in the industry to develop and advocate for technology that achieves a secure, standardized yet adaptable environment. As you'll hear from those of us testifying today, and others in the industry, there are many exciting recent and currently underway developments to get us there.

III. What AGCO Is Doing To Help Farmers Overcome Data Hurdles

Before we can do all that, we must demystify this idea of "big data." We must educate the industry and growers themselves on what farm data is. Many generate and use data every day and don't even realize it. There's a good deal of confusion and some fear of the unknown surrounding agricultural data. AGCO's focus is on helping growers make sense of their data, and keeping it private so they can use it how they want, to maximize its potential. AGCO leads and participates in critically important agriculture industry associations and initiatives that are working to address these issues through information sharing and education. Much of a farmer's concern over his or her data comes from the nature of the farm business itself. Most other industries would consider this type of information to be proprietary or trade secret, however, due to the relationship between a farmer and his or her operation, farmers see it as personal data. This data also falls into a few categories. Agronomic data is the record of what was done in each field, and operational results. Machine data is information about the performance and operational settings of the equipment that was used. There are also other categories such as weather data, financial information, supply chain information and several others, but machine and agronomic are generally the most discussed.

In terms of technology development, AGCO is actively implementing its strategic decision to focus on engineering equipment that accurately records the data parameters required for farm managers to engage in robust analytics that enable better decision making, while ensuring this smart equipment can then implement management plans derived from that data. To respect growers' data privacy choices, we've separated our data pipelines; one for machine data, and one for more sensitive agronomic data. For agronomic data AGCO has chosen to not aggregate, evaluate or even store the data other than to facilitate the transfer between the machine and the software that the grower or the grower's advisors use to manage the information. The second data "pipe" is for machine data; we encourage growers to share this information with us and our dealers. Machine data is less sensitive to growers since it generally is difficult to use to determine any of that farmer's "secret sauce" in producing their crop, or determining their profitability. This data can be used to provide services for improved uptime as well as optimization for efficient operation. Machine data is also valuable for equipment manufacturers like AGCO to use when developing the next generation of farm equipment.

We call this strategic initiative Fuse®—AGCO's open approach to precision agriculture that optimizes the farm, providing mixed-fleet operations improved access to farm data and better connections to trusted service providers. This enables more informed business decisions, reduced input costs, and improved yields and profitability. Within this strategy, Fuse Technologies is the technology foundation—tools—including machine guidance, telematics and advanced sensors to create smart, connected machines, fine-tuned for each application that can communicate with farm managers, third party service providers, and each other. On top of this technology foundation, AGCO's dealers are now beginning to offer Fuse Connected Services, which combines the right machines, technology, parts, service and support to help customers optimize their operation and maximize uptime through preventative maintenance, machine condition monitoring and year-round consultation. This system is highly flexible—our customers who have the ability to manage their data on their own can leverage our tools to do it themselves, while those who prefer extra support can get it from their AGCO dealers.

AGCO's strategy is made possible in large part through a focus on mobility, and our pioneering open approach. Our tools and technologies are easy-to-use and developed for maximum accessibility from the farm office, in the field or on the go. We co-develop with a wide range of industry partners and suppliers from Silicon Valley to the Corn Belt—allowing for advanced, nimble and quick-to-market innovations that will help growers keep pace with the farming data revolution. Our open approach also allows growers to choose the service providers they work with, while maintaining a high level of data privacy and security.

IV. Conclusion

As farm sizes increase, data will enable growers to continually optimize and become data-driven managers of their fields. By developing technologies to capture, process and utilize farm data, OEMs like AGCO and other suppliers will help growers become not only qualitative but quantitative experts of their land, using the knowledge gleaned from their data to truly optimize their operations and improve productivity, putting the right amount of inputs in the right spots in the field, at the right time. Agricultural data is the ultimate grower tool to minimize risk and increase profitability while enabling them to become better stewards of the land.

AGCO applauds this Committee for highlighting this important topic. It's an exciting time to be part of the agriculture industry—new technology innovations and ways to utilize data are propelling growers' productivity and efficiency. We are experiencing an unprecedented level of cooperation among farmer advocacy groups, industry associations, biotech companies, equipment manufacturers and technology providers—all coming together to help growers utilize data to feed the world. We look forward to your continued support.

Mr. NEUGEBAUER. I thank the gentleman.

Now, Mr. Ferrell, you are recognized for 5 minutes.

STATEMENT OF SHANNON L. FERRELL, J.D., M.S., ASSOCIATE PROFESSOR AND FACULTY TEACHING FELLOW, AGRICULTURAL LAW, DEPARTMENT OF AGRICULTURAL ECONOMICS, OKLAHOMA STATE UNIVERSITY, STILLWATER, OK

Mr. FERRELL. Mr. Chairman, Ranking Member Peterson, and Members of the Committee, thank you very much for this opportunity to speak to you. I want to commend you for your wisdom. You put the lawyer at the end, which indicates to me you have probably done this before.

I also want to echo the comments of the Chairman and Congressman Lucas with respect to Dr. Stone. I would be remiss if I didn't mention the impact that Dr. Stone had on me. We are having this conversation today largely because of some of the work that Dr. Stone did. In addition to the accomplishments that Congressman Lucas raised to our attention, Dr. Stone was also instrumental in developing SAE Standard J1939, which sounds like a bunch of alphabet soup, but it is the framework upon which machine data is basically built and transmitted. And so we really wouldn't be having this conversation today without Dr. Stone's work.

As the Congressman alluded to also, my brother passed away earlier this week, but I wanted to come here and speak today in spite of that because the last conversation I had with him was about how we could apply some of these principles to his cattle marketing strategies. And so I thought it was fitting for the memory of both Dr. Stone and my brother that I come speak to you today.

Many of the previous speakers have already made many of the points I was going to make about the opportunities that big data provides, and some of the parameters of the consensus-driven discussions that we have had in the industry, which I am very encour-

aged by, so I am going to move my comments more directly towards a couple of the legal questions that I think that are on everyone's mind with respect to this data. First, what does the law really have to say currently about the ownership of agricultural data; and second, what protections are out there for the privacy of that data, generated and shared by farmers and ranchers?

So on the first point of whether the law really gives us an ownership interest in agricultural data, I will give the classic law professor answer of: *it depends,* which I know is kind of a punt, but I will put it this way. In the regime of Federal law, the trademark, patent, and copyright, there is really no good fit for agricultural data. It really just doesn't have any protection under those various umbras. And so what we would then look to would be to state law, and specifically the Uniform Trade Secrets Act. And one could make an argument, although it is not necessarily a slam-dunk argument, that agricultural data could be protected under state law as a trade secret, however, that is not really, again, a very clear fit. And so if Congress chose to act on that and to enhance those protections, one thing that could be done would be to perhaps adapt the Uniform Trade Secrets Act on a Federal level, or provide a more clear legal definition of where agricultural data fits in the concepts provided by the UTSA, and provide a more clear protection of agricultural data within that framework.

On the privacy side, there really isn't a good fit under Federal law for agricultural data either. Health information has HIPAA, financial information has Gramm-Leach-Bliley and the Fair Credit Reporting Act, but agricultural data really has no place to go at the Federal level defining the level of privacy protection. So, ways that Congress could address that issue are, first, to enact legislation that clearly and narrowly defines the circumstances under which disclosure of agricultural data can be compelled by Federal agencies, and also the circumstances under which Federal agencies would be allowed to disclose that information specifically with regard to the Freedom of Information Act. And second, to strengthen the safeguards that would prevent inadvertent disclosure of agricultural data held by Federal agencies or the unauthorized access to that data by other parties. And again, I think that the current consensus process is doing a good job of developing those protections on the private side, and I really think Congress should lend its support to that action as well.

We really have seen tremendous strides through collaboration with all the stakeholders in this industry, and I think that Congress could also be very well served and could advance the cause of big data's adoption in agriculture if we support those public consensus-driven efforts led by American Farm Bureau Federation and lots of the service providers in the industry.

With that, I want to, again, extend my appreciation to Chairman Conaway, Ranking Member Peterson, and the Members of the Committee. I greatly appreciate this opportunity and look forward to answering any questions that you may have.

Thank you.

[The prepared statement of Mr. Ferrell follows:]

PREPARED STATEMENT OF SHANNON L. FERRELL, J.D., M.S., ASSOCIATE PROFESSOR AND FACULTY TEACHING FELLOW, AGRICULTURAL LAW DEPARTMENT OF AGRICULTURAL ECONOMICS, OKLAHOMA STATE UNIVERSITY, STILLWATER, OK

Executive Summary

Today's technology affords farmers the ability to instantaneously collect data about almost every facet of their cropping operations from planting through harvest. Many agricultural producers have concerns about their rights in this data and their privacy if they choose to share their information to take advantage of the numerous tools afforded by the big data revolution as they struggle with how to balance the advantages of automatic and continuous uploading of that data to other parties such as equipment dealers, input vendors, and consultants with the potential loss of confidentiality in such transfers.

The current intellectual property framework fails to provide a clear niche for agricultural data in the realms of trademark, patent, or copyright law. Agricultural data may fit within the realm of trade secret, but that fit is, at best, arguable. To the extent Congress wishes to enhance the intellectual property rights held by agricultural producers in agricultural data, adaptation of the Uniform Trade Secrets Act to accommodate the unique characteristics of agricultural data may be a viable approach.

The greater concern may be in the privacy issues surrounding the sharing of agricultural data through big data applications. Current Federal privacy laws do not directly address one's privacy rights with respect to information like agricultural data. Ways in which Congress can directly address privacy issues in this field is (1) to enact legislation clearly and narrowly defining the circumstances under which production of agricultural data can be compelled by Federal agencies and the circumstances under which agricultural data held by Federal agencies can be disclosed, and (2) strengthening the safeguards preventing the inadvertent disclosure of agricultural data held by Federal agencies or the unauthorized access of that data by outside parties.

Significant steps are already underway to facilitate consensus among industry stakeholders regarding these issues. This Committee and Congress as a whole may best be able to facilitate the realization of big data's potential advantages to U.S. agriculture through support of this consensus effort, support of educational efforts to help agricultural producers make informed decisions about how to engage with big data systems, continued development of more robust protections for agricultural data shared with the government, and continued support of improved broadband access in rural areas.

Acknowledgements

Dr. Terry Griffin of Kansas State University's Department of Agricultural Economics, Dr. John Fulton of Ohio State University's Department of Food, Agricultural, and Biological Engineering, Ms. Maureen Kelly Moseman, Adjunct Professor of Law at the University of Nebraska College of Law, Mr. Todd Janzen of the Plews Shadley Racher & Braun LLP firm in Indianapolis, Mr. Ryan Jenlink of the Conley Rose, PC firm in Plano, Texas, and Mr. Matthew Steinert of Steinert Farms, LLC in Covington, Oklahoma contributed greatly to the development of this testimony.

Perhaps the greatest contribution to this testimony and my understanding of agricultural data systems, though, was made by Dr. Marvin Stone. Dr. Stone was a giant in the agricultural data field, contributing tremendously to the development of the Green Seeker technology that significantly advanced machine-sensing of plant health. He was also instrumental in the development of the SAE J1939 standard that forms the foundation for many of the machine data technologies at the heart of this discussion. Beyond being a giant in the field we examine here today, Dr. Stone was a mentor to myself and hundreds of other students at Oklahoma State University. He and his wife were both killed in the tragic accident last Saturday at the University's homecoming parade. I hope this testimony honors his memory, the contributions he made to this field, to the U.S. agriculture industry, and to all of his students.

Issue Analysis

1. Introduction

I would like to thank Chairman Conaway, Ranking Member Peterson, and the Members of the Committee for the opportunity to present my observations on the legal issues surrounding the concept of big data and its application to data collected by U.S. farmers and ranchers. This new frontier in agriculture presents a fascinating and sometimes paradoxical mix of cutting edge technology, recent legal changes, and centuries-old doctrines of common law. In my testimony today, I will

lay a framework for discussing the legal issues surrounding big data in agriculture, discuss how the current U.S. legal environment addresses ownership and privacy rights in agricultural data, and suggest some potential avenues for policy responses that may facilitate the economic advantages to be gained from the application of big data principles to agricultural data while dealing with the concerns associated with such applications.

2. Framework for Legal Issues Surrounding Big Data in Agriculture

The concept of big data has exploded in a relatively short period of time. As a result, the national dialogue continues to develop both common definitions for the core terms in the discussion and the central issues of the discussion. Since these definitions and issues continue to evolve, my testimony today will provide some framing for both.

2.1 Defining Core Terms in the Big Data Discussion

Two terms immediately rise to the top in an examination of the agricultural data discussion: Big data and agricultural data itself.

While the term **big data** is relatively new, it refers to a concept that is not. There are many definitions for the term, but a straight-forward one might be "a collection of data from traditional and digital sources inside and outside your company that represents a source for ongoing discovery and analysis."[1] While this definition sounds much like traditional data analysis (and it is), recent advances in both data collection and transmission increase the analytical power of data analysis procedures by orders of magnitude. The "big" in big data comes from the fact data sets continue to grow exponentially both in breadth (with more and more firms collecting data) and depth (with data from more and more firms being aggregated by service providers). Big data can be defined in the agricultural context to mean the analysis of large numbers of data points both from a producer's own operation and from other operations to discover actionable information at the farm level and to identify trends at the regional or industrial level.

Another term vital to the discussion is **agricultural data.** The concept of agricultural data is almost too broad to define, but looking at research in the field and conversations surrounding agricultural data as part of the big data debate indicates the term centers around two more specific concepts: telematics data and agronomic data. **Telematics data** (sometimes called "**machine data**") refers to the information an agricultural implement (such as a planter) or self-propelled vehicle (such as a tractor or combine) collects about itself. Almost by definition, telematics data comes from agricultural equipment owned, operated, or hired under contract by the agricultural producer. **Agronomic data** refers to information about a crop or its environment, such as "as-planted" information from a seed planter, "as-applied" information from a fertilizer sprayer, yield data from a grain combine, and so on. While agronomic data resembles telematics data in that much of it is gleaned directly from agricultural implements, agronomic data can also be obtained from many other sources such as hand-held sensors, aerial platforms such as manned survey flights or flights by unmanned aerial systems (UAS, commonly called "drones"), and even satellite imagery.

Although not as prominent to the discussion as big data and agricultural data, another important term to define is **service provider.** Service provider (sometimes called an "**Agricultural Technology Provider**" or "**ATP**") is the term frequently used to describe a party external to the farm providing some service in regard to either crop production or management of the crop enterprise. Crop production services could include fertilizer or chemical applicators, custom cultivators, or harvest contractors whose equipment generate agricultural data regarding the farm. Management services include traditional services such as crop consulting and scouting, but increasingly include services targeted specifically at data collection and analysis.

2.2 Framing the Legal Issues Surrounding Big Data in Agriculture

The issues involved in the discussion of big data in Agriculture is almost innumerable, but many can be captured under the umbrella of two over-arching concepts: ownership of agricultural data, and protections against the unauthorized disclosure of agricultural data. Although each of these issues is discussed in greater detail later in this testimony, a brief framing of each issue is provided here.

It is important to note this discussion would not occur were it not for the tremendous potential the nascent farm data revolution promises. Existing technologies

[1] Arthur, Lisa. 2013. *What is big data?* FORBES, CMO Network blog entry. Available at *http://www.forbes.com/sites/lisaarthur/2013/08/15/what-is-big-data/*, last accessed November 15, 2014.

such as real-time kinematics (RTK) and auto-steer have already provided substantial economic returns to farmers.[2] Improved sensing of soil conditions, crop health, and yields has led to significantly improved management information for agricultural producers.

To date, much of the gains from improved sensing technologies and their sharing with service providers have come from eliminating inefficiencies in the utilization of agronomic and machinery inputs. Put another way, we have seen significant increases in the use of "data." Perhaps the most dramatic gains lie ahead, though, as agriculture puts the "Big" in big data by compiling datasets of sufficient size to enable much more robust statistical analyses of multiple factors influencing commodity production. Examples of how the aggregation of farm data across large datasets can significantly increase value to farmers are illustrated in *Table 1* below.[3]

Table 1: Comparison of Primary and Secondary Agricultural Data Uses

Data	Primary Use	Secondary Use
Yield monitor data	Documenting yields; on-farm seed trials	Genetic, environmental, management effect (G×E×M) analyses
Soil sample data	Fertilizer decisions	Regional environmental compliance
Scouting	Spray decisions	Regional analytics

Yield monitor data on one farm can help document the farm's productivity on a field-by-field basis and can illustrate how a seed hybrid performed on said farm in 1 year, given the environment of that farm for that year and the management practices employed during that year. Big data aggregation of similar data across hundreds or even thousands of farms allows for the evaluation of that seed hybrid across tens of thousands of permutations of these factors, enabling both seed companies and agricultural producers to learn in 1 or 2 years what would take decades of collections by use of traditional seed trials. Soil sample data coupled with yield data can inform an agricultural producer about the nutrient uptake of the crop on his or her farm, but big data could allow all the agricultural producers in a region to effectively tackle nutrient loading to impaired water bodies through voluntary management of non-point pollution. Crop scouting can help an individual agricultural producer make decisions about the application of a particular pesticide, but big data could allow a crop industry to spot trends in plant pathogens that could be used to head off the spread of potentially devastating plant health threats.

Bringing about the full economic benefits of big data in agriculture require a robust system by which large numbers of agricultural producers can share their data since the predictive power of statistical analysis increases with the number of observations available for each variable examined.[4] The agricultural data industry is working tirelessly to create those systems. Perhaps the issue of greater concern to this hearing is not whether we will have systems that *can* accept and analyze that data; it is perhaps how Congress can facilitate the development of an environment in which farmers *will* share their data. Metcalfe's Law states that the value of a network is proportionate to the number of its members. Put another way, Facebook has little value if you are its only member, but it has tremendous value when populated by millions of members. Thus, agricultural producers can only harness the value of big data if we can foster an environment in which they are comfortable sharing their data. Doing so requires answers to questions of what rights they can retain in their shared data. Do they retain ownership of their information? Is there any hope of retaining their privacy in that information once it is shared?

2.2.1 Ownership of Agricultural Data

As agricultural producers began to realize the information they were generating (and, in some cases, sharing with service providers) had potential economic value, questions began to arise regarding who had the superior "ownership" right to that information, given that multiple parties had a hand in its creation. Thus, this issue might be framed as "*Who owns data generated about an agricultural producer's operation?*"

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[2] *See, e.g.,* Matthew Darr, "Big Data and Big Opportunities," paper presented at Precision Ag Big Data Conference, August 21, 2014 (Ames, Iowa).

[3] Table and scenarios taken from Terry Griffin, "Big Data Considerations for Agricultural Attorneys," paper presented at American Agricultural Law Association Annual Symposium, October 23, 2015 (Charleston, South Carolina).

[4] *See generally* George G. Judge, *et al., Introduction to the Theory and Practice of Econometrics* (2nd ed, 1988), 96.

2.2.2 Privacy Rights for Agricultural Data

As discussed in more detail below, it is possible—and even likely—the greatest economic value of agricultural data to the farm owner comes not from his or her own analysis of the data but from its aggregation with data from hundreds or even thousands of other farms (in a true big data model) to provide management information and trend identification that could not be derived from any smaller dataset. While aggregation may in some ways actually reduce the disclosure or discovery of information about any one farm, it naturally also raises fears about the release of that information (whether the result of intentional activity such as database hacking or an accidental disclosure). This leads to the second question: "*What protections prevent the disclosure of agricultural data to outside parties?*"

3. Current Legal Framework for Ownership of Agricultural Data

The United States has one of the most robust systems of property rights in the world, empowered by a legal system making it easy (relatively speaking) to enforce those rights. Thus, the first place many look for a means of protecting one's data from misappropriation and/or misuse is the property right system. This requires one to examine who "owns" agricultural data. The answer to the question is not simple, though, as traditional notions of property ownership find challenge in their application to pure information.

The notion of property ownership typically involves some form of six interests, including the right to possess (occupy or hold), use (interact with, alter, or manipulate), enjoy (in this context, profit from), exclude others from, transfer, and consume or destroy. Some of these interests do not fit, or at least do not fit well, with data ownership. Excluding others from data, for example, is difficult, particularly when it is possible for many people to "possess" the property without diminishing its value to the others, just as the value of a book to one person may not be diminished by the fact other people own the same book.[5] Thus, the better question may be "*What are the rights and responsibilities of the parties in a data disclosure relationship with respect to that data?*"[6]

Data is difficult to define as a form of property, but it most closely resembles intellectual property. As a result, the intellectual property framework serves as a useful starting point to define what rights a farmer might have to their agricultural data. Intellectual property can be divided into four categories: (1) trademark, (2) patent, (3) copyright, and (4) trade secret. The first three areas compose the realm of Federal intellectual property law as they are defined by the Constitution as areas in which Congress has legislative authority.[7] Since trademark is not relevant to a discussion about data,[8] the analysis will focus on patent, copyright, and trade secret.

3.1 Application of Patent Law to Agricultural Data

The U.S. Patent Act states "whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor" (35 U.S.C. § 101). Generally, for an invention to be patentable, it must be useful (capable of performing its intended purpose), novel (different from existing knowledge in the field), and non-obvious (somewhat difficult to define, but as set forth in the Patent Act, "a patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains").[9] Patent serves as a poor fit for a model of agricultural data ownership since it protects "inventions." Raw data, such as agricultural data, would not satisfy the definition of invention.

It should be noted patentable inventions could be derived from the analysis of agricultural data. While this does not mean the data itself is patentable, it does suggest that any agreement governing the disclosure of agricultural data by the agricultural producer should address who holds the rights to inventions so derived.

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[5] Smith, Lars. 2006. "RFID and other embedded technologies: who owns the data?" *Santa Clara Computer and High Technology Law Journal.*

[6] Peterson, Rodney. 2013. "Can data governance address the conundrum of who owns data?" *Educause* blog, *http://www.educause.edu/blogs/rodney/can-data-governance-address-conundrum-who-owns-data*, last accessed November 15, 2014.

[7] U.S. Constitution, Article I, § 8, clause 8.

[8] The Federal Trademark Act (sometimes called the Lanham Act) defines trademark as "any word, name, symbol, or device, or any combination thereof . . . to identify and distinguish his or her goods, including a unique product, from those manufactured or sold by others and to indicate the source of the goods, even if that source is unknown." 15 U.S.C. § 1127.

[9] 35 U.S.C. §§ 102, 103.

3.2 Application of Copyright Law to Agricultural Data

The Federal Copyright Act states the following:

> Copyright protection subsists, in accordance with this title, in original works of authorship fixed in any tangible medium of expression, now known or later developed, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device. Works of authorship include the following categories:
>
> literary works;
> musical works, including any accompanying words;
> dramatic works, including any accompanying music;
> pantomimes and choreographic works;
> pictorial, graphic, and sculptural works;
> motion pictures and other audiovisual works;
> sound recordings; and
> architectural works.[10]

More so than trademark and patent, the copyright model at least resembles a model applicable to agricultural data. At the same time, however, the model also has numerous problems in addressing agricultural data. First, the list of "works of authorship" provided in the statute strongly suggests a creative component is important to the copyrightable material. Second, the term "original works of authorship" also has been interpreted to require some element of creative input by the author of the copyrighted material. This requirement was highlighted in the case of *Fiest Publications Inc.* v. *Rural Telephone Service Company,*[11] where the U.S. Supreme Court held the Copyright Act does not protect individual facts. In *Fiest,* the question was whether a pure telephone directory (consisting solely of a list of telephone numbers, organized alphabetically by the holder's last name) was copyrightable. Since the directory consisted solely of pure data and was organized in the only practical way to organize such data, the Supreme Court held the work did not satisfy the creative requirements of the Copyright Act.[12] This ruling affirmed the principle that raw facts and data, in and of themselves, are not copyrightable. Put another way, the fact that ABC Plumbing's telephone number is 555–1234 is not copyrightable. However, an author can add creative components to facts and data such as illustrations, commentary, or alternative organization systems and can copyright the creative components even if they cannot copyright the underlying facts and data. Continuing the analogy, ABC's phone number alone is not copyrightable, but a Yellow Pages® ad with ABC Plumbing's number accompanied by a logo and a description of the company's services *would* be copyrightable.

Agricultural data in and of itself may not be copyrightable, but it can lead to copyrightable works. For example, agricultural data may not be copyrightable, but a report summarizing the data and adding recommendations for action might be. Again, then, it is incumbent upon those disclosing agricultural data to include language in their agreements with the receiving party to define the rights to such works derived from the data.

A separate issue regarding copyrights deriving from agricultural data also continues to emerge. Increasingly, the original agricultural data is never even disclosed to the agricultural producer; rather, the data has been processed into a report or a new form through use of a computer algorithm. Quite simply, agricultural producers may often receive a completely computer-generated report with no human author. This requires moving into the realm of copyrights in computer generated works—an area that is far from settled.[13] The evolution of understanding who holds the rights to computer-generated works with regard to agricultural data played out recently in the discussions surrounding comments by Deere & Company on proposed exemptions to the Digital Millennium Copyright Act[14] regarding copyright protection systems in vehicle software.[15]

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[10] 17 U.S.C. § 102(a).
[11] 499 U.S. 340 (1991).
[12] *See id.*
[13] See generally Marshall A. Leaffer, *Understanding Copyright Law, 109–110* (5th ed. 2011).
[14] 17 U.S.C. §§ 512, 1201–1205, 1301–1332; 28 U.S.C. § 4001.
[15] *See* Deere & Company, "Long Comment Regarding a Proposed Exemption Under 17 U.S.C. 1201" (2015). Available at *http://copyright.gov/1201/2015/comments-032715/class%2022/John_Deere_Class22_1201_2014.pdf* (last visited October 25, 2015). *Compare* Kyle Weins, *Wired* (Business Blog Section, online edition) (editorial) "We Can't Let John Deere Destroy the Very Idea of Ownership," April 21, 2015. *http://www.wired.com/2015/04/dmca-ownership-john-deere/* (last visited October 25, 2015).

3.3 Application of Trade Secret Law to Agricultural Data

While trademark, patent, and copyright do not appear to fit as models for farm data ownership, trade secret has the potential to appropriately serve the agriculture industry's concerns regarding rights in data shared with big data service providers. Importantly, trade secret is a function of state law (unlike trademark, patent, and copyright, which are all creatures of Federal law). At the time of this testimony, all but three states have adopted the Uniform Trade Secrets Act, providing a degree of consistency in trade secret law across most states.

Under the Uniform Trade Secrets Act ("UTSA"), a "trade secret" is defined as:

> . . . information, including a formula, pattern, compilation, program, device, method, technique, or process, that:
>
> (i) derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by, other persons who can obtain economic value from its disclosure or use, and
>
> (ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy.

Importantly, this definition makes clear "information . . . pattern[s], [and] compilation[s]" can be protected as trade secret. This, at last, affords hope of a protective model for farm data. This is not to say that trade secret is a perfect model for protecting farm data, however. Note the two additional requirements of trade secret: first, the information has actual or potential economic value from not being known to other parties, and second, it is the subject of reasonable efforts to maintain the secret.

The first provision requires that to be protected as a trade secret, farm data such as planting rates, harvest yields, or outlines of fields and machinery paths must have economic value because such information is not generally known. While a farmer may (or may not) have a privacy interest in this information, the question remains as to whether the economic value of that information derives, at least in part, from being a secret. The counterargument to that point is the economic value of the information comes from the farmer's analysis of that information and the application of that analysis to his or her own operation—a value completely independent of what anyone else does with the information—and that the information for that farm, standing alone, has no economic value to anyone else since that information is useless to anyone not farming that particular farm.[16] One can see this first element poses problems for the trade secret model. It should be noted here there is a clear economic benefit to the collection of farm data; otherwise companies would not be investing billions of dollars to position themselves in the agricultural data industry.[17] This represents a question yet to be answered clearly by the body of trade secret law: whether one can have trade secret protection in information that standing alone has no economic value to other parties, but does have such value when aggregated with similar data from other parties.

The second provision—the data be subject to reasonable efforts to maintain its secrecy—also finds problems in an environment where the data is continuously uploaded to another party without the intervention of the disclosing party. The fact data is disclosed to another party does not mean it cannot be protected as a trade secret; if that were the case, there would be little need for much of trade secret law. Rather, the question is how and to whom the information is disclosed. As noted in the Restatement (Third) of Unfair Competition's comments on the Uniform Trade Secret Act, ". . . the owner is not required to go to extraordinary lengths to maintain secrecy; all that is needed is that he or she takes reasonable steps to ensure that the information does not become generally known."[18] The question becomes what constitutes "reasonable steps" to keep continuously uploaded data protected. Almost certainly this means there must be some form of agreement in place between the disclosing party and the receiving party regarding how the receiving party must

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[16] An agricultural producer could, hypothetically, use such data to bid rented agricultural land away from another tenant if they could somehow demonstrate they could provide the landowner with evidence they could increase the landowner's returns. However, this seems a tenuous argument for the economic value element of the UTSA test and has no application at all in a scenario with owned agricultural land.

[17] *See* Bruce Upbin, *Forbes* (Tech business blog), "Monsanto Buys Climate Corp for $930 Million," October 2, 2013. *http://www.forbes.com/sites/bruceupbin/2013/10/02/monsanto-buys-climate-corp-for-930-million/*.

[18] Smith, *supra* note 4, *citing* Restatement of Unfair Competition (Third) § 757 (1995).

treat the received information, including to whom (if anyone) the receiving party may disclose that information.

While an explicit written "non-disclosure agreement" (or "NDA") is not necessary to claim trade secret protection, such an agreement is almost certainly a good idea if an agricultural producer wishes to retain a protectable ownership interest in their data if such an interest exists. Not only can such an agreement clarify a number of issues unique to the relationship between the disclosing and receiving parties, but also can address numerous novel issues in the current information environment that trade secret law have not yet reached.

While the concept of NDAs as separate agreements may be practicable for one-on-one relationships, such as those between agricultural producers and smaller consulting firms, negotiating separate agreements with multiple entities poses significant transaction costs. This problem is particularly magnified when one considers larger corporate service providers who would face the issue of negotiating tens of thousands of NDAs. Unsurprisingly, such entities choose to create standard agreements in their form contracts. While certainly understandable, this in turn creates the "opt-out problem" wherein a farmer who believes the form contract does not adequately protect his or her interests is forced to either agree to the form or do without the product or service—which may be the only product or service compatible with a significant portion of the very expensive equipment he or she already owns or uses. This then provokes the discussion of whether such contracts are enforceable or are, instead, adhesion contracts. There is yet to be found consistency among Federal courts as to the enforceability of such software use agreements.[19]

To conclude the trade secret analysis, colorable arguments exist both for and against the proposition farm data poses an "ownable" and protectable trade secret. That said, this option provides the best doctrinal fit among the traditional intellectual property forms, and farmers wishing to preserve whatever rights they do indeed have in that data seem best advised to use the trade secret model to inform the their protective measures. Even so, use of trade secret doctrine as a protective measure for agricultural data has drawbacks in the lack of consistency among states in trade secret law (although the UTSA has done much to add consistency to the field) and the fact it is often a "backward looking" and costly solution since trade secret must frequently be used to seek damages (which are often difficult to both prove and quantify) through litigation after a disclosure has already been made.

4. Current Legal Framework for Privacy Rights in Agricultural Data

Those concerned about the disclosure of personal data can certainly cite a number of damaging data breach examples. Recent history suggests many of the real threats in data transfers come from insufficient controls to prevent the disclosure of personally identifiable information ("PII") to outside parties and inadequate agreements on the uses of data by parties to whom it is disclosed.

To the extent producers regard agricultural data as proprietary, their concerns about its disclosure naturally invite a review of the release or theft of proprietary information in other sectors. One need not look far into the past to find numerous examples of the disclosure of PII, whether merely inadvertent or the result of targeted hacks. Attacks on companies' payment systems have resulted in the credit card information of hundreds of millions of customers from Adobe Systems (150 million customers), Heartland Payment Systems (130 million customers), TJX (parent company of TJ Maxx and Marshalls, 94 million customers), TRW Information Systems (credit reporting company, 90 million customers), Sony (70 million customers) each of which dwarf breaches attracting more media attention such as Home Depot (56 million customers) and Target (40 million customers).[20]

Theoretically, a hacker could tap into the tractor/implement network (also called the tractor/implement bus) using a number of commercially-available technologies allow farmers to plug into the network and access Controller Area Network ("CAN") messages directly; for example, one could purchase a CAN message reader to read

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[19] The asymmetry of EULA's has led to allegations they represent "adhesion contracts" and should not be enforceable as a matter of policy. However, some courts have found insufficient evidence of adhesion and held such agreements enforceable. *Compare* cases finding EULAs enforceable: *Ariz. Cartridge Remanufacturers Ass'n* v. *Lexmark Int'l, Inc.,* 421 F.3d 981 (9th Cir., 2005); *ProCD, Inc.* v. *Zeidenberg,* 86 F.3d 1447 (7th Cir. 1996); *Microsoft* v. *Harmony Computers,* 846 F. Supp. 208 (E.D.N.Y. 1994); *Novell* v. *Network Trade Center,* 25 F. Supp. 2d. 1218 (D. Utah, 1997) with cases finding EULAs unenforceable: *Step-Saver Data Systems Inc.* v. *Wyse Technology,* 939 F.2d 91 (3rd Cir. 1991); *Vault Corp.* v. *Quaid Software Ltd.* 847 F.2d 255 (5th Cir. 1988); *Klocek* v. *Gateway, Inc.,* 104 F. Supp. 2d 1332 (D. Kan. 2000).

[20] Julianne Pepitone, "5 of the Biggest-ever Credit Card Hacks," (2013) *CNN Money,* available at *http://money.cnn.com/gallery/technology/security/2013/12/19/biggest-credit-card-hacks/* (last accessed May 21, 2015).

machine diagnostic codes for repairs.[21] Someone wishing to "steal" data would likely not want to be present to retrieve the data from the device, though, and would likely prefer to use a CAN data logger coupled with a device to wirelessly transmit the data. Many data loggers are available to the public as well; for example, the "Snapshot®" device used by Progressive Insurance for some insurance programs is simply a CAN data logger plugged into a vehicle's On-Board Diagnostic (OBD–II) port.[22]

While such an approach would work for standard messages transmitted over the bus, it would not work for proprietary messages. To decode such messages, the prospective hacker would have to develop a system for decoding the information being provided from the task controller for the implement, and that task would take almost as much work (if not more) than the work in developing the task controller system in the first place.[23] Note, that several companies now provide means for reengineering proprietary CAN messages (such as those related to crop yield) so farmers can automatically transfer yield data to the cloud. Such technology could also be used to decode other proprietary information.[24] Perhaps ironically, the growth of proprietary data network protocols that lead to complaints about the lack of interoperability of farm equipment systems could also provide greater protection against data breaches.

Additionally, the Global Positioning System "GPS" receiver in most systems connects directly to the implement's task controller. As a result, a "bug" might receive information about the commands sent to the implement but without the associated location data, rendering it meaningless. The bug would require its own GPS receiver along with implement data (the configuration and dimensions of the implement), which today could be done for a modest equipment cost.[25] Obtaining agronomic data via a physical connection to an implement poses a task manageable for someone knowledgeable in SAE J1939 and ISO 11783[26] technology.[27] However, building and deploying such a device poses a significant amount of effort (to say nothing of the potentially-criminal trespass involved in deploying it) in relation to the prospect of collecting data on only one farm.

As illustrated from this discussion, a number of factors in the configuration and operation of farm data networks limit the opportunities for hackers to take agricultural data directly from the agricultural producer. Admittedly, most producers put little thought into their systems being physically hacked but worry instead about their data being accessed through an intercepted cellular signal. First, virtually all cellular signals are encrypted when transmitted and decrypted at the cellular tower;[28] without the decryption key, interpreting any data transmitted would be difficult (although not impossible for a sophisticated hacker; recent news has highlighted the ability of some groups to do so[29]). The use of data encryption through a secure sockets layer ("SSL") protocol by the farmer and his or her service provider

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[21] Interview with Dr. John Fulton, Ohio State University Department of Food, Agricultural, and Biological Engineering, July 6, 2015.

[22] *See* Progressive Corporation, "Snapshot® Terms and Conditions," *https://www.progressive.com/auto/snapshot-terms-conditions/* (last visited July 6, 2015).

[23] *See* interview with Dr. Marvin Stone (June 10, 2015).

[24] Interview with Dr. John Fulton, Ohio State University Department of Food, Agricultural, and Biological Engineering, July 6, 2015.

[25] A relatively quick search of Google will yield many GPS receiver units for less than $50.

[26] SAE International, "The SAE J1939 Communications Network: An Overview of the J1939 Family of Standards and How they are Used," 5 (white paper), available at *http://www.sae.org/misc/pdfs/J1939.pdf* (last visited October 25, 2015). *See also International Organization for Standardization, ISO Draft International Standard ISO/DIS 11783: Tractors and Machinery for Agriculture and Forestry—Serial Control and Communications Data Network* (2012). The ISO 11783 standard is often referred to as the "ISOBUS standard" and defines how the on-board computer networks on most agricultural equipment works and how their individual components work together. Combined, SAE J1939 and ISO 11783 govern much of how the data-collection network on any agricultural equipment works.

[27] Mikko Miettien, "Implementation of ISO 11783 Compatible Task Controller," XVI CIGR (International Commission of Agricultural and Biosystems Engineering) World Congress, Bonn, Germany (2006), available at *http://users.aalto.fi/~ttoksane/pub/2006_CIGR20062.pdf* (last visited July 11, 2015).

[28] For a primer on the process of encoding and decoding cellular signals, *see How Stuff Works,* "How Cell Phones Work," *http://electronics.howstuffworks.com/cell-phone.htm* (last visited October 8, 2015).

[29] *See* Craig Timberg & Ashkan Soltani, *By Cracking Cellphone Code, NSA Has Ability to Decode Private Conversations,* THE WASHINGTON POST, December 13, 2013. Online edition, available at *http://www.washingtonpost.com/business/technology/by-cracking-cellphone-code-nsa-has-capacity-for-decoding-private-conversations/2013/12/13/e119b598-612f-11e3-bf45-61f69f54fc5f_story.html* (last visited July 1, 2015).

in data transfers adds another difficult-to-break security barrier to interception of the data.[30]

Most agricultural data disclosed to a service provider is likely in the form of telematics data, raw data regarding crop production, GIS information about the farm, and other similar types. Conversely, hackers frequently go after large concentrations of data with easily-converted financial value, such as credit card information. Thus, it may be difficult for hackers to make a "quick buck" from agricultural data making it a less-appealing target of attack. Nevertheless, an adage in computer security is "where there is value, there will be a hacker."[31] As a result, systems storing agricultural data are less likely to be directly attacked, but farmers are understandably concerned that PII may be stolen if, for example, their vendor account information is somehow linked to their agricultural data or if their account information is stored with a third party that is a more appealing target. Depending on the type of computer at issue and its common use, the Federal Computer Fraud and Abuse Act ("CFAA")[32] may provide a means of prosecuting unauthorized access of the computer in the event agricultural data linked to PII is compromised. Discussed below, the Federal Electronic Communications Privacy Act (ECPA)[33] could also be used as a potential prosecutorial tool for those attempting to intercept agricultural data during the data transmission process.

The theft of PII by criminals is one threat posed by data transfers, but so too is the inadvertent, or perhaps intentional but misinformed, disclosure of data by the party receiving that data. Take, for example, "the disclosure of thousands of farmers' and ranchers' names, home addresses, GPS coordinates and personal contact information" by EPA in response to a Freedom of Information Act (FOIA) request regarding concentrated animal feeding operations (CAFOs) which prompted a lawsuit from the American Farm Bureau Federation and National Pork Producers Council alleging the agency overstepped its authority in doing so.[34] While this event represents the disclosure of information by an enforcement agency, many farmers fear the converse—that an enforcement agency could compel a data-receiving party to disclose information even if such disclosure were not legally required. Another concern is whether an adverse party in litigation (or even a party contemplating litigation) could persuade a party holding a farmer's data to disclose the data as an aid to their case, again even if such disclosure was not legally required.

Much work remains to be done on defining governmental safeguards against disclosures, and even more work remains to be done in defining how the government can obtain electronic data. Although laws such as the ECPA (heavily modified by the USA Patriot Act) govern the acquisition of information through intercepted communications, there is little law to prevent a government agency from simply requesting data from a service provider. Anecdotal evidence suggests service providers and their legal counsel continue to struggle in defining parameters for how to respond to non-subpoenaed requests for data by government agencies.

All these issues surround restrictions on the taking of information by some unauthorized (or at least questionable) means. While there are at least some laws potentially applicable in these circumstances, there are no laws defining an inherent privacy right in agricultural data.[35] For example, the Federal Health Insurance Portability and Accountability Act ("HIPAA")[36] provides privacy rights and restrictions against disclosure of health information; the Gramm-Leach Bliley Act (also known as the Financial Modernization Act of 1999)[37] and Fair Credit Reporting Act[38] protect financial information from disclosure; the Privacy Act of 1974[39] restricts disclosures of personal information by held by the Federal Government. As of now, though, there are large categories of agricultural data that may fall between the

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[30] *See* Clemens Heinrich, *Secure Socket Layer (SSL),* in ENCYLOPEDIA OF CRYPTOGRAPHY AND SECURITY 1135 (Henck C.A. van Tilborg, Sushil Jajodia, eds., 2011)

[31] Sam Sammataro, "Cybersecurity for Small or Regional Law Firms," paper presented at American Agricultural Law Association Annual Symposium, Charleston, South Carolina (October 23, 2015).

[32] 18 U.S.C. §§ 1030 *et seq.*

[33] 18 U.S.C. §§ 2510 *et seq.*

[34] Sara Wyant, "Farm Groups File Lawsuit to Stop EPA Release of Farmers' Personal Data." *Agri-Pulse* (2013), available at *http://www.agri-pulse.com/Farm-groups-file-lawsuit-to-stop-EPA-release-of-farmers-personal-data-07082013.asp* (last visited May 21, 2015).

[35] Todd Janzen, "Legal Issues Surrounding Farm Data Ownership, Transfer, and Control," paper presented at American Agricultural Law Association Annual Symposium, Charleston, South Carolina (October 23, 2015).

[36] 42 U.S.C. § 300gg, 29 U.S.C. §§ 1181 *et seq.* and 42 U.S.C. §§ 1320d *et seq.*

[37] 15 U.S.C. § 6803.

[38] 15 U.S.C. §§ 1681 *et seq.*

[39] 5 U.S.C. § 552a.

cracks of these laws with no Federal (and in most cases, no state) protections against its disclosure.

5. Potential Policy Responses To Address Big Data in Agriculture

Having reviewed the current legal environment surrounding the ownership rights and privacy protections relevant to agricultural data, what can this Committee and Congress do to enable U.S. farmers and ranchers to take maximum economic advantage of big data tools? As referenced above, big data cannot be big data without "buy-in" to the system from large numbers of agricultural producers, and, at a fundamental level, that buy-in requires trust in the system from those producers. That trust, in turn, likely requires answers to the questions of ownership and privacy in agricultural data.

None of the Federal intellectual property laws directly address who holds a protectable intellectual property right in agricultural data. Arguably, the most appropriate fit may be found in state law under the UTSA, although the applicability of that law is questionable as well. The UTSA may provide a useful map to any Congressional efforts to help define ownership rights in agricultural data. Passage of statutory law defining ownership of "agricultural data" may be a daunting task given the complexity of the current Federal and state intellectual property framework (which also draws from centuries of common law). Thus, it may be advisable instead to use a consensus-driven approach among agricultural producers and service providers to define agricultural data rights. The coalition led by the American Farm Bureau Federation and its "Privacy and Security Principles for Farm Data"[40] represents a tremendous step forward on this issue. Other groups, such as the Open Ag Data Alliance, continue to build coalitions on the technical side of the big data issue to develop systems and standards embodying the principles of interoperability, security and privacy.[41] The next step is to see continued cooperation among groups such as these in integrating their principles in legally-binding service agreements.

Modern agricultural producers are expected to be proficient in a broad array of the disciplines of science and business, but few have a background in intellectual property law. Support of educational programs to help these producers understand the legal issues at play in big data service agreements could do much to help increase trust, advance the consensus process, and empower producers to make informed decisions about the cost-benefit analysis of sharing their data under those service agreements. The consensus process may also provide a vehicle for developing an understanding among all stakeholders as to the privacy protections necessary and appropriate to protect agricultural data, which occupies a unique space between purely personal and business information. Such information does not readily fit into the existing framework of Federal privacy laws, and as business information, may not belong in such a framework.

One matter in which Congressional action may be directly applied is the development of clearer guidelines regarding the production of agricultural data held by private data aggregators, more robust safeguards against inadvertent disclosure or intentional hacking by outside parties, and clear guidance on when disclosure of government-held data is, and is not, required under the Freedom of Information Act[42] or other circumstances.

Finally, although outside the direct scope of a discussion of legal issues in agricultural use of big data tools, rural access to wireless broadband services is crucial to fully utilizing the potential of agricultural data systems. Congress should be encouraged to continue its efforts to expand access to this vital utility.

Concluding Remarks

The application of big data to agricultural production holds the potential to improve the profitability of U.S. agriculture and to better prepare its farmers and ranchers to handle the inherent risks of the industry. Additionally, big data could play a vital role in the further development of tools and techniques necessary to feed an ever-growing, hungry world. I commend this Committee for its foresight in addressing these issues, and sincerely thank the Committee, Chairman Conaway, and Ranking Member Peterson for the opportunity to address you today.

Mr. NEUGEBAUER. Thank you. I would remind other Members that they will be recognized for questioning in order of seniority for

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[40] American Farm Bureau Federation, "Privacy and Security Principles for Farm Data," November 13, 2014 (revised May 5, 2015). Available at *http://www.fb.org/tmp/uploads/PrivacyAndSecurityPrinciplesForFarmData.pdf* (last visited October 25, 2015).

[41] Open Ag Data Alliance, "Principals and Use Cases," *http://openag.io/about-us/principals-use-cases/* (last visited October 25, 2015).

[42] 5 U.S.C. § 552.

Members who were here at the start of the hearing. After that, Members will be recognized in order of arrival. I appreciate Members' understanding.

And with that, the chair would recognize himself for 5 minutes.

Mr. Tiller, one of the big concerns in west Texas and in other parts of the country is, obviously, water. And one of the things that is exciting about data that we are gathering is: how we can more efficiently utilize that in the future, and make sure that we are using that resource in an appropriate way, both environmentally but also financially because when you are running those wells, it is costing money. But could you kind of just briefly describe some of the technology out there and how producers could utilize that?

Mr. TILLER. Yes, there is actually a lot of technology today that—and I have seen more in the last couple of years around—especially when we are talking center pivot irrigation, drip irrigation, that actually monitor, operate those pivots in ways where should you irrigate, should you not. I have often said that when we get to binary decisions, when you have a yes/no, should the pivot be on or not. And that is going to come about because of algorithms that come out of various companies. I think many times we need to look harder at the bottom line. It is very hard when you have limited water like west Texas. There may only be 300 gallons a minute that you can pump and you are trying to irrigate this field. It is not a lot of water. But there are ways to look at the bottom line using data really to decide in this pivot, in this area of land, can we maximize profitability, not yield, can we maximize profitability. And that is only answered with the right numbers.

I am very encouraged as I talk to growers, they understand we are in hard times and the best way we can handle these issues is to understand these underlying costs. And so with that said, that is going to be data-driven.

There are a lot of devices, quickly, that have to do with measuring soil moisture. There are devices that measure temperature in the canopy. All these things can be used to help these guys with irrigation.

Mr. NEUGEBAUER. And so, obviously, the more data that we can gather from a broader spectrum, the more important that information is and more useful it is. What are some of the impediments that you all are finding to getting producers to embrace this technology, and more importantly, wanting to share their data?

Mr. TILLER. In our part of the world, because there is such limited water and it is not in great capacities, many growers don't employ that exact technology that I am talking about because they think that I only have so much water, gee, I couldn't manage it anyway. When am I going to cut it off? But I am starting to see some that are, telling neighbors. It is sort of word-of-mouth. Someone realizes that someone is getting a heads-up by actually employing some of those. I have been in Nebraska, great grower there that employs a ton of technology, but he has a lot more water to work with.

But with that said, with better weather data analytics, deciding when it might rain and actually understanding weather patterns better, integrating those things back into the system, I think that is going to be a game-changer in trying to save water. But again,

I think it is profitability down at that land layer when we are going to decide how do we plant this and save our water resource, and be profitable at the same time.

Mr. NEUGEBAUER. Yes. And I think one of the things that we were—I think maybe Mr. Rushing or—I can't remember which—who was talking about that there are kind of two sets of data out there; there is the financial data and then there is the operational data. And, obviously, being able to integrate both of those pieces of information is important to using it to be, as you mentioned, more profitable.

And so in the future as you are collecting the operational data, that subset is used for certain kind of purchases in the financial, so when we start granting access, how are we going to position that where the producer can look at his data and he can look at other people's data but not attribute it to one individual in making that proprietary—who wants to—Dr. Stern?

Dr. STERN. Yes. You have characterized it well, that there are different—and it is probably more than just two sets of data. Ultimately, we believe this has to be a decision that is made by the grower around what data needs to be shared, and then it is the responsibility of us in the industry, or others associated with receiving that data, to make sure that the data that they are getting is used for the purposes under which they have agreed for us to use it. The question then is can you get more value by aggregating a lot of that data, and when you talk to growers, they are very, very open to the concept of aggregating and anonymizing data——

Mr. NEUGEBAUER. Yes.

Dr. STERN.—because they recognize that that can bring benefits back to their farm. Generally, when I talk to growers they say, hey, look, I don't want you to sell it to anybody, I don't want marketers calling me at dinnertime, those types of things, but if you can do things by aggregating data that is going to help me be more productive. I am really willing to do that. So the framework in that understanding at the grower level is there.

Mr. NEUGEBAUER. I thank the gentleman.

I now recognize the Ranking Member, Mr. Peterson, for——

Mr. PETERSON. I thank——

Mr. NEUGEBAUER.—5 minutes.

Mr. PETERSON. I thank the gentleman.

I don't even know where to start. As somebody that has tried to get USDA to be able to talk to each other, even within the Department, and this is frustrating, I am concerned about how we are going to come up with a format that is available to everybody that is standard. It looks like everybody is kind of going off in different directions, which is a problem. And I don't know, are they moving—are you guys moving all this data to the cloud, because that is where this is going to end up? Is that going on, instead of trying to put it on individual servers and whatever?

Dr. STERN. Yes, I—absolutely, that—I mean when you think about where data is going, ultimately it is going to be going to the cloud. And with respect to The Climate Corporation, it is going to The Climate Corporation cloud. And there needs to be a mechanism by which, across the industry there is easy movement of data. It gets back to the concept that a grower owns their data, and they

should be able to transfer it from one cloud to the other. If they are working with us 1 year, if they are working with AGCO, whatever it is, and so there needs to be standards. We have proposed something called the Open Ag Data Alliance that begins to set standards, very similar to the broader software industry, around how data can move freely from, if you will, one cloud to the other.

Mr. PETERSON. So you are beginning that?

Dr. STERN. We are beginning that.

Mr. PETERSON. So how far along is it?

Dr. STERN. I would still say it is in early days. I think we have a bunch of companies working with that. It is being actually run out of Purdue University. But it is early days in the system, but for this to be really efficient and to be able to allow growers to do what they need to do——

Mr. PETERSON. Are you going to be able to incorporate the information that some of these companies are now developing with drones, which is probably the most exciting thing that has happened here, is that going to be able to be integrated into this?

Dr. STERN. Absolutely. I think the concept of being able to use drones in agriculture is something that we need to think seriously about. How do we allow growers to be able to access that technology safely and appropriately, but it will be a game-changer rather than a——

Mr. PETERSON. That is a whole other question, how we keep these yahoos from screwing up this thing, that are flying these things around causing——

Dr. STERN. Exactly. Yes.

Mr. PETERSON.—trouble. But the other thing I am concerned about, there is a lot of information out there that is going to get wound into this regarding the environmental issues and we have just got this terrible fight going on. In my opinion, we are making huge progress in agriculture in terms of developing technology and so forth, but, frankly, in the environmental area, these people are trying to go back 200 years. And that is what they are pushing is no technology that it has got to be natural, we have a fight going on in Minnesota over buffer zone strips to clean the water quality, when the best thing we could do is till the land, and they are fighting us on that. So how do we get these environmental people to start using technology to help the environment instead of fighting us, instead of saying that the only way this is going to be good is if we go back to Buffalo Commons and have everything in grass and buffalo running around?

Mr. FERRELL. Well, and one means of addressing that, and one of the most exciting promises of big data is the fact that it allows for regional compliance amongst producers when it comes to environmental issues to really be a true possibility. For example, if we had the kind of sensing technologies that we have talked about today at the farm level, and can integrate information at a more regional level through some of the big data aggregation technologies that Dr. Stern was mentioning, we could really have meaningful impact on non-point source pollution issues, which is something that we have struggled with for a long time. And we have been making strides with incentive-based approaches, and the incentive-based approach is a good way to do that, but we have a

way of giving the incentive-based approach real teeth if we can have a level of regional coordination that allows farmers to do much better farm level nutrient management that in turn provides regional results. And that is one of the really exciting promises that this has for environmental compliance in agriculture.

Mr. PETERSON. Do you think these ideologues that have their mind made up about everything are going to pay attention to the actual data and not just go off on their tangents?

Mr. FERRELL. Hope springs eternal, sir.

Mr. PETERSON. Mr. Hurst?

Mr. HURST. Yes, one of the points I guess I would like to make, and maybe for people—we are assuming a level of knowledge here that may not be—everybody may not have. The first thing you need to understand about this is it cuts our use of inputs in a very, very real sense.

Mr. PETERSON. I know.

Mr. HURST. We have a yield record from a certain place in the field for 5 or 10 years, we find out that that place is less productive than the average place in the field, and now I have the ability to shut any input that I am applying to that place in the field, I use less because it will be ineffective there. So it is a huge environmental——

Mr. PETERSON. Well, I understand that. The problem is we have a lot of folks in the environmental community that do not want to recognize this.

Mr. HURST. Sure.

Mr. PETERSON. That is the problem. I don't know what we do to bring those people into the 21st century, but that is a whole other fight.

I yield back.

Mr. NEUGEBAUER. I thank the gentleman.

Now the gentleman from Oklahoma, Mr. Lucas, is recognized for 5 minutes.

Mr. LUCAS. Thank you, Mr. Chairman.

And, Mr. Ferrell, just for the sake of our colleagues here, you and I are a little bit different in age, but raised at two different ends of the same highway in western Oklahoma. Could you expand for a moment on your earlier comments? You are in a position where you teach, where you interact with the constituents back in Oklahoma at Oklahoma State. What kind of questions are you getting from the folks back home about these very issues, and how are you responding to those questions?

Mr. FERRELL. Well, the questions that we are seeing in western Oklahoma are largely indicative of the questions that I have heard from the other witnesses here today. I think farmers are excited about the opportunities that big data analytics can provide them, and that is tempered a little bit by their trepidation in that they don't really understand the mechanics of how that works. And we are kind of inherently private. Farmers and ranchers are very kind, generous, hardworking people, but sometimes they don't want everyone else knowing their business, and there is just a lack of understanding about what someone else is able to discern about my business when I participate in one of the systems that we are talking about today. And realistically, there shouldn't be a lot of con-

cern because when we are talking about the aggregation technologies at use, we see that the aggregation actually protects anonymity of the individual producer. So their concerns are very understandable and well-founded, but for the most part, we can address those through education. I think the more that farmers and ranchers understand the mechanics of how data is shared and analyzed, they would see that a lot of those concerns don't have to be concerns for them. And I think that is really important because we have kind of a chicken and the egg issue wrapped in a trust issue in that, for big data to really work, it has to be *big.* We have to have large numbers of producers that are willing to share their data in these large robust datasets for us to really get that advantage. And the irony in that is that you can see more insights about your own farm, as Mr. Hurst was saying, by looking at lots of other farms as well. I think education is going to be a big piece of that.

I have devoted a lot of my work to educating the farmers and ranchers on the legal side of things; what really are your legal rights with respect to your data, how do you protect those. As I mentioned earlier, the public dialogue that we have had has been excellent. And the next step is for us to continue that dialogue, and move from the principles that we have had established through the Farm Bureau dialogue and start maintaining the dialogue with our service providers to see those principles are actually integrated into the agreements, those legally binding service agreements that farmers and ranchers are signing on to, and that we also educate farmers and ranchers about how to read those things. Not everybody reads their iTunes use agreement when they want to download that next song, but you are agreeing to everything that says, and you have to take some time to actually read the fine print on that, and hopefully will help them do that reading.

Mr. LUCAS. You mentioned in your opening testimony the potential need for statute changes, whether Federal or at whatever level, to help facilitate this. You wear a hat both as an ag economic Professor, and as an attorney, how focused should we be and how aggressive should we be thinking about those kind of statutory issues, or is that still just a little bit away until some other things clarify themselves?

Mr. FERRELL. Well, I think that, again, I have been tremendously encouraged by the efforts that the stakeholders in the industry have undertaken to really advance that dialogue, and very quickly too, in that space. I think perhaps the low-hanging fruit for Congress is to address some of the data concerns that farmers have with respect to data held by Federal agencies. The EPA lawsuit of a couple of years ago where we saw a lot of information from our livestock operations put out there, the disclosure of lots of the farm subsidy information by the Environmental Working Group has led to farmers having a little bit of trepidation about that information. And so one of the ways to enhance the trust level, at least on the Federal side, is to perhaps more clearly delineate what information is and is not subject to FOIA requests that farmers are transmitting to agencies like FSA and NRCS, *et cetera,* and to really make clear what information that the Federal Government can and cannot request for production from those public service providers as well.

Mr. LUCAS. Thank you, Mr. Ferrell.

I yield back the balance of my time, Mr. Chairman.

Mr. NEUGEBAUER. The gentlewoman from Washington, Ms. DelBene, for 5 minutes.

Ms. DELBENE. Thank you, Mr. Chairman. And thanks to all of you for being here today. We really appreciate it.

My district is a good example. My district is home to a lot of big technology companies, as well as a lot of agriculture, a lot of specialty crop agriculture, and we are already seeing some of the merger there. I think one thing that is incredibly important for folks to understand is technology isn't kind of its own separate area anymore. It is kind of basic infrastructure, and we need to think of it as basic infrastructure and the types of businesses that are running, but also understand how best to use that. And as someone who worked in technology for many years, the talk about developing standards is something that we have gone through many times before, and hopefully can inform some of the work that all of you are doing to make sure we are doing the right things in this area in particular.

I think this hearing also shows that privacy is definitely not an issue of any one particular industry; it is an issue that we have, and it is not just a technology issue, it is everyone's issue. Just like bulk collection of information from an ordinary citizen by a Federal agency has been a great concern, and something we focused on in the other committee I am on, the Judiciary Committee, so would the collection of precision agriculture data and the release of that data.

Mr. Ferrell, you talk about a few things in your written testimony as well. We know that for digital information, we don't always have the same standard of protection of digital information that we do of physical information, which is why we have seen some folks more concerned about information going to the cloud or being used digitally. One example you bring up is the Electronic Communications Privacy Act. That was a law that was written in 1986. A lot has changed since 1986, especially about the way we communicate electronically, yet we still have not updated that law. And so can you tell me a little bit how updates to laws like the Electronic Communications Privacy Act and others would have an impact and potentially help folks feel more comfortable with big data and technology in agriculture?

Mr. FERRELL. Certainly, and you make a very good point. First, things have changed a little bit in information communication since 1986. And second, people have privacy concerns almost omnidirectionally. I kind of wonder how Facebook knows what I just searched on Amazon. I thought that seems kind of weird. And so this is a concern with respect to agricultural data that is unique to agriculture, but it is indicative of concerns that cut across almost all industry sectors and private individuals as well.

And so one of the struggles that we face, going forward, if we want to enhance some of the statutory protections on privacy is defining what is *agricultural data,* because we could argue that it is unique in that it contains information that is generated by a producer, and their activities, their management decisions on the farm, and that is provided to a service provider in the expectation

that they are going to receive a direct benefit from that. You can make an analogy to your Amazon purchasing history in that, well, I went to Amazon, I wanted to get these products, and so those products provide a benefit to me, but then Amazon has that information, uses it to make suggested sales, in some way may share that information with other organizations, and then I kind of start to feel a little bit differently about that.

So agricultural data has some similarities with that, but also has some uniqueness, and the particular problem that we face is, do we want to do that on an industry-by-industry basis, or is the better approach to step back a little bit and say, well, what protections do we want to have in place for what we might basically call consumer-generated data. That is your Amazon purchasing history, that may include your farm's data, but we could also argue that includes your financial reporting data and your credit score, things of that sort.

So we really need to have a dialogue about what are the rights of the individual with respect to data generated by their activity, but perhaps collected by a third party, whether that is directly or indirectly——

Ms. DELBENE. Now——

Mr. FERRELL.—and so I think——

Ms. DELBENE.—a warrant standard probably for digital data, like we have for physical data, might also kind of be another place we can start.

Mr. FERRELL. I would definitely agree with that.

Ms. DELBENE. Dr. Stern, you talked about some of the standards that were being developed, and when we talk about security in particular, and also a lot of these standards, they are moving targets, right, where you are getting new technologies, what you might think is the most secure infrastructure you could put in place today, may change tomorrow. How are you adapting those, knowing that this is a dynamic environment and things are going to be continually changing?

Dr. STERN. Sure. At The Climate Cooperation, we have a dedicated team of cybersecurity specialists, and so we are constantly looking at industry best practices and new technology. You are exactly right, I mean this is a very, very rapidly moving area as we talk about digital ag and, of course, the threats associated that could come in around us with respect to data security are evolving rapidly. So I feel like this is going to be just an area that the entire industry needs to be vigilant about, and continue to work on.

I think there is space for us to collaborate industry-wide, competitors or not, to figure out how do we go ahead and safeguard data. And while the OADA Project, which is about how does data get transmitted, which is more about of an API type of approach, I do think there is work to do on how do we really work across the industry on data security because it evolves daily.

Ms. DELBENE. Yes.

Thank you. My time has expired. I yield back, Mr. Chairman.

Mr. NEUGEBAUER. I thank the gentlewoman.

Now the gentleman from Iowa, Mr. King, is recognized for 5 minutes.

Mr. KING. Thank you, Mr. Chairman. And I thank the witnesses.

And I turn first to Dr. Stern, I am over here, Dr. Stern. The Climate Corporation of San Francisco is on that list. Is that part of a Google initiative that has come together with Monsanto that is part of this package of The Climate Corporation?

Dr. STERN. No. The Climate Corporation is—if I understand the question, is a wholly owned subsidiary of Monsanto.

Mr. KING. Yes.

Dr. STERN. And maybe I misunderstood——

Mr. KING. Well, was it generated within Monsanto, or was it——

Dr. STERN. Okay. No, it was a private company that we purchased 2 years ago just about now, and it was started 6 years earlier, and predominantly was developing this technology for the crop insurance business. And we both felt, from The Climate Corporation and Monsanto, saw how you could use big data and analytics to actually influence a lot more operations on the farm than just insurance.

Mr. KING. Could you tell us just a little bit about the genesis of Climate Corporation forming, who the brains are behind that?

Dr. STERN. Yes, sure. So the founders were executives at Google 10 years ago or so and left. David Friedberg, who is the CEO of the company, started a company called WeatherBill, which was really focused on, hey, there is a bunch of industries out there that weather impacts their success; golf courses, ski resorts, bike rentals, that type of thing. And so that was the genesis of the business. It evolved into a core competency of weather prediction, weather forecasting, weather data. And today, we still get three million weather feeds a day which feeds into the agronomic model. So that was the origin. And——

Mr. KING. I appreciate that. That puts that together and links up with the memory that I have of that.

And now I want to just try, if I can summarize what you can do with Climate Corporation and the association with Monsanto. And I am just thinking in terms of, I come from the heart of the Corn Belt, so——

Dr. STERN. Right.

Mr. KING.—so I think in terms of this. Monitoring rainfall in a grid across the field, and monitoring the humidity and the sunshine, the growing days that we have, the growing units that we have, and then being able to send maybe a text or an e-mail to the producer that says you have a window here that your nitrogen has either leached down or been uptake into the plant, and you have a window here of 18 hours before you are going to get 1½″ rain, you had 20 pounds in. Is that some of what you do?

Dr. STERN. You nailed it. That is exactly what we do. And there is tremendous use cases right now, and they will just give them the Nitrogen Advisor in the fall application. We just had a large grower in central Illinois that just did that. They looked at the Nitrogen Advisor, they recognized through the modeling, that if they—and what the weather is, if they applied last week, they were going to lose about 20 pounds because a rainstorm was coming in. They delayed that application for a week and they felt they saved a lot of money and put the right amount of nitrogen down that was going to ultimately not leach. So I think that is exactly right how you——

Mr. KING. This science squeezes more production and gives you an opportunity to ration inputs to match up with the weather patterns that you have seen and the ones that you see coming.

Dr. STERN. Yes. That is exactly—it——

Mr. KING. And can you monitor also then for either insect or plant disease?

Dr. STERN. Yes, we have a program right now developing what we call—looking at disease and stress and pests, and a lot of that will come from satellite imagery. It could come from drone information over the field. It also utilizes our understanding of the germplasm, what is planted there, different—just like humans have different susceptibility to different diseases, well, different types—different germplasms of corn have different susceptibilities. And so the power of big data and data analytics is you can bring all that information together; weather, soil, humidity, what is being planted in the field, and begin to make predictions about what the outcomes could be and allow growers to make better decisions. And so pests and disease are—a lot of diseases are windborne. So just understanding wind and wind direction, you could be able to go ahead and help growers, if you will, downwind in understanding that disease pathogens could be coming their way.

Mr. KING. Then I would like to turn to Mr. Tiller, and I thought yours was an excellent testimony, and please tell Monte that, but I was fascinated because it is the narrative that you have is that you are out there as a producer, fourth generation farmer, you saw the need to integrate this information. When I first saw that need in our construction company, I went in and tried to find somebody in business that could integrate that information. They told me what you need is a wife. Well, I had one, but she wasn't on that task. So——

Mr. TILLER. Well, you are scaring me. I don't know where this is going, so——

Mr. KING. Well, I think that you have really brought a big picture here together, and it sounds to me like it is all the data that you could possibly ask for, and want and need, brought together, integrated from sources that are formed elsewhere, but synced together through macros and relational databases that you can use in a fashion that is friendly—user-friendly. In the seconds that I have, I would just like to ask, how much of what Dr. Stern has proposed is already integrated into your operation?

Mr. TILLER. Actually, what he is proposing, this is cutting-edge stuff. I mean Climate Corp, there are some others that are all developing algorithms and processes to do this. We call that the best of tools. Climate Corp may win that best of tools. That doesn't affect us because we have a database of information that we hope someday Climate Corp rides against. And what I mean, ride against that data. And we may want to store it, and we will have to work through those things. And I think as we grow in numbers of growers who want to do it this way, we will have companies want to engage us in that pattern. But there are—Climate Corp and others that are literally—it is cutting-edge stuff I am watching, you mentioned drones, and if those get cleared by FAA, you are going to see literally a lot more go on of plant health monitoring

where you don't have to worry about cloud cover and those sorts of things. So does that answer your question?

Mr. KING. It does, and I appreciate all of your testimony.

And I yield back.

The CHAIRMAN [presiding.] The gentleman's time has expired, actually.

Ms. Kuster, 5 minutes.

Ms. KUSTER. Thank you. Thank you for being with us.

I am from New Hampshire, it is a much smaller state, with much smaller farms. We have 4,400 total farms, 47,000 acres. So that is probably describing one farm of my colleagues here. And we have a strong agriculture economy, and I am very excited to report that we are actually growing, a five percent increase, in new farms. A lot of young people coming, starting new farms.

So I would just love if any of you could comment on whether there is any application to a smaller farm model or a collection of farms in a smaller farm economic, and how that might help. We have a lot of specialty crops, a lot of value-added products; maple syrup and such, and just if there is anything you could comment.

Dr. STERN. So just in general, the neat thing about this technology, it is scalable. It is precision ag, and so it gets down to not just a single field, but even subfield level. So whether you are farming 10 acres or whether you are farming 10,000 acres, the value proposition and what these tools can be used for on the farm is the same.

First of all, it spans the farm size issue which is great. With respect to specialty crops, early on, right now, we are looking at some specialty crop applications. It is the magnitude of the data that you need around those crops——

Ms. KUSTER. Yes.

Dr. STERN.—in order to go ahead and begin to understand how you can build algorithms, but, at least for us right now, our focus, as you can imagine, is on the large row crops, but we certainly believe these tools are applicable. And in California, there are other companies that are actually looking at some of the high value specialty crops that are grown in the Central Valley, so I am very optimistic that these technologies will find their way into both specialty crops and small-holder farmers in the U.S. as well as to broad acre crops.

Mr. TILLER. Could I add a little bit to that also?

Ms. KUSTER. Sure, yes.

Mr. TILLER. We have taken the view at Grower Information Services Cooperative that all those farmers are important. We have had some very small farmers come to us and want to be part of that, and we encourage them to do so. And the point would be that I would say, around financial information, I don't care what size your farm is you need a profit and loss statement. And so every organization needs that. It doesn't matter if you are a million acres or you are 200, you have to do those things.

So how many factors do you have? Maybe you only have one field. That is still the same. You are taking it down to the field level, you are trying to decide is it profitable, what can we do with it, using data analytics to do that. And so it works. It is scalable.

So I just want to make that point that we encourage small growers to join us.

Mr. HURST. And one of the exciting things about this is the technologies tend to go down in price, right?

Mr. TILLER. Yes.

Mr. HURST. So that is the only thing that—I mean my combine doesn't go down in price when I trade it off, or anything else that I buy, but my iPhone does, right? So we have a chance that the technology here will decrease in price, rather than increase.

Ms. KUSTER. And then just adding to that. I have a lot of dairy farmers, I am just wondering if you have had any experience in livestock or dairy?

Mr. RUSHING. I think from an AGCO point of view, we also have a business called GSI. Part of that business is also producing protein systems——

Ms. KUSTER. Yes.

Mr. RUSHING.—that support feeding poultry and pork producers. And we are seeing a lot of value come out of those operations as far as data is concerned as well. Imagine, you can watch the operation throughout the year, understand what the best conditions are for producing the best chickens or the best pigs, and then recreate those conditions based on that information. And now if you can aggregate that information with other pork and poultry producers you can start to recreate that on every farm. So the value of data goes from row crops to high value crops, all the way down to livestock growers, and even in the dairies we are seeing the same thing on the dairy side by, again, just recreating those same conditions where you got the best results.

Ms. KUSTER. Well, as you were talking, it reminds me that historically, we didn't call it data, we called it experience, and it was passed down from generation to generation, and we have a lot of young farmers so this is a new way for them to come into it, but just the reference to having a wife reminds me of a very quick story about, I was in a dairy barn and we were talking about the—they are actually birthing calves all year long, and I said, well, how do you know in this small operation if there is a problem with a birthing, and do you have somebody who stays up 24/7, how do you manage that? And the farm spouse looked up and she said, well, you see that window right there, and I said, yes, and she goes, that is our bedroom, closest to the barn. She said, he can sleep through a normal birth that is not difficult, but as soon as he hears her having a hard time, he is up and out in the barn. So I thought, with all the technology in the world, you can't beat a system like that.

But thank you.

The CHAIRMAN. The gentlelady yields back.

Mr. Gibbs, 5 minutes.

Mr. GIBBS. Thank you, Mr. Chairman. Thank you for holding this hearing. Thank you for the witnesses.

I just want to first of all reiterate what the Ranking Member was saying about the environmentalists and that issue, and it just needs to be said again that technology has improved production and also it protects the environment, because we can pinpoint our inputs and, for people who might not know, you can be riding in

a combine at 5 miles an hour shelling corn, and get real-time data on moisture, yield, and I mean it is just incredible.

And so that leads to the next part, when Mr. Ferrell mentioned about the EPA let those records go of the livestock farmers and some other cases, it is paramount that we protect this data for several reasons. Obviously, it is a privacy issue, but I also think when you get this big data amassed enough, and before the trends of what is happening in the market conditions and the markets is made public, if they are in the wrong person's hands, you are opened up for market manipulation and all kinds of problems. So I think that the industry has to work with our elected officials and get this right because technology is moving fast and we have to get that right.

I am trying to, I guess, understand the technology we put up in the cloud, and Dr. Stern, for the farmers to be able to use this, because you get all this data and, it doesn't do us a whole lot of good. I am a farmer so I can say it doesn't do us a whole lot of good because you can't use it unless you can really analyze it, and that is what they have to go to your respective entities to do that. And so you are very supportive, all of you there, to have protections in place. I, as a farmer, can say here is our contract, you can't upload that, at least maybe in the aggregate maybe you can but not in the individual cases, and you are all agreeable on that, right?

Go ahead, Dr. Stern, if you have a comment.

Dr. STERN. Yes, to be clear, the way it kind of works right now in the system is that we have a contract, an agreement, with an individual grower who owns the data. They agree to share that data, and in the agreement it is very clear on what we will use the data for. And the Farm Bureau standards also help an awful lot on making sure growers can have a lens from which to go ahead and look at those agreements.

Once that data is uploaded into the cloud, okay, the concept to aggregate it allows us to go ahead and look at it as a whole. The individual data itself helps us look specifically back at their farm, and it is typically an input into a broader model that we have developed that allows that specific information to help go back and give specific——

Mr. GIBBS. I think it is also clear to me that we need to pass legislation so even the government can't come in and do it.

Dr. STERN. Yes.

Mr. GIBBS. Are we agreeable?

Dr. STERN. I would agree that——

Mr. GIBBS. Yes.

Dr. STERN.—we——

Mr. GIBBS. Mr. Ferrell?

Mr. FERRELL. Well, I just want to address one point that you made, Congressman, and it is a good point: one of the concerns that producers have had is the potential for market manipulation because if you want to know what the corn market is going to do, it sure would be nice if you had the means of instantaneously knowing what the corn harvest exactly looked like.

Mr. GIBBS. Yes, it is like insider information.

Mr. FERRELL. And I am glad that you used that term because I have actually kind of researched that issue a little bit, and it is not,

by definition, *insider information,* it is just really good market intelligence. And so the current legal framework that they have really wouldn't prohibit anyone from doing that. So that may be one thing that we need to address is if we are going to entrust someone with the capability of being a data aggregator, do they, should they have the ability to use that information in the commodities marketplace. That is just another policy——

Mr. GIBBS. And, Mr. Hurst——

Mr. FERRELL.—issue that has been raised.

Mr. GIBBS.—I know you——

Mr. HURST. Yes. I guess we all agree that the farmer owns the data. It becomes a little more complicated than that. Does the landlord own the data? Does the crop rent tenant own the data? Does the cash rent landlord own the data? Does the applicator that is driving a machine through my field that I have hired, is that my data or his data, is he transmitting it, is it leaving my farm? I don't know. Lots of stuff still to be worked out.

Mr. GIBBS. Of course, my opinion is if the farmer is paying cash rent, it is the farmer's data. I would lean that way, unless someone else——

Dr. STERN. That is exactly how we look at it as well, that it is between—agreements between us and the farmer, and it is up to the farmer within their land lease agreement to determine with the landowner their own arrangement around the data.

Mr. GIBBS. Yes. Yes. And, Mr. Hurst, I am sure you are enjoying your presidency of the Missouri Farm Bureau. In my past life, I was President of the Ohio Farm Bureau, and I knew one of your predecessors, and lived in the boot heel of Missouri.

Mr. HURST. President Cruz.

Mr. GIBBS. That is right. Thanks.

Thanks. I yield back.

The CHAIRMAN. The gentleman yields back.

Mr. Aguilar, 5 minutes.

Mr. AGUILAR. Thank you, Mr. Chairman. Thank you to the panel for joining.

I represent an area in southern California. And I was picking up, and, Mr. Hurst, you mentioned it in your testimony, and we have just kind of elaborated on that as well, but the discussion of your term was a data-driven partner, and just kind of understanding what that could mean. In my district, is the corporate headquarters for ESRI, which is a geographic information systems company that is quite large, and their relationship—and they often partner with USDA. And you mentioned this discussion of a data-driven partner, and I want to just expand on what that could look like, and could there be a role, while I am completely in favor of making sure that this does remain the rights of the farmers, is there a role for that data-driven partner to play a role in connecting the USDA program or aggregating the data that can be helpful, because as Mr. Ferrell mentioned, this depends on having that large number of inputs that would be necessary, and is that a role that these technology companies can play?

Mr. HURST. Yes. As far as the USDA, it would be very handy. When I make my report, my crops each spring, a report is generated at the FSA. I literally walk that or drive it, my crop insur-

ance agent is quite some distance away, and he enters those figures by hand. So I have traveled to the office, the FSA office 20 miles from home, made that—given him—them that information, they don't have the ability to talk to my crop insurance agent, and all of this information resides on my thumb drive that I have for my planner, which tells me exactly how many acres of all these crops I planted, and nobody can talk to each other. All that information is already accessible to the FSA, to my crop insurance agent, but I have no way to transfer it in an efficient manner, and that would be extraordinarily helpful.

Mr. AGUILAR. Dr. Stern?

Dr. STERN. Yes, I would completely agree with Mr. Hurst. This technology will drive efficiencies through agricultural production in a variety of different ways, not just simply productivity gains on the farm, but the interactions with the crop insurance agencies, USDA, FSA, is a great example. All of this data is digitized. The farm is digitized. It is going to be stored in places and it is going to be organized. And there are a lot of opportunities to be more efficient from the grower perspective and from the government perspective, by us working together with the USDA to find ways that this specific information can be transferred electronically. I mean the technology is there to do it.

Mr. AGUILAR. Right.

Dr. STERN. And we hear that from growers all the time, and it is an area that we, in fact, we feel that the tools that we are developing can actually be employed almost now to help do that. So it is a big opportunity in our opinion.

Mr. AGUILAR. Thank you.

Mr. Ferrell, I——

Mr. FERRELL. No, I would just completely agree. And one of the things that Mr. Rushing and I were actually thinking of while we were having that discussion was two issues that are out there, and Dr. Stern alluded to this, the Open Ag Data Alliance and the Ag Gateway Program, which are two—I don't know if open source is necessarily the right word to use, I wouldn't use that, but collaborative efforts to develop some of those data transmission and storage standards to really facilitate some of the data transfers that Mr. Hurst and Dr. Stern were referring to.

Mr. RUSHING. Yes, if you look at the history of farm equipment, you can remember years ago when you went to hook up an implement in the tree line and it didn't have the right couplers on the end of it. And then we standardized to one type of coupler in the industry. It is a simple example, but then after that you saw ISOBUS come. And ISOBUS now allowed data to transfer freely between different brands and different products and—of different types of equipment.

I think now what you are seeing with the Ag Gateway Initiative, through SPADE and also a project called ADAPT, is to come up with standardized approaches to transmitting data. I know that many of the government entities are also involved in those discussions as well as farm software providers, farm machinery manufacturers, all those guys are together now and looking at ways that they can standardize on how that data is transferred and used.

There are also things outside of the OADA I know that is in the industry now, and those things are like also data co-ops. So data cooperatives are starting to come up, sponsored by different universities so that there can be some neutral places where anybody that wants to consume that data can come in and consume it based on the farmer's permissions.

Mr. AGUILAR. Great. Thank you so much.

Mr. Chairman, I yield back.

The CHAIRMAN. The gentleman yields back.

Mr. Benishek, 5 minutes.

Mr. BENISHEK. Thank you, Mr. Chairman.

Well, this sort of reminds me of—I am a doctor, so this information technology and data kind of is in the medical field and how you can't get the information from one place to another. So tell me—there are two questions that the testimony has gotten me thinking about, and one of them is the ownership of the data. One of you mentioned the fact that if John Deere—or I don't know who the ownership of the tractor is, that maybe you don't own the data, which seems about as logical as if you buy a computer, that the data on the computer should be yours not Microsoft or whatever. Right? So tell me how does that actually occur? I mean I don't understand it, frankly.

Mr. TILLER. I saw——

Mr. BENISHEK. Who would sign a contract like that?

Mr. TILLER. Yes. It is a contractual agreement. I don't necessarily personally like it. Most farmers I know, and I would like to get Blake's take here in a moment, they don't personally like that, but at the moment there are—and they are not alone, they are not alone. I mean John Deere's agreement does—they use the word *control*. So they take the word own out and they say you can control your data.

We at Grower Information Services Cooperative take the position that the grower needs to own his data. And I used to use the example of, you park your car in your neighbor's garage long enough, he will forget that it is under your control, and before long he will think he owns it. And maybe he does. So, Blake, what are your thoughts on that?

Mr. HURST. Well, there is a controversy about the ability to go in and work on the software, which is if they are very large corporations they don't want you modifying their software and then the data.

One of the other questions that comes—the ownership question that comes up, I understand that I own my data, but when it goes into a database, do I own $\frac{1}{100}$ or $\frac{1}{1,000}$ or $\frac{1}{1,000,000}$ of that database? I have a feeling that that may be a place where some controversy could occur because the farmer might well feel that he still had some ownership interest in that database. The person that holds the database may have the opposite opinion.

Mr. BENISHEK. You mentioned a co-op. Now, to me the data should be like a farm co-op.

Mr. TILLER. That is the way we operate.

Mr. BENISHEK.—do you know what I mean? That is——

Mr. TILLER. Same principle as a corn marketing cooperative——

Mr. BENISHEK. Right. Right.

Mr. TILLER.—at Growers, we—at GiSC we are a data marketing cooperative. We are trying to be the data aggregator who we can bring that data together.

I want to make a statement around the aggregate data. I mean it is a huge question, and once we aggregate data and we have let's say we have 10,000 growers that are put together, because I want the data sets to be large enough where everybody is anonymized. It is kind of like putting sugar in a cake, once you bake the cake, show me how you are going to get the sugar out. You can't. So we have to be big boys in agriculture. As a farmer, I have a large operation. When I sign an agreement and say you can aggregate, I can't really expect to go back and pull that out. I am just wanting to make sure the farmer's educated and understands that. That is all.

Mr. BENISHEK. Right.

Mr. TILLER. I mean growers, we are very set on let's make sure we educate them so that they understand, once they have agreed to this aggregation, what that means.

Mr. BENISHEK. There are so many questions that come up about this to me. So does the—if you buy this John Deere tractor, that you sign this contract, is that like a 20 year deal then or the tractor can last a long time.

Mr. TILLER. As long as you want to use the controller there. I mean there is sort of—I don't know how to best explain it because it is even confusing to me, even though I have dealt in the issue the last 4 or 5 years watching it evolve. It is the position they have taken, for whatever reason, I can't answer for them, I wish they were here to answer for themselves around it, but it is a position they have taken. I mean and they have been very stern that they make great technology by the way they do it.

Mr. BENISHEK. Well, the other question that comes up is the interoperability of the data. You guys have kind of talked a little bit about it, so is it over different platforms, is it coordinated, is——

Mr. TILLER. It is all proprietary data. There is very seldom—there are a few formats, but for the——

Mr. BENISHEK. Well, one county has predominance of one company, the next county over might use a different company, they can't aggregate that data and make——

Mr. TILLER. It is——

Mr. BENISHEK.—use of it?

Mr. TILLER. It is very tough, but you can do binary transformations where you can create——

Mr. BENISHEK. Right. Right. Right.

Mr. TILLER.—your own way to actually——

Mr. BENISHEK. Yes. Yes.

Mr. TILLER.—take that data in and consume it, but for the most part, you have Ag Gateway and you have OADA, two different—I call them standards groups, trying to develop standards around how we can make this happen. And it is in the works, and it will be in the works——

Mr. BENISHEK. Well, this is——

Mr. TILLER.—for years——

Mr. BENISHEK.—a problem across all this data, not only for you guys but for medicine, and that is——

Mr. TILLER. Yes.

Mr. BENISHEK.—that is exactly the problem we face here, and it is—to me, you are being held hostage by the, I don't know, I call them data weenies, because they are the only people that know how to work it, and you have to pay them——

Mr. TILLER. You could be and that is——

Mr. BENISHEK.—so much a month and——

Mr. TILLER.—and that is a portability issue. So when I want to leave a particular chemical company or—I am talking about regional vendors, and I have data on their digital platform and I am ready to move, and I am unhappy with them and I want to go to someone else, will they make my data portable so I can leave. Some will, some won't, and some will make it portable. It is not a very good format for me to consume it with another set of software. So——

Mr. BENISHEK. Thank you.

Mr. TILLER.—that is really where it goes.

Mr. BENISHEK. Thank you, my friend.

The CHAIRMAN. The gentleman's time as expired.

Ms. Plaskett, 5 minutes.

Ms. PLASKETT. Yes, thank you, Mr. Chairman. Thank you, witnesses, for this lively discussion on a topic which is difficult at best for some of us.

But I wanted to expound on a question that my colleague, Ms. Kuster, brought up to you with regard to smaller farmers. And one of the questions was, we talked about the benefit, that there is a benefit to the smaller farmers in doing this, but is there a decreased benefit to the smaller farmers in relation to the larger ones in terms of the data collection, and the cost-benefit that goes into them doing it in comparison to the larger farmers, does it push them out of the market of benefit in doing this?

Mr. FERRELL. I will take a swing at that one. I will take off my lawyer hat and put on my ag economics Professor hat.

Ms. PLASKETT. Those are big hats.

Mr. FERRELL. Yes, they are and it takes a large hat rack to keep them all straight.

I think there really are some important benefits for our smaller producers, and the reason that I say that is because any time that you are dealing with volatility in the commodities market, which is arguably the entire history of forever, when you have that volatility, the producers in the long run that come out ahead are the low-cost producers because they can withstand those changes in prices, and if they can stay the most efficient low-cost producers, they are the ones that are going to survive.

Typically, that has put small producers at a disadvantage because they just don't have the economies of scale, they may not have the capital structure to withstand those kind of buffeting influences of the market. But with the kind of data tools that we have talked about today, to some extent they have the same decision-making capacities that a much larger operation might have. If they can have access to the insights afforded by some of the big data analytics that we have discussed, they can make management decisions with the same level of precision and information intelligence that the larger producers can. So I think that there are

some real advantages for the small producers from those technologies.

Now, that is if we are looking at coming from big data down to the individual level.

Ms. PLASKETT. Yes.

Mr. FERRELL. But that is a two-way street, and one way that have to really participate in making those management decisions as best we can is by having good farm-level data——

Ms. PLASKETT. Yes.

Mr. FERRELL.—and that requires sensing technologies that we have talked about, and sometimes that it is on the larger equipment that may be beyond the operational scale——

Ms. PLASKETT. Right.

Mr. FERRELL.—of those smaller producers. So that is kind of the bad news for small farms and ranches, but the good news is, as we mentioned earlier, as that technology drives forward, we are seeing ever-decreasing costs of integrating that technology. We are seeing it put on smaller and smaller implements and—sorry, implements and tractors. Those——

Ms. PLASKETT. This——

Mr. FERRELL.—types of things.

Ms. PLASKETT. This may be where cooperatives really work in favor of——

Mr. FERRELL. Yes.

Ms. PLASKETT.—the smaller farmers——

Mr. FERRELL. Yes.

Ms. PLASKETT.—banding together in terms of doing the data.

Mr. FERRELL. Absolutely. I think we are going to see those costs driven down, and we are going to see more access to more types of equipment systems that have that technology. So it is only going to get closer and closer to the small producer.

Dr. STERN. Just another comment on that. For instance, if you look at our Nitrogen Advisor, that is built on a very large data set. An overwhelming majority of it is publicly available data, or data that we ourselves invested in in our research farms to generate. So the scale piece that if you have a larger farm, or for some reason they have more information, it is going to drive more information for them *versus* a small-holder farmer, that is not really the basis of it. We are looking at it field by field. I would say also the way we price the products are per acre. Ultimately growers are going to make their decision on whether or not that is the appropriate value. But I truly believe the technology is very scalable, and I completely agree with Mr. Ferrell that in some ways it is a leveling technology.

Ms. PLASKETT. Right. The other question I had was, we have talked specifically about crops and farmers, can you talk about how this translates to livestock?

Mr. RUSHING. As I mentioned earlier, there are a lot of opportunities to utilize this data loop inside of things like poultry, beef production, and pork production.

Ms. PLASKETT. Can you give an example of that?

Mr. RUSHING. So, for example, if you can identify within the crop cycle of raising, say, poultry, you can identify specific environments or specific conditions where you produced the best chickens. And

you can identify that throughout the crop cycle, identify what you did as far as feed——

Ms. PLASKETT. Yes.

Mr. RUSHING.—what the temperature was in the house, what nutrients you used, then you can recreate those conditions based on understanding that cycle and when those events happened.

So that is one place where we have seen it being used. We have also seen it being used in milk production where you are able to see what types of feeds are used, and then be able to recreate those same conditions to replicate the productivity.

Ms. PLASKETT. Okay, Dr. Stern——

Dr. STERN. I will——

Ms. PLASKETT.—you would like to——

Dr. STERN. I will give one more example.

Ms. PLASKETT. Yes.

Dr. STERN. For an integrated farmer who is producing—maybe they are a dairy farmer but they are also producing row crops, again, our Nitrogen Advisor allows them to use the manure that they will be spreading on their field as an input into that calculation. So we take that calculation into the algorithm and it allows us then to understand overall fertility in the fields, so they don't necessarily have to go and apply any more nitrogen fertilizer to that field. So that is a little bit of a different twist, but it is how livestock and row crop operations can integrate with the——

Ms. PLASKETT. Thank——

Dr. STERN.—technology.

Ms. PLASKETT. Thank you so much.

Thank you, Mr. Chairman.

The CHAIRMAN. The gentlelady's time has expired.

Mr. Davis, 5 minutes.

Mr. DAVIS. Thank you, Mr. Chairman.

Mr. Hurst, thanks for being here. Your written testimony mentions some key differences in big data in agriculture from the big data that is collected about individuals, say, from Google searches or social media interaction. The difference seems to be not just in the data that is collected, but also the risk that the collection of that data imposes, say, for information maybe on some pesticide applications or use of GMO seeds. Is there anything that we haven't asked you regarding these aspects of data that you would like to relay to the Committee that can be helpful in us determining future policies?

Mr. HURST. Yes, the point I was trying to make was that if Google or Amazon knows that I like to read murder mysteries, it is a value to them as a marketer, but it is not something I care if anybody else knows.

It may be that farmers are nervous about public knowledge of the applications they use of pesticides, even though they are applying them well within the prescribed limits and following all the labels. So this information is more sensitive in that sense. It comes very close to the same level of sensitivity as financial information or Social Security Numbers, or any of those things.

And one of the other points that I guess I was trying to make when talking about is we freely give that information to Facebook, right? I read somewhere that every customer or every member of

Facebook, their value is worth $20 to Facebook. So you think about the average person's buying power and then you multiply that by 20 or 30 or 40 to get to the buying power of farms, and our information has a great deal of value as farmers. It would really be nice as we go through this process that we get—keep in mind that it would be helpful to agriculture if we were able to monetize that in ways other than just the benefits it makes for my productive capabilities.

Mr. DAVIS. Well, thank you, Mr. Hurst.

Dr. Stern, you mentioned that a farmer in central Illinois, the breadbasket of America, of course, since I represent there, was able to use precision agriculture and data to determine when it would be correct—when it would be best to put nitrogen in the field. I hope that that farmer was in my district. But can you explain, besides the fact that all good things happen right out of central Illinois, can you explain to us how we can make that more useful as we move into the future?

Dr. STERN. Sure. And this farmer was just south of Springfield, so I don't know whether or not that is——

Mr. DAVIS. Probably my home county.

Dr. STERN. Yes.

Mr. DAVIS. Christian County in Taylorville.

Dr. STERN. I think we——

Mr. DAVIS. The best farmers.

Dr. STERN. Yes. And in my testimony I said we are just on the cusp of this digital revolution, and we are in the very early days in this technology. This is just a simple example of timing, understanding how much nitrogen was left in their field after the growing season, because that is what the Advisor does in understanding weather. In the future, if we just stick to nitrogen or fertility in general, so it is not just nitrogen, whether it be phosphorus and potassium, as we span the scope, we will have a better picture of fertility in the field, and we will get—right now, our Advisor looks at the entire field.

Mr. DAVIS. Yes.

Dr. STERN. We are going to get to subfield levels where we are looking at soil maps or other information that is generated in the field that allows us to say this part of the field has a different fertility profile than this part of the field. And the third piece of information that will come in will be around the genetics and what is being planted. Different genetic lines of corn will respond to nitrogen differently.

So when you begin to bring all this together, and this is in our roadmap of products that we are going to be developing, you can begin to see more of an operating plan that we can work with growers to develop that covers fertility broadly on a subfield level, all the way to how to optimize what is being planted, both from a—seeding population as well——

Mr. DAVIS. Okay.

Dr. STERN.—as where seeds are being planted. So that is just a little snapshot of——

Mr. DAVIS. Well——

Dr. STERN.—I think the power of the technology.

Mr. DAVIS. Thank you. And I would urge each of you as we leave this hearing today to also ensure that when you come back to us, help us understand what government can do to halt technology like this, and what we can do to stop that from being implemented out here in Washington, D.C., at the policy level.

And in my last few seconds, Mr. Ferrell, my colleague from Oklahoma is gone, so I was going to ask you to explain to him what an iTunes agreement was, but—yes, yes. But has anybody told you that you sound just like our former colleague, Cory Gardner? I had my head down and I was thinking Cory is in this place.

Mr. FERRELL. I would defer to my colleague, Mr. Fischer. I will leave it to him to let me know that fact. He had not yet apprised me of that, but I wouldn't be surprised.

Mr. DAVIS. Well, those of you who may not know who Cory Gardner is, he got demoted to the U.S. Senate.

So I yield back the balance of my time.

The CHAIRMAN. The gentleman's time has expired.

Mr. Yoho, 5 minutes.

Mr. YOHO. Thank you, Mr. Chairman. Gentlemen, I appreciate you being here.

It is fascinating to see the advancement of technology and how fast it is going.

Dr. Stern, the information you are getting is coming from satellites. Are those your own, or are you tapped into the LANDSAT satellites of NASA's?

Dr. STERN. Yes, part of the information we get is from satellites, but we actually purchase satellite imagery from a variety of different venders that are not our satellites.

Mr. YOHO. Yes, we did an ag seminar in our district and—showing the farmers what they can get off the LANDSAT. And, of course, they can gather all this information on their own. Of course, the thing they are missing is the algorithms that assimilate that stuff to come out with the recommendations, it is a whole different ball game. You can get the raw data but put it into practical terms.

Mr. Ferrell, you had brought up the CAFO situations, the concentrated animal feeding units. And we know what happened with the EPA, they gave that information out mistakenly. And we just need to make sure that information when it is collected, that the farmer or the person that it pertains to is protected. I think there has to be a way that we up here can protect the citizens. Yes, people have a right to know some things, but in situations like that, it is a national security situation. If you look at one of our big feeding operations, and of course, I come from the State of Florida, and we have some of the ranches down there, hundreds of thousands of acres, it is a very precarious situation if somebody were to get into that. And working off what my colleague here, Mr. Davis, had brought up was that if you guys are out there in the industry, you are out there in the field, coming up with the ideas that we can institute on this end to protect you out there so that you can continue to do what you are doing. And one of the things in our district is we have six drone companies. One of them is developing software right now where they can go over a farm field and they can take an image of the cattle, and they can predict how many

young calves there are, what the average body weight is, and it is just going to revolutionize the ag industry. But in order to be able to do that, they have to have the permission and the policies in place so that they can fly the drone. And so, again, use this Committee as something to move that legislation forward so that we can benefit all of agriculture, yet protect the privacy of the neighbors and of the individual.

Where do you see this going? I mean what do you see the biggest challenge that we are seeing? I mean you have mentioned a lot of that, and we will start with you, Mr. Ferrell, the impediments maybe in the industry?

Mr. FERRELL. I say this with a bias of someone who works in Cooperative Extension, so I am out there always talking to those producers, and I really think, at least at this point in time, the barrier may be almost informational. And what I mean by that is that farmers can see the benefits that this technology promises, but there is just a hesitancy to engage with that technology because either they feel that the current safeguards aren't adequate, or they just don't understand what those safeguards are. And so really, the technology is being driven incredibly quickly. I think it will be there when the producer is ready, and one of the best things that we can do is to have continued educational efforts to make sure those producers read and understand those agreements in the contracts they enter into with the service providers so that they feel comfortable with the protections that they have, and to facilitate the dialogue that we already have in establishing some of those basic principles of data ownership, rights, privacy, and disclosure of uses, and really overarching that principle of transparency.

Mr. YOHO. Okay, I go along with the lines of Mr. Gibbs, if I am paying for that information, that information is mine. And, the service agreements and all that, I know that has to be worked out and those are things that we have to look at.

Mr. Rushing, do you have any thoughts on that?

Mr. RUSHING. Yes, one of the big challenges is going to be data standardization; making sure that there is specific formats that everyone can use, and that is going to open up more choices for the farmer to be able to choose what types of equipment, what types of products, what types of services that he wants to be able to use as well. So if any support can come, it is in helping establish those data standards within the industry and also across the world, so that we can build this equipment and the services and products to communicate with each other.

Mr. YOHO. Do you feel that is something that should be done in a private industry, those standards, keep the government out of it because we don't want to show up and say we are here from the government to help you?

Mr. RUSHING. Definitely. Definitely.

Mr. YOHO. Okay.

Mr. RUSHING. It has to be done by the industry. And a lot of the industry organizations we talked about today are working in that direction, but it can't come fast enough.

Mr. YOHO. Anybody else want to weigh-in in the last 30 seconds?

Dr. STERN. Yes, I would just add that, ultimately, growers are always looking for new technology to optimize their operation, and

this is really new technology. And so they are going to need to work with it for a little bit and see the value that these digital tools bring to their farm. In doing that, they will become more trustworthy of it, they will understand the value that it brings, and they will be more engaged in the technology.

I will just say 70 percent of growers out there right now are touching different pieces of this technology, so they are very receptive to it.

Last, broadband, with respect to how this Committee could help, expanding broadband.

You have to move the data around.

Mr. YOHO. Thank you.

Dr. STERN. That is important.

The CHAIRMAN. The gentleman's time has expired.

Mr. Kelly.

Mr. KELLY. The thing that is bad about being last is—thank you, Mr. Chairman—or very close to last, is most of the great questions have been asked.

But I have been thinking about this thing while you have talked, and there are so many competing interests here. You have data, which is the farmers'. They own the farm, they own the yield that comes off of that crop, they own several things. You have Climate Corporation, which owns a lot of the weather data and those type of things. There are soil samples which may be owned by a whole lot of different people. And then you have the algorithms, and the things that turn that data from being data into actionable information or something that you can use. And then you have the collector. John Deere owns the tractor that has the GPS on that owns that. It is very difficult to make sure that each one of those parties is represented in the correct way that doesn't give them an unfair competitive advantage over the other. I shouldn't be able to sell you my product and use that as an unfair competitive advantage to make sure that you use only this, whether it be from any one of those sources.

So do any of you, and, Mr. Ferrell, how do we keep people from using that as an unfair competitive advantage, and how do we make sure that the smaller farmers or the farmers who are sometimes not as technology savvy or don't have as much information, how do we make sure they are educated when they make those decisions of how to sell that?

Mr. FERRELL. You saved the good question for last. I don't think they took all the good ones. I think that was an excellent question.

And it is tough because, I was actually just looking at some information earlier this week that showed the number of companies that were evolving in the space of ag data management, transfer, analysis, and it is pretty large. It is not going to stay that way. We are going to see industry consolidation. We almost always see industry consolidation as we go on. And that is tough because the marketplace gives you choices when you have choices that you can make with your dollar. And at least at this point in time, we let the consumer kind of pick who is going to best serve their needs and their ownership interests in that data. That consolidation is going to come.

I keep going back to the concept that we have had with success thus far in the dialogue amongst all the stakeholders, and thus far, that has really served this industry well. I am impressed by that in the fact that we have seen the concerns of the consumer, here the farmer and rancher, represented really well and very early on in this process. I have been really amazed at how quickly we have come to a consensus in the industry about some of these principles.

I think the key to the question that you are raising is to maintain that consensus process and to make sure that those principles are embodied in the contracts that these service providers are going to be using, because we can have principles all day long, but they are not legally enforceable until they are in that agreement that that farmer or rancher has signed. And so that is part of it. I think the other part of it is, like we talked about, making sure that farmers and ranchers understand what that framework looks like, and making sure that they make educated decisions about which service provider they choose based on which service provider best fits their needs and their interests in that data.

Mr. KELLY. I will open it up to everyone, but it is very important to me that we don't allow people to make uneducated decisions about what they are giving away, and there is a value to all of those products. And it is also important that one person, because of information or because of the size of their organization, that they don't use that either as an unfair advantage, or also that we share those profits that should be shared. And I am kind of looking out for protecting the little guy. I want to make sure that someone is not taking an unfair advantage of them. Any other ideas?

Mr. TILLER. Well, that is the reason for something like a data cooperative where you can actually give that small grower, or all the growers, literally power of a voice, very educated around what is going on in the industry. This is a very evolving industry. I mean just from what you are hearing here, you can begin to see very quickly what is going on. I mean, of course, I am proposing what we are doing, but as a grower, I mean there was a reason that I wanted to go down this path. I didn't think that I could stand alone and really keep that place of significance, where I really said it should be a grower-centered world where I am talking about my data.

Mr. HURST. As we went through the—I am sorry.

Mr. KELLY. I just have time for one final point.

While doing that and taking care of the small guy, we also don't need to stifle innovation by doing that, and I understand that too. And if you can comment real briefly, Mr. Hurst, and I yield back the rest of my time after your answer.

Mr. HURST. Yes, our transparency evaluations, all the principles we have developed, all those things were to make sure the farmers had good information when they made these decisions. Thanks.

The CHAIRMAN. The gentleman's time has expired.

Mr. Austin Scott, 5 minutes.

Mr. AUSTIN SCOTT of Georgia. Thank you, Mr. Chairman. And, gentlemen, thank you for being here today.

One of the things that we talk about with regard to the data, whether it is control or ownership, one of the other things that we are going to make sure—or need to make sure that we address is

if that data is submitted to any of the government agencies, is whether it is or is not subject to the Freedom of Information Act. And certainly, that is private data and somehow we need to make sure that we get that language correct when we do that.

So I want to ask you this question, Mr. Rushing, because AGCO has taken the position that the farmers should only control the data. I certainly agree with you on that. Other companies have taken a different position on that. Why has AGCO taken the position that you have, and how is the farmers' ownership of that data protected in the agreements, and why would other companies take a different approach?

Mr. RUSHING. So the first thing to make sure that we realize is AGCO is a machinery company, so we are focused on machinery and assets. We are not necessarily so focused on crop production data. We can't provide goods and services that are going to benefit the grower by understanding a lot of that crop production data. It is our job to take the prescription that is developed or capture the data in the field in regards to yield or how something was applied, and then utilize that in the machines, so make sure the machine is capable. So our position has been that the grower or the farmer owns the data. He will give whomever he wants permission to utilize that data, and as a result, we built two pipes. We build a pipe that is specifically focused on the machine because if I can see that farmer's machinery data, say, for example, machinery health, I can then respond to that farmer with additional services that are going to benefit him. One of the biggest challenges farmers have is downtime.

Mr. AUSTIN SCOTT of Georgia. Yes.

Mr. RUSHING. If they are down in the field and they are not operating, then it is just like a factory being down, it is not being productive. So how we can utilize that information based on how the machines are performing, we can come back and we provide services to keep that machine running, keep it repaired, keep it optimized, keep it performing like it is supposed to be performing in the field.

So from that respect, we want to make sure that when we say to the farmer you own your data, but if you will let us see it we can provide you value in return through these services and through these other opportunities.

For crop production data though, we can't. So what we say to the farmer, it is your data, and not only is it your data, we are going to facilitate your transfer of that information to whomever you want to transfer it to. And also in the process, as it is transferred through the pipe, it is deleted. We will never look at it, we will never use it, we will never try to understand your operation from an agronomic standpoint because we can't provide you any value in that regard. And that is basically why we have taken the position that we have taken.

Now, we are making connections to a lot of folks here on this panel to make sure that they can consume that data if the farmer chooses, but again, the farmer will make that choice, whether it is machinery data shared with us or it is agronomic data or task data shared with some other ag service providers.

Mr. AUSTIN SCOTT of Georgia. And so if I buy one of your machines, is there a certain computer system that I have to use for your machine, or can I purchase different computer systems that might collect the data, and would that be available on other companies who don't share your belief that the farmers should own the data? If I buy a machine where the company thinks they own the data, do I have the ability to take their data collection out and put my own in?

Mr. RUSHING. The farmer can always select an aftermarket solution that he can plug into the machine to collect specific amounts of data. It might not necessarily be everything on the machine. The OEM, or the original equipment manufacturer, has a lot of access to the technology on the machine that an aftermarket provider wouldn't have, but there is an option for a farmer to buy an aftermarket solution and install it on the machine.

Mr. AUSTIN SCOTT of Georgia. Yes. Okay.

I don't have any further questions, Mr. Chairman. Thank you, and I yield the remainder of my time.

The CHAIRMAN. The gentleman yields back. Thank you.

Mr. Allen, for 5 minutes.

Mr. ALLEN. Thank you, Mr. Chairman. And I will be quick here. I just wanted to welcome Mr. Rushing to our hearing today. Nice to have a fellow Georgian——

Mr. RUSHING. Thank you.

Mr. ALLEN.—up here with us. And thank you for being here. Thanks to all for your testimony. And I would just encourage you to do this; to all get together and let's solve this problem so the farmer gets the information he needs, but also he gets paid for furnishing that information. It is a fair deal, and I encourage you all to get together and work this out as you know what happens when Congress gets involved. I think it would be better if you could do this privately, and I thank you for your work.

I yield back.

The CHAIRMAN. The gentleman yields back.

I want to thank our panel. This has been a refreshing hearing this morning. You are not coming here looking for solutions, you are coming here simply to tell the Agriculture Committee about things that are working in the private-sector. I echo Mr. Allen's comments. The private-sector does a better job than Congress can when it comes to fixing all the problems that you are already recognizing. The collegial manner in which you are working across interests is encouraging to me. There may very well be some things that Congress needs to do to protect markets and others. I have been told that the high-frequency traders figured out if they got their servers closer to the market, they can save a couple of segments of a blink of an eye, and then they could execute their deals quicker. This agricultural data, particularly during the harvest, is stunningly valuable. As we walk this path, we will need your help and others' help in the industry to make sure that we don't have unintended consequences by people trying to exploit big data.

The other thing is that early adopters, like Mr. Tiller and others, are willing to make the investment ahead of time because they see the vision down the road. Later adopters must make this decision on a cost-benefit analysis. The money they save from investing in

big data must be greater than the costs. I think what we have heard this morning is that it is becoming more affordable, and more folks want to adopt it, simply based on the current cost-benefit analysis and the desire to be on the leading edge.

Under the rules of the Committee, the record for today's hearing will remain open for 10 calendar days to receive additional material and supplemental written responses from the witnesses to any questions posed by a Member.

This hearing of the Committee on Agriculture is adjourned. Thank you.

[Whereupon, at 11:51 a.m., the Committee was adjourned.]

[Material submitted for inclusion in the record follows:]

SUBMITTED STATEMENT BY DEERE & COMPANY *

Deere & Company ("John Deere") respectfully submits these comments for the record as part of the Committee's October 28, 2015 hearing on the subject of "Big Data and Its Role in Agriculture."

John Deere is a global leader in the manufacture of agricultural, construction, turf and forestry equipment. Deere provides advanced agricultural and other equipment and services to customers that cultivate, harvest, transform, enrich and build upon the land to meet the world's dramatically increasing need for food, fuel, fiber and infrastructure. Deere has been providing innovative equipment, technology and services to customers since 1837, and today is pioneering state-of-the-art data and information solutions designed to greatly enhance productivity and sustainability.

The Value of Data-Enabled Agriculture

John Deere believes that the growth of data-enabled agriculture is as transformational today as was the introduction of self-propelled machines to the farm almost 100 years ago. Insights producers generate from data will be critical to meeting the goal to produce enough food and build the infrastructure required to sustain a growing global population. Properly used, agricultural data has the potential to greatly improve precision, productivity, profitability, and sustainability on the farm.

American farmers face constant pressure to improve efficiency, environmental stewardship, and output. For this purpose, farmers look to advanced smart farming technology solutions, including solutions that take advantage of mobile and fixed broadband access. Today, producers are able to farm to within a few centimeters of accuracy thanks to innovative GPS-enabled positioning systems that are now standard on virtually all modern farming equipment, as supplemented with data available from satellite signals. Using these high precision techniques, advanced agricultural equipment and services now include technology that provides real-time agronomic data that can be analyzed to optimize the precise amount of seed, fertilizer and pesticides needed, reduce costs for fuel, labor, water, and identify best practices for fields in a given location. (Deere's precision ag technologies, for instance, give farmers access to detailed agronomic information in the field essential for improved decision-making with respect to managing costs and recourses.)

Where possible, producers use data and communication technologies to interact with customers and vendors, follow commodity markets, obtain real-time information on field conditions, weather and other environmental factors, and manage fleets and regulatory compliance. Farmers can also employ innovative machine-to-machine ("M2M") operations in the field and machine-to-farm ("M2F") from the field that enable producers to make significant improvements in real-time productivity and cost management.

Today these technologies are making an enormous contribution to improved use of limited resources, regulatory compliance and ag sustainability. Precision technologies are enabling more efficient, prescriptive use of soils, water, fertilizer, herbicides and fuel by allowing producers to tailor farming practices and applications to the specific conditions of an individual field.

For example, when the farmer leaves his field in the fall, he is able to share harvest yields directly and immediately with trusted agronomist advisors. This helps the advisor to prescribe the appropriate amount of nutrients to be added back to the soil, based only on what the farmer took off at harvest, and ensure those nutrients are added and incorporated before winter. The farmer can also make decisions on which seeds to buy for next year, taking advantage of early order price discounts. By reducing inputs, improving resource management, minimizing land impacts and lowering costs, these technologies are delivering the promise of sustainability on the farm.

The economic impact of these technologies is significant. According to recent reports, data-driven decisions about irrigation, fertilization and harvesting can increase corn farm profitability by $5 to $100 per acre, and a recent 6 month pilot study found precision agriculture improved overall crop productivity by 15%.[1]

The Importance of Data Privacy

In addition to offering a full line of innovative, high-quality agricultural equipment to producer customers worldwide, John Deere provides data and data application services that support customer business needs and the optimal utilization of

* **Editor's note:** John Deere was invited to testify but declined.

[1] *See* Kurt Marko, FORBES, *Precision Agriculture Eats Data, CPUC Cycles: It's a Perfect Fit for Cloud Services* (Aug. 25, 2015), available at: *http://www.forbes.com/sites/kurtmarko/2015/08/25/precision-ag-cloud/*.

Deere machines. These services are provided through Deere's proprietary data management platform, John Deere Operations Center.

John Deere believes that all involved in the generation and use of data and data services should have effective processes in place to ensure privacy, security and control for the producer. Deere has been actively engaged with individual customers, grower organizations, ag service providers, agronomists and many others to develop practices and processes that ensure producer privacy and control, while making data processing, analysis, and use as seamless as possible. Deere believes that the market participants across this value chain—through collaboration, private agreement and mutual trust—are best able to develop and implement the necessary practices and protocols that protect producers and serve commercial needs. To this end, Deere has developed a set of business data principles that govern its use of machine data, production data and personal information, and are incorporated into every customer's John Deere Operations Center services contract. These principles are designed to ensure the customer is always in control of whether and how his data can be used, by whom, and for how long. These principles are:

1. Deere provides data and end-user application services to support the business needs of its producer customers and improve the use of Deere equipment and technologies.
2. The producer's business data should be differentiated into machine, production, and other data, and each data subset should be managed in accord with these important distinctions.
3. Deere utilizes customer business data only with the customer's consent, in order to improve grower productivity and profitability, and to optimize the utilization of John Deere products and services in the customer's farming operations.
4. The producer customer retains control of his business data including whether, what and how his data is used and shared. The customer may withdraw this consent or request that data be deleted from his account at any time.
5. Any disclosure of customer business data is determined solely by the customer's designated account preferences and through contractual agreements with John Deere.

John Deere believes farmers own the information generated by their farming operations. However, farming is a complex, dynamic industry. Farmers use Deere's tools and offerings in many different ways, which may complicate the issue of ownership. Expectations, relationships, contracts and laws regarding data control and ownership vary from place to place, operation to operation and even on a single farm. For example:

- Custom harvesters or equipment operators who may have the right to share production data.
- Landlord and/or tenants who may have the right to share some or all production data from a farm.
- Agronomists and other consultants who may have the right to share data.
- A farmer may buy licenses to use commercial prescription files, other technologies, or seed hybrids that the farmer does not own.

Different circumstances can make determining who *owns* data complicated and unclear. This is why Deere believes that customer *control* of the data is the most important issue. Deere's data management services and applications are designed to ensure customer control of business data.

There are important distinctions between the types of data that are generated through integrated ag technologies, and Deere and its customers agree to manage these differentiated data sets accordingly. John Deere segregates customer data into three subsets—Machine Data, Production Data, and Other Data.

Machine Data are data that generally relate to how equipment is functioning (fuel consumption, vehicle diagnostic, engine performance). This data may be utilized, with the customer's consent, in original or anonymized form to proactively address equipment issues and improve the customer's experience with the machine. Production Data relate to the work being performed by the customer, and enable Deere to administer services the customer has opted into, such as field tasks, location history or wireless data transfer. Customers may choose to allow Deere to anonymize Production Data and share it with agronomists, service providers and other input providers, for purposes of benchmarking, product performance reports or set ups under similar conditions.

Other Data are data that are identified for special handling because of their more sensitive nature, such as variable rate prescriptions, user-entered notes and user-formatted reports. Other Data may not be anonymized for external sharing, even if a customer opts to allow John Deere to anonymize and share Machine and Production Data. These distinctions are a critical part of the data management process. They preserve customer control while distinguishing the sensitivities associated with certain data sets. They are reflected in the contractual agreements between John Deere and its customers.

It should be noted that the marketplace for technology around data collection, transmission, storage and use is evolving rapidly and will continue to evolve in the years to come. Producers will continue to be presented with new options and product offerings that can deliver even greater value, while rewarding the most innovative technology and service providers at the same time. This can best happen through the collaborative private sector efforts of market participants, without the specter of more rigid standards or codes imposed from outside that could stifle innovation.

Finally, it should also be noted that, without essential broadband connectivity to croplands, many of the potential benefits of "big data" in agriculture can never be realized. Real-time ag services using data generated on the farm are dependent on reliable, high-speed wired and wireless connections to the Internet—connections that in turn depend on a robust rural broadband infrastructure that is currently lacking in many parts of the country. More attention must be given at the Federal level to ensure that the build-out of wireless broadband infrastructure, including connectivity in the fields where farmers and equipment operate, is achieved.

Deere & Company appreciates the Committee's consideration of its views, and looks forward to working with the Committee on these important issues.

SUBMITTED QUESTIONS

Response from Blake Hurst, President, Missouri Farm Bureau; Member, Board of Directors, American Farm Bureau Federation

Questions Submitted by Hon. David Rouzer, a Representative in Congress from North Carolina

Question 1. Mr. Hurst, I have farmers in my district who are concerned with how ownership of data could affect the price of machinery. For example, if a tractor company owns the software in their tractors and a farmer was to trade his tractor to a dealer that is not with the same tractor company, how would these dealers handle the software? Would this make the trade-in value depreciate substantially since the dealer in this scenario would not actually own the software within these tractors?

Answer. I'm afraid that I cannot answer this question with any degree of confidence. As I understand it, the concern goes to the software that operate the tractor, not the data generated by the farmer's use of the machine. If I trade my J.D. to a competing dealer, and he does not expect to be able to work on that machine when he sells it to another farmer, because he doesn't have access to work on the software that controls the machine, that prospective loss of revenue could mean that I would receive less for the machine I trade in than I would if went back to a J.D. dealer. But I'm afraid I'm totally speculating here, and have no data to back up my speculation. On a personal note, when we trade something that's been used on our farm, it normally old enough and worn out enough that is has little value.

Question 2. Mr. Hurst, another concern I have heard from my farmers is the ability of on-farm mechanics to repair broken equipment on the fly without concern for the legal implications of altering the "implied license to operate the vehicle." I have heard that farmers can't just repair the equipment without having a technician from the tractor company come out to the farm due to the computer based programming aspect of these machines. Are their ways to rectify this concern?

Answer. I think that is a concern for those farmers who feel comfortable with the software, and might be able to make repairs themselves. There is no doubt that repairs are more expensive because of the highly technical nature of the machines. So, if the internal workings of the engine need repair, all of us are forced to use technicians from the company that sold us the tractor. I don't see an easy solution to this problem, which of course is the same challenge faced by back yard mechanics who a generation ago could work on their cars, but now must take it to a dealer who has the diagnostic equipment needed to figure out what's going on.

Question Submitted by Hon. Ralph Lee Abraham, a Representative in Congress from Louisiana

Question. The value proposition of the data collected on a farm is an interesting one. Are farmers getting paid for their data now? How can farmers potentially leverage their data as a revenue source?

Answer. No, farmers are not being paid for their data, at least as far as I know. There is at least one start up which is attempting to use a data repository to market data from individual farmers. As you might imagine, there is resistance from folks with an interest in the data. Their value proposition involves the farmer paying them to manipulate, store, and prepare "prescriptions" for individual farmers. It will be very interesting to see how the market develops.

Response from Matt Rushing, Vice President, Advanced Technology Solutions (ATS) Product Line, AGCO Corporation

Question Submitted by Hon. David Rouzer, a Representative in Congress from North Carolina

Question. Mr. Rushing, it seems the data connected to the physical piece of equipment has more influence on value and ownership than actually owning the equipment. How can companies, especially the farm equipment companies, reassure farmers that they own the physical equipment that they purchase?

Answer. Farmers own the equipment that they purchase. AGCO's position is that they also own the data they collect. And while data will continue to be a bigger and bigger part of the value proposition in agriculture, it will still be the machines that actually engage the ground. AGCO strives to deliver the most open policy in the industry of optimizing ground engagement through data management and connections to different technologies. This openness will ensure that customers have ever-increasing choice to customize their operations for maximum effect.

The only complexity regarding ownership arises because there are legal, regulatory, environmental, and safety requirements that equipment manufacturers must meet to ensure the safe and compliant operation of the machines. Consequently, there are certain software licenses associated with the equipment to protect the integrity of the overall machine electronic architecture to ensure meeting these requirements. Just as for certain consumer products—like a computer or mobile device—the purchased hardware is clearly the property of the customer, but the consumer is not buying the accompanying operating software itself, but rather a license to use it.

Question Submitted by Hon. Ralph Lee Abraham, a Representative in Congress from Louisiana

Question. A farmer will be the first to tell you that there is a strong interest on the farm in preserving and protecting natural resources, including soil and water. How can you foresee the data that is being collected on the farm being used to improve conservation of natural resources?

Answer. The use of data in farming can help farmers optimize how they manage their fields and crops—allowing them to reduce waste all around, including that of water, and over-application of chemicals.

Big data will play an important role as weather conditions tend to be unpredictable and volatile. The analysis of macro climate trends and improved forecasting will enable growers to select drought tolerant varieties, or possibly faster growing crops to mitigate weather risk. Additionally the data can help them better manage irrigation and other nutrient and seed applications to best fit the expectations for the coming growing season and time farming activities in-between weather events so the plants are able to get the maximum benefit from fertilizers and chemicals with minimal loss due to wind and rain. Related to this, modeling of the spread of disease and insects should enable more prescribed applications based on true threats and not preventative applications that are done more as insurance policies.

The technology on machines will also be able to accurately record what was done, and where, within a field. This information is valuable for reporting and traceability purposes and also serves to inform models used to plan the next pass across the field. These models are then able to take into account numerous variables ensuring the right amount of nutrients are put in the right places in the field. This helps maximize yield and ensure no inputs are wasted or end up in an environmentally sensitive area.

Response from Shannon Ferrell, J.D., M.S., Associate Professor and Faculty Teaching Fellow, Agricultural Law Department of Agricultural Economics, Oklahoma State University

Question Submitted by Hon. Ralph Lee Abraham, a Representative in Congress from Louisiana

Question. How does big data fit into the current farm economy?
Answer.

At this moment, I would characterize the role of big data in the farm economy as "emerging" and its role in agriculture as "limited, but growing rapidly and poised for even faster growth."

Since the mid-1990's with the emergence of a number of precision agriculture tools and sensor technologies beginning to be integrated to agricultural implements, farmers have been starting to accumulate data at the farm level. Fairly shortly thereafter, farmers began sharing that data with service providers such as crop consultants, and databases containing larger numbers of farms began to emerge. This laid the foundation for big data in agriculture as we know it today. Conversely, the ability to collect data about a larger range of parameters for both the field and machinery, and to wirelessly transmit that data to a consultant or other service provider in real-time is a relatively recent development. That capability, coupled with significant advances in the analytical systems available to service providers aggregating this data, will likely lead to significant expansions in the integration of big data tools on our farms and ranches. Although there is only limited research on the actual economic impact to individual farms and ranches from these technologies, anecdotal evidence suggests many farmers who are already using these tools are experiencing significant improvements to their decision-making capabilities, and with that, improved profitability. With the expansion of big data tools—which I would anticipate to continue rapidly over the next 5 to 10 years—I believe we would begin to see more widespread impacts to the farm economy as a broader cross-section of producers increase their efficiencies through such tools.

Question a. When we had higher commodity prices, to what extent were farmers adopting the use of big data?
Answer.

Recent periods of high commodity prices likely laid the foundation for adoption of big data tools through the purchase of new farm equipment integrating improved sensors and data communications equipment; indeed, many farmers may have joined big data systems through such purchases without intentionally doing so.

With the most recent periods of increased commodity prices (2008–2009 and 2012–2014) coinciding with fairly generous Internal Revenue Code Section 179 allowances for depreciation of capital assets, equipment manufacturers saw significantly increased sales of new tractors and combines, many of which included improved sensors for machine parameters (including harvest yield sensing) and for their external environment. These machines, at an increasing rate, also had integrated cellular modems that could be used to transmit data from these sensors to a service provider. In addition, for a number of years, farm equipment have been equipped to upload machinery diagnostics back to the manufacturer regardless of the farmer being cognizant of this data transfer. Thus, while the most recent periods of higher commodity prices may not have led directly to increased adoption of big data tools, it is quite likely they laid the foundation for increased adoption of such tools by enabling agricultural producers to procure the equipment needed to facilitate that adoption at a later date.

Crop Farm Received and Paid Indexes, All Items by Quarter—United States: 2011=100

USDA–NASS, 10/25/2015.
http://www.nass.usda.gov/Charts_and_Maps/Agricultural_Prices/cropfarm.php.

Question b. How has that been affected by the recent downturn in the farm economy?

Answer.

While recent data suggests declines in new farm equipment purchases, the downturn in commodity prices may actually speed adoption of big data tools as farmers seek ways to increase efficiency and reduce operating costs.

By all accounts, the recent downturn in commodity prices has had a significant negative impact on new agricultural equipment sales, but as mentioned above, recent favorable conditions may have put data-enabled equipment in the hands of many agricultural producers.

[October 2015 Flash Report]
[United States Unit Retail Sales]

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	October			YTD—October			Beginning Inventory Oct. 2015
	2015	2014	%Chg	2015	2014	%Chg	
2WD Farm Tractors:							
< 40 HP	11,469	9,305	23.3	105,443	97,564	8.1	65,586
40 < 100 HP	5,931	5,851	1.4	50,671	50,830	−0.3	33,048
100+ HP	2,717	3,853	−29.5	20,829	27,259	−23.6	10,226
Total 2WD Farm Tractors	**20,117**	**19,009**	**5.8**	**176,943**	**175,653**	**0.7**	**108,860**
4WD Farm Tractors	391	507	−22.9	2,562	4,426	−42.1	1,048
Total Farm Tractors	**20,508**	**19,516**	**5.1**	**179,505**	**180,079**	**−0.3**	**109,908**
Self-Prop Combines	457	572	−20.1	4,489	6,938	−35.3	1,397

[*These data are, in part, estimates that are subject to revisions when final detailed data become available. Because of the seasonal nature of the industry, comparisons of monthly data from one period to another should be done with extreme caution. These data represent the machines in each product category being sold at retail in the fifty states and District of Columbia by most, but not all, of the manufacturers.*]

Source: Association of Equipment Manufacturers, *http://www.aem.org/AllDocuments/AEM/MI/Reports/15%2010%20USAG.pdf.*

With this in mind, the downturn in agricultural commodity prices might actually increase the adoption of big data tools. The rationale for such a scenario is that big data tools hold the potential to help producers make much more efficient input and

machinery management decisions, thus decreasing their overall operating costs and helping them preserve as much profitability as possible given the prevailing market conditions. As history has repeatedly shown, the farmer and ranchers best-positioned to handle difficult times are the consistently low-cost producers. In order for big data tools to provide this potential benefit to producers, though, the companies providing them must have price points that make them cost-effective in the current market environment. Many service providers offer big data services at no direct costs to the farmer, or at least offer a 'freemium' version such that the farmer does not pay a fee for an entry level service. Upcharge services are sometimes available for farms desiring additional services. Other service providers charge a nominal annual per farm fee. These pricing structures are set to attract as many farmers, and farmers' fields, as possible so that a critical mass of farmers enroll in the system. The idea is that when the system has fewer than the critical mass of farmers, then farmers do not have adequate incentives to participate; and that when the system has at least a critical mass of members, then additional farmers have clear incentives to enroll.

Continued risk-management education programs to help producers understand how to effectively use such tools for their own operations will also be vital to adoption of measures that can help preserve farm profitability.