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**USDA 2015 Agricultural Outlook Forum
Smart Agriculture in the 21st Century
Plenary Panel
A Discussion on Innovation, Biotechnology, and Big Data
Moderator: Secretary Tom Vilsack
Panelists:
Cory J. Reed, John Deere & Company
Dr. Robert T. Fraley, Monsanto
Mary Kay Thatcher, American Farm Bureau Federation**

**Thursday, February 19, 2015
Crystal Gateway Marriott Hotel
Arlington, Virginia**

Secretary Tom Vilsack - Introduction

Well I want to get the next panel started, but I'm going to do this in a very abbreviated introduction so that we have as much time for our dialogue. Let me start with Dr. Robert Fraley, who is to my left, the Executive Vice President Chief Technology Officer of Monsanto. I like to introduce him as a World Food Prize Laureate who received that designation award in my home state of Iowa in 2013. So Doctor, thank you for being involved in this panel discussion.

To my immediate right is a good friend of producers all across the United States, someone who has worked for a while, I won't say how many years, advocating on behalf of American farmers and ranchers at the American Farm Bureau that's Mary Kay Thatcher. She is the Senior Director of Congressional Relations at the American Farm Bureau. Mary Kay, thanks for participating today.

And last, but certainly not least, Cory Reed, who is the Vice President of Intelligent Solutions, is that right, the Intelligence Solutions Group at John Deere. Certainly, a company that we all are familiar with. Coming from Iowa, I certainly appreciate the extraordinary investment that John Deere has made. I can tell you that I have to be careful about this I suppose, but my grandson is a John Deere fan... (Laughter). He's five years old... (Laughter continues) ...but he only plays with the green one.

This is a conversation where we're going to start with individual remarks from the three participants and then we will have a dialogue between ourselves for a few minutes and then we'll open it up to questions in the audience. You know the focus here is on innovation, the focus is on biotechnology in 21st century American agriculture, which is the focus of this conference. I couldn't have three better folks to participate in this dialogue.

Robert, I'm going to start with your opening remarks then we'll go to Corey then we'll finish with you Mary Kay.

Robert Fraley, Monsanto

Well, thank you Mr. Secretary. What a great privilege and honor it is to be here. I'd like to start, and maybe take the long view. We heard this morning, the prices and the ups and downs in the commodity market, but let's step back and talk about both the challenges and the opportunities that lie ahead. I've had the privilege of growing up on a small farm in central Illinois. I've been in agriculture with Monsanto for the last 33 years. I've seen agriculture all around the world. I can tell you there's never been a more interesting or more important time for agriculture. I'm sure you all know the challenges, world population growing, world wealth increasing, and demand for food continuing to skyrocket. A quick analysis that I go by is that between now and 2050 we need to double the world's food supply. A big part of that is going to be increased production, some of it will be reduced waste, which will be really important, some of it could be improved diets; but putting it into perspective means we have to produce more food in the next 35 years than we have in the entire history of the world. So I particularly look to the young kids in the room because the things that we do and the policies that we decide today are going to determine the kind of world that you live in. I really think it's so important that you understand both the importance and the seriousness of it.

Ambassador Quinn who manages the World Food Prize would say it's probably the greatest challenge facing mankind, but I'm not going to take the Malthusian view here. I'm going to tell you as a scientist that with the incredible innovation that's coming into agriculture, the phenomenal advances in biology that let us literally breed corn and tomato seeds gene by gene, the incredible infusion now of data science and information technology, I think will create the next green revolution and will enable us to improve productivity and yields. A real key for us to be successful around the planet is to take the land that we farm today and sustainably intensify yields and production, that's the best thing we can do to preserve the environment, it's the best thing we can do for food security. I'm convinced that we can achieve that and the data shows it already.

The last two billion people that have joined the planet have only required another 50 or 75 million acres because of the increased yields in productivity of U.S. and other farmers around the world. I can actually see a world by 2050 where we have achieved food security for everybody on the planet, and we've done it so efficiently that we can now think intelligently about how do we reforest, how do we restore wetlands; and that's a great thing because I remind you all that the only process in the world that fixes carbon is crops and plants and agriculture. The more smartly we can manage our farmlands, our pasture lands and our forests, [the more we] can address food security in an enhanced environment at the same time.

Secretary Tom Vilsack

Thank you, Robert. Corey, data is something that John Deere knows a little bit about.

Cory Reed, John Deere

Thank you Mr. Secretary. Thank you very much for being able to be here. I think Robb laid out the backdrop very well. I'm going to take a little bit of a right turn and look at my friends from National FFA

over here. If I look back when I started and when I left the farm in the 80's in Ohio, the most exciting thing for me is what it represents for young people today. At that time a lot of kids were coming off the farm passionate about agriculture, but feeling like they had to do something else to be successful going forward. I would submit to you that it's inverted today. We're looking for the best of every discipline to come into agriculture and the work going on in science, technology, engineering, and math, and what's happening in the space of technology is exploding the opportunities for young people going forward so whether you're one of the 610 thousand FFA [members] or you're one of the college students here, there's phenomenal opportunity in our industry.

For Deere, we've been doing this a long time, 178 years, and we say today there's never been a better time to be in the industry. We think about it from the perspective of our producers and the customers that buy our things. First of all, their expectations are changing, their expectations of quality and of what's delivered to them in the market has changed, not just from John Deere but from everybody. And it's moving from individual products, individual machines to the quality of the systems delivered on their farms to help them drive the top line yield and manage the cost in their operation.

Innovation has followed an amazing path, somewhat, around the world from mechanization through scale, through automation and optimization, but innovation is changing. For us in the last 50 years at Deere, it's been a lot about bigger, faster, stronger machines; in fact that was the 20th Century. [Regarding] this morning's conversation about 1923, the average size tractor we were selling was in the 30 horse power range. Today we're selling them in excess of 600 horsepower --- tractors that scale will continue, but in addition to bigger, faster, stronger in our industry, people have different expectations. Our producers have expectations about easier, smarter, and more precise, and, in fact, as the industry is changing, precision is being driven through the technologies available to move from average at the farm or the field level down to the square meter and today in the universities with Ag programs around the world they are working on plant-by-plant type technologies to understand how you can appropriately put the right seed in the right place, but understand that throughout the growing cycle, how healthy it is and how you care for it. It's incredible. The data space opens up whole new issues related to integrity and commitment in the marketplace, and I think we'll have a chance to talk about that. We are putting 178 years on the line, and we tell folks you need to understand who you trust and who you're willing to go to work in unlocking this potential in the marketplace. We're excited about that opportunity. So I would tell you, there has never been a better time. We look forward to the conversation; it's an incredible time for agriculture.

Secretary Tom Vilsack

Mary Kay, I always sort of react whenever someone talks about STEM, and I always wondered where is the "A" in all of that. Wouldn't it be better if it we had a STEAM program? (Mary Kay chuckles) agriculture in the arts, but somebody who understands the "A" in STEM, okay.

Mary Kay Thatcher, American Farm Bureau

Thank you and thanks for the opportunity to be here. Corey, I couldn't agree more. I think it is a very exciting time, and I think it's exciting too when we talk to our universities and they say we have more

people enrolled in agriculture than we've had in a long time. So we get a lot of not only the FFA and the 4-H'ers but a lot of the leadership programs and the young people are just incredible. We also think it's a very exciting time. We have been incredibly involved in the biotechnology issue for several years and continue to be, especially, in the GMO labeling issue right now. But we really view the whole issue of Big Data as the new biotechnology, and we also view it as something that while biotech didn't seem like it took 20 years, this latest technology will move even faster, so we've dedicated ourselves, as have the other Ag organizations, to really trying to help farmers understand the technology see if it's a beneficial thing to them, and see if maybe we can lower a little bit of the fear factor from something new coming out.

Secretary Tom Vilsack

Very good, well this is an opportunity for us to sort of delve a little bit deeper into the comments that you all made. Robb, let me start with you. Mary Kay talked about the 20-year or more history of biotechnology, actually, it's probably what several thousand years that it's been.

Robert Fraley, Monsanto

We had a long discussion of when we really began genetically modifying crops.

Secretary Tom Vilsack

One of my observations, and I'd appreciate your feedback on this, is that we've done a pretty good job of explaining to American producers the benefits, but maybe we needed to do a little bit better job explaining to consumers and to society what potential benefits might be attached to GMOs and biotechnology. It's something I think you know a lot about, so how do you make the case to the non-farmer that this is okay.

Robert Fraley, Monsanto

Well, you're exactly right. When I first joined Monsanto in '81, my task was to develop the methods to create GMO crops, and by '82 we'd produced the world's first genetically engineered crop. By '96, almost 20 years ago, the first crops went into the marketplace. So, on the one hand, it's been probably one of the most rapidly adopted technologies in the history of agriculture. Today, GMO crops are planted in [nearly] 30 countries, they're planted on about 25 percent of the world's farm land, and they're planted by farmers all over the world. That's exciting to see that progress.

On the other hand, if I look back, and if there's one thing I could have changed in my career, or what we did, we were excited about the science, we were excited about the products. We put all of our effort into communicating to farmers the benefits of reducing tillage, reducing chemical use, increasing yields, improving productivity and profitability, and that's gone really well. Over 90 percent of the corn, soybeans, cotton, sugar beets, and canola farmers in the U.S. are using the technology. But what we missed was the opportunity to carry that message directly to the consumer. I think we thought it was somebody else's responsibility, the food industries, or somebody else. I think what we've realized now is it is our responsibility as an industry, as a company, we're at the beginning of the food chain. So while

all this was going on, obviously, there were critics, and activists, and social media has been used very aggressively. You can find anything you want to on the Internet, but I think there's still a very huge opportunity to reach the consumers.

Maybe one of the mistakes I've made in my career is to look too much at the extreme views. There's the anti's, there's the pros, but 80 percent of the population in the middle is really wanting to understand is their food safe, is it economical? They want to make the decisions (the moms and housewives) in terms of purchasing and feeding their families. [With] cooks and chefs we have a huge opportunity I think to take that interest in food. The only thing my kids watch at night is cooking shows. There's a huge interest in food. We can explain to them why this science is safe, why it has benefits.

I start with what we saw this morning; it's remarkable to think that we're living in a country where we spend less on food than any other country in the world, 10 percent of disposable income. What a gift to consumers and lifestyle choices; what a gift in terms of addressing poverty and inequality. But clearly, trying to talk to a consumer about what yield is and how it translates into better food is a tough task. A lot of times I find it's really important to talk about the environmental benefits to consumers. There's a huge interest in knowing that these technologies have dramatically reduced pesticide use or that they've helped reduce the escape of carbon because we do fewer trips over the field. But then finally, it really has to get to the benefits these technologies have to consumers.

You just said it this morning, we've got better, healthier potatoes that have just been approved. We've got the arctic apple that is going to help reduce food waste. We've got a number of soybean products in the industry that are going to basically turn soybean oil; I used to say it was an oil that was like olive oil, until a couple of the scientists in my group who were working on it came back to me and said, technically, it's really better than olive oil in terms of low trans-fat and low sat [fats] and then being able to enrich soybeans with things like omega 3 fatty acids that provide the heart health benefits. There's a lot in it for the consumers.

What's exciting to me is when I talk to companies in Silicon Valley or university professors, there are projects that are turning into products all across the country. We're seeing a renewed interest in food and how this technology can help us address both nutrition and food security.

Secretary Tom Vilsack

Corey, if I can turn to you for just a second, but first, I want to explain to the audience that we're sorry that Dr. Suter is not with us today. He suffered a little problem with his back and had to get some medical treatment. He's from IBM and that's a solutions company, but Corey you're going to have to be the solutions guy here. Talk to me about the intersection of innovation, data, and John Deere. How does it translate to your company, and how does it then translate out into the agricultural community?

Corey Reed, John Deere

Let me start with when I go out and talk to producers, the first thing I hear from them in that space is that there's a sea of information and a sea of data flying at them today. We're probably collecting,

sensing being able to bring more information and data in front of them than at any time in the past; but first, it's to help them organize it, to help them put it in a position where they can secure, and control it; and then give them the tools to be able to unlock the value. Whoever you are in the industry, whether it's John Deere or anyone along the value chain, I think that's where the focus has to be right now, going from the sea of information into the vital few decisions that an individual producer on their farm locally can implement in order to either drive their top line yield or manage their cost. We think about that from an equipment manufacturer perspective.

Two things I would say, number one, we're extending beyond the individual machine into how do we create systems that allow them to operate better, grow higher yields, and manage costs; but we also know that if you're a John Deere customer, you spend a great deal of your resources, your capital acquiring a major capital asset. Our first objective is to use that technology, use that data to help optimize that individual investment for them. The second, though, and probably as important as anything in the chain, is to understand that the work getting done in the fields and farms of the U.S., the quality of that work, has a high degree of variability depending on the conditions locally to them. It's nothing relative to what the producer is doing. It's just being able to sense how is it that I plant better? How is it that I harvest better? What are the things that I can do to manage the variability operator to operator in my crew.

The next set of solutions in that space are tools that allow them to visualize that data in a useful way, to be able to drive insight about that variability and to make those handful of decisions to help them do those jobs better. We know the tremendous potential that sits in the seeds and fertilizers and chemicals that have been created in the industry, and the ability to take that potential and place it appropriately, to space it to the right depth, the right control and singulation and variability leads to better results. So how do you move from an understanding of all that data into practical tools on the farm that will allow you to do it.

The third bucket, which is a huge area of opportunity, that's really the industry. There's a huge industry behind it is able to manage all of the things related to agronomy on the farm. One of the things that's interesting is, we're hiring a lot of agronomists, not to make agronomic recommendations, but to be able to understand agronomy in a way so that we know how it gets applied through the hard iron moving through the field and what software [to use] ---that is probably the fastest growing space in John Deere where we're hiring people today is software developers, what tools for visualization, decision making, and implementation that can you give a producer to allow them to turn those insights into changes in how they work in the field and decisions that they make about how to produce a crop better? So from that stand point that's our focus --- it's moving from the sea of Big Data into the insights and then practical tools to be able to operate on the farm.

Secretary Tom Vilsack

Mary Kay, when Corey was in his opening remarks, he touched on the issue of trust, which I thought was an interesting observation in terms of all of this information. Who do you trust to collect it? Who do you trust to analyze it? Talk to me a little bit about Farm Bureau and how you as an organization are

walking that fine line between all the great benefits that we've heard here of innovation and data with that trust issue.

Mary Kay Thatcher, American Farm Bureau

So it's interesting the way we got involved in Big Data, which was a year and a half ago when several of our farmers called us and said, we beta tested some product for an equipment company or a seed company or whomever, and we just signed the contract, and went off and planted. It wasn't till a couple of months after planting that had enough down time to sit and read the contracts that signed, and weren't very crazy about the contracts that they signed and weren't very crazy about some of those details and they asked, "What do you know about this?" In essence, we didn't know much about it. So we spent a lot of time and got the other Ag groups together. Eventually, we got seven Ag groups and six Ag tech providers, Monsanto and John Deere being very active partners of those six Ag tech providers, and we spent a long time talking and trying to understand both sides of the issue, and indeed have come up with some principals as sort of a first cut at what's happening.

I think it's been a really great partnership. It's been very different for me as someone who lobby's Congress, and says we've got to fix this reg, we've got to fix this legislation. It wasn't like that. In fact, we prefer never having to add new legislation, but it's really been discussing and understanding more why the companies have to do 'X' and having them understand what is important to us.

I can tell you for sure for both Monsanto and John Deere, that the contracts that they put out for farmers have changed in the last year. I think largely because of the discussion with farmers about what's going on. On the other hand, farmers perceptions about what can and cannot be done has also changed. Now I think we're to the point where we have to go out and take the information that we've all garnered, and we all as a group are still working on that to try to educate farmers. That's a real challenge because we have some farmers who are gung ho about this technology, have used it, have seen the benefits, have seen more profits come, have said fairly publicly, the way I intend to garner more ground to rent is that I intend to go to landlords and say look at the technology issues. Look what I can prove to you, etc. We have others, as a good friend of mine likes to say, we've got farmers that think they have more in their head than they could ever get out of what happens with technologies.

So certainly [there are] different ways of educating people and talking to different consumers, but I think the partnership that agriculture and agri-business has had on this has been great.

Robert Fraley, Monsanto

I'd just like to acknowledge the role that you played in Farm Bureau to really bring this [about]. I think [you] handle it in a great way and provide for the common understanding and the protection of the grower and enable the science, and to be able to take all of this data that's being generated and more data that's going to be generated in the future, as we put more sensors and more data layers involved, and let that data be turned into useful benefits to farmers. You guys have done a great job. It's pretty clear that the opportunity to bring both the advances in biology and data science together is what's

going to drive productivity in not only U.S. agriculture, but world agriculture, so a lot of what's going on here is precedence setting in terms of how we address some of these challenges on a global basis.

Secretary Tom Vilsack

This is a question for all three of you. I think back to 7 or 8 years ago, if I had come to this conference as a audience participant, not dissimilar to Krysta Harden, and not knowing what I now know about all of this, I might have been sitting in the back thinking to myself this sounds great for a large operation. This sounds like really something that a guy who owns thousands of acres and has a big operation is a very sophisticated producer, this is all about that producer. So my question to the three of you is can you make the same case that I think is easily made to that commercial sized operator? Can you make the same case about innovation, open data, technology, biotechnology, to the entrepreneurial producer? The folks that are starting small and even to the extent of organic production, can you make that same case, and if you can why don't you try it on this audience? (Laughter)

Robert Fraley, Monsanto

Let me start with a little known fact. I talked about the biotechnology traits and adoption, and its use in [nearly] 30 countries around the world. There are actually more small holder farmers in Latin America, India, China, and Africa using biotech than there are farmers in the United States. The logic and the reason are so simple. You're taking all this sophisticated knowledge, literally the sequencing and mapping of every gene in a seed and then the biotechnology traits, but you're delivering that to a grower as a seed. Every farmer in the world knows what to do with the seed, so the barriers to adoption are very little. The same thing I see happening right now with data science and information technology - -- and it's not going to be the big tractor with the computer --- it's going to be the smartphone.

Today we're reaching 3 million small-holders in India with a text message about the weather, about the environment, about the cropping situation. As I look to Africa, four out of every small farmer in Africa are already getting access to a mobile phone, so every analysis that I've seen says that in the end this technology, because of its basically, scale neutrality, whether it's the advances in biology or the advances in data science, actually benefits the small-holder, the small grower disproportionately. They may not have the big tractors, the fancy equipment, they're starting at a lower base. But they can suddenly step change into modern farming in a way that would have never been possible. So I really think one of the most exciting aspects of this is how it will benefit global agriculture and that's going to be important.

Cory Reed, John Deere

I fully agree. I believe, if you take the U.S. as an example, certainly, there are advantages to scale that are harder to overcome around the initial investment. But the return side of this, you also have to look at the gap to target where some of the largest producers already have some of the best advice on the farm. Some of the largest producers already have some of the latest technologies. One of the great things about the latest advancements in technology is the ability to take it back across the entire fleet no matter what age. So today one of our primary technologies, which we're really starting launching,

this effort in the precision space for us was precision guidance technology. We now have over 750 platforms that you can put that technology on that can take it back to the entire machine population. So whether you're a 500-acre farmer, a thousand or five thousand, you have the ability to use that technology to reduce overlap, to manage inputs, and it's the core technology that enables you from a geospatial standpoint to unlock all of the other opportunities that come with precision agriculture.

Right seed in the right plot of land, right amount of nutrients in the right place. Those core technologies, I believe, are as important throughout the size scale in the U.S. Robb hit it on outside the U.S., today the biggest challenge for companies like ours is predicting how fast they'll move, and it's been extremely interesting to watch adoption curves in other parts of the world and see how fast smaller producers are moving to the latest technology to drive optimization and efficiency in their operation. Countries like India, China, and South America have incredible the adoption rates.

Mary Kay Thatcher, American Farm Bureau

I don't know Mr. Secretary, I think if I focus mostly on the Big Data issue, it's really hard for me to see how it doesn't drive consolidation in the agriculture industry much faster than we've seen it. I think whether you like it or not, Big Data is here to stay, and so our job is to figure out how to manage that, and I do think that I can make a separate case that we don't have as many adapters of technology as some would like to see. A friend of mine who has one of these Big Data companies, a startup, has told me several times that he beta tested 103 farms with this. But when he put his little device in the tractor at the end of the year, only 20 farmers knew how to get the information out, and it was a pretty much plug and play kind of a deal. Twenty more hired somebody to figure out how to come take it out for them, and the rest of them just bought the device and never did anything with it. I think that there are small farmers that if they wanted to take advantage, and if they look at the teeter-totter analysis and it says there's more pros than cons to this, in my mind, small farmers have a real opportunity right now to indeed adopt the technology and use it, I think, to go to landlords and get more land.

Secretary Tom Vilsack

Interesting. Let's talk about data and innovation in the context of some of the challenges that producers, regardless of size, are going to face. Let's begin with climate and climate change, talk to this audience about what you see the role of innovation and Big Data playing as it relates to adaptation and mitigation of climate, and the challenges that will present for producers. Anyone can take it.

Robert Fraley, Monsanto

I think it's going to provide one of the truly great opportunities. About 10 years ago in our company, I commissioned a small subset of our scientists, we call them science fellows, they are really our top notch scientists in the company to look at climate change to look at all the data and come back with the response as an agricultural company. What do we need to do and do differently to mitigate climate change? There's no doubt that we've seen a tremendous change.

In the time I've been at Monsanto, I've watched the crop production zones move almost 300 miles further north. One of the main things is that we have the opportunity to grow crops in parts of the world, in the Dakotas and in Canada that have never been possible. But that means you need the Big Data to be able to breed crops faster. One of the big benefits of data science and plant breeding is now that you know all the genes in the plant, and you can do the recombination, and you can analyze every one of their kernels, the brothers and sisters on the ear of corn, you can accelerate the rate of gain of breeding, target it to not only temperature, drought and environment, but the really big ramification that I see from a changing climate from a U.S. and for many other production areas, isn't what a lot of people focus on in terms of temperature and drought. It's the one- or two-degree change that changes when insects will hatch or when a disease will break out. So I think a really important role for data science is going to be to allow us to map, tag, identify, recombine, and create seeds that are much more robust in terms of their ability to resist insects and pests, which are going to be one of the real challenges of climate change. So that's just one example where we're using literally all of this genomic data, which is driven by big science and Big Data, to produce the better seeds that are going to allow us to offset some of the challenges that climate change creates.

Cory Reed, John Deere

I would add that I think one of the very practical things that we see is weather, weather patterns, weather volatility, along with the notion that all of the information and data that's coming to us suggests that there are optimal times to do each of the major jobs throughout a production cycle. There are optimal times to plant, there might be 5 to 7 days that is an optimal window. You can do it over a period of 3 weeks or 4 weeks but there's 5 to 7 days, those days move depending on weather patterns, depending on conditions.

One of the things that technology and data have allowed producers to do and will continue to do is to optimize the decisions they make and be able to hit those optimal windows at every cycle along the way in more near real time. A lot of production agriculture in the past has been planned off season, executed in season, and what data information is changing is that you can adapt faster, make crisper decisions about if it rains and nitrogen and looks like it's going down in my crop and do I need to apply now, here's how much, and here's the window of time. Those practical applications, I think, are the tremendous opportunities that we have to be able to capitalize on and while there's a risk on the weather side for each of our producers, they now have better tools to be able to plan and manage those risks in their operation.

Mary Kay Thatcher, American Farm Bureau

I think that's true, one of the reasons people adopt is the sustainability of agriculture is going to improve by having this data. It's improved via Autosphere, for example, when we don't have to put the same amount of pesticide over the whole field. I mean no question that this will continue the trend of farmers being great conservationists.

Secretary Tom Vilsack

Recent data that I've taken a look at in terms of agriculture's emissions on climate, we're at about nine percent, eight or nine percent of the U.S. emissions [for] agriculture. Internationally, it's 14, 15 percent, so we are doing a better job relative to our economy than agriculture in other parts. When you add forestry into the mix, we're actually sort of a net sync, and the challenge is for us to maintain that. That that ratio, which is why we are really focused at USDA on using data, using information and defining our programs and targeting our programs in a way that sort of amplifies what you all just talked about to the extent that we're going to set goals in terms of how we can help producers reduce emissions so we can maintain that ratio. Because if we're going to get serious about this, obviously the emission period, the issue is a critical one so data innovation is going to play a role.

Let's talk about that issue of pesticides. I'm going to ask you, Mary Kay, to weigh on this initially because I know the Farm Bureau is very interested in water these days. Obviously, there is a regulatory approach to this. Talk to me about what you see the future might be relative to water quality, land, soil health using innovation, using data in a way that maybe creates a new paradigm for how we reach targets, how we set standards, how we encourage folks to be more sustainable. Talk to me a little bit about your thoughts about that.

Mary Kay Thatcher, American Farm Bureau

Just as I said, I think it's tough to get your arms around, and you've got people who are comfortable with this technology and they're not, when you talk about sustainability issues, you can get both sides of the spectrum pretty fast too. Certainly, there are plenty of farmers out there who really view this as a way to make sure that they meet environmental targets. Although, in some respects, I would equate it with the old story about the two guys who are running through the woods, and the bear is chasing them. One stops to tie his shoe laces and the other says, what are you going to do? You're not going to outrun the bear? He says, I don't have to, I just have to out run you.

We have farmers who say, I only have to prove through all of my records here that I'm more sustainable than my neighbor when the EPA comes knocking. So I think there is some of that attitude. I think there are also people that are afraid to death, and you talk about the fear in big data of at some point when John Deere can monitor how long my tractor is idling. At some point, if the EPA gets a hold of this, are they going to come down on me because all of a sudden there is data that I really didn't want them to have. So I think there are plenty of fears out there, probably the fear of someone like an EPA getting the data might be at the very top of farmer's concerns.

Cory Reed, John Deere

I think one of the great opportunities, and you used water as an example, today there are water technologies that allow you to sense soil moisture profiles to be able to only have to apply when you need to make sure that from a quantity standpoint, you're managing very closely the needs of the crop together with the science that's in the seed and know water use efficiency and be able to grow the output from less water and more efficient use of water. All of these things are extremely important for our industry and will be demanded on the consumer side. I think that's the part from an industry standpoint that more and more this is being driven off of what consumers want to know about how

their crops have been grown. The technologies are there to allow us to get those baselines to be able to understand the footprint at individual farm levels and be able to manage it. To me that's the tremendous opportunity that the industry has today. Obviously it's not always easy to do.

To Mary Kay's point earlier, about the users and the non-users, the opportunity for us across this table is to make it easier to integrate. First, educate people on the benefits of understanding the baseline of their operation, but make the technology easier to integrate across all of the sources of where they're getting the offers today, and then be able to use it to manage what they're doing. Water quality is a great example of where today there's just an enormous potential using data and technology to manage it.

Mary Kay Thatcher, American Farm Bureau

And, I think you would get our California farmers, after the passage of the Ground Water Sustainability Act in California, or whatever it's called that's gone into place, I think you would get a lot of folks there saying we can't meet that new mandate without Big Data.

Robert Fraley, Monsanto

There's just a couple of examples where I think agriculture has really responded well, and how the new technology has made a difference. When I was a kid, I'd come home from school, and we'd get on the tractor, and we'd plow all the fields in Iowa and Illinois. That was the way we did. We controlled our weeds. The way we managed our farms was with the development of better tractors and equipment. Particularly with the development of the herbicide tolerant crops, we've seen practices like conservation tillage and no till double or triple in those parts. Those have had a huge impact on reducing erosion and improving water quality. I think one of the real opportunities, as we think about the use of the new knowledge in soil and data science, is going to be how more precisely we can use nitrogen. The ability now to know exactly the nitrogen level in the field, to be able to track that on a daily basis during the growth of the crop, to be able to make a very rational and economical decision on any additional nitrogen that may be needed or not, I think is going to be a real boon, using the data science tools to both be better stewards and better economic managers of probably one of the most important inputs as it relates to greenhouse gas emission and CO2.

Secretary Tom Vilsack

We've got about 5 minutes left in this segment, so I want to get to a couple of key questions. What is one advice the three of you would give to people like myself who are in government? What role does government need to play or not play in this issue of innovation, in this issue of Big Data? Are there things we need to be doing more of, less of, what advice would you give us to allow all of these benefits to accrue more quickly?

Robert Fraley, Monsanto

Three quick things, and to the young kids in the audience, first thing is, we need a massive support for STEM, in particular from an agricultural...

Secretary Tom Vilsack

You mean STEAM. (Robert chuckles)

Robert Fraley, Monsanto

STEAM. We are officially renaming it STEAM now. (Secretary Vilsack and the audience chuckles) We need to support STEAM, and particularly as you know, Ag and the food industry is under represented with women and minorities. That's a huge opportunity to bring more brains and more human capital that can make a huge difference to this challenge of doubling the food supply.

Second thing is we're blessed with a great set of institutions with the Land Grants, and now is the time to re-invest in agriculture. It's core to food security, food security is core to world peace, it's key to the environment. We need to invest more.

And the last thing, and I know you've been terrific on this, you know this is an area of science whether it's data science or biotech, that needs appropriate regulation. We just have to avoid over regulating and making sure that our policies make the science move forward. So it's so great to see the arctic apple and the potatoes get approved. We lead the world in terms of the gold standard for how we test, how we regulate, and how we approve these products and that's so important that we continue to do that.

Secretary Tom Vilsack

Great, thank you.

Cory Reed, John Deere

Yes, and I agree with those, I would add research and development, I think was covered by Robb in the universities infrastructure, is one of the things we don't talk a lot about. A lot of the things that we're doing today are being built off of the great telecommunications capabilities that are already in the country, but there are gaps in that space, and that's one of the key enablers for how this information, how data moves around. We think there's a tremendous opportunity there to continue to build, and our approach to this is to be as agnostic as possible to those key technologies that are out there.

Education, education, education, for me, whether it is the young people coming through the STEAM programs or whether it's educating the public about what we're doing in our business in agriculture is extremely important. I think those would be the only two that I would add to Robb's [list].

Mary Kay Thatcher, American Farm Bureau

And I might add that I think that the whole issue of Big Data could be really a savior for the Extension Service and what they have provided for farmers. Times have changed significantly, and they are such a

valuable asset that I think they could be even more so. I think too that the industry could probably use some help from the really smart people at Agriculture about how the health industry has already moved through a lot of this same technology places and the HIPPA legislation. Now USDA could help all of us with that transformation of portability and privacy and transparency --- and all those things, too.

Secretary Tom Vilsack

One of the things I've been thinking about is this issue about regulation. Obviously there are two types that I think intersect this topic. One is the one that Robb mentioned, which is there has to be some check on this to make sure that it's not going to create a problem in the fields or not going to create a safety issue, which is appropriate regulation to get products in the market, but to do it in an efficient and effective way. There's the issue of regulating conduct based on societal benefit.

This generation of young people and the utilization of smartphones, to your point Corey about broadband and the infrastructure, one wonders whether or not we are getting, and you mentioned consumers and the market driving a lot of this, whether we're getting to a point where it may not be about regulating conduct, it may be about establishing a standard of conduct and with the capacity of data knowing whether you're meeting that standard in marketing that you've met that standard. In other words, instead of regulating, you essentially say as a societal benefit, we want performance to be at "X." With social media and with Big Data or information, we're going to know whether you're an "X" or not, and if you're not an "X," folks are going to know it.

It seems to me that maybe incentivizing and encouraging as opposed to regulating may be a new dynamic and something for government to begin thinking about in this 21st Century, with innovation and technology, anyway, it's something to think about.

Alright, so the rest of the time, I've got like 48 more questions here... (Chuckles) ...is available for folks and the microphones. I would encourage individuals to take advantage of that. Alright, we've got a California person there. (Laughter)

Audience Member Question

Thank you. Thanks for this panel. I'm Glenda Humus, and I'm the state director for Rural Development in California and this topic is exceedingly timely. I'm thrilled to share with you that we're about to have our first Ag Hack-a-thon in April, something organized by our California Ag technology round table, [of] which USDA-RD, California, is one of the founding members of. The Farm Bureau's Young Farmer Rancher Organization is participating. We've got USDA data, thanks for our recent open data initiatives and a host of other partners, particularly, our community colleges. We're teaming up the young farmer ranchers with hacker clubs from the community colleges and code for America types and asking them to find solutions to problems. So the young farmers/ranchers are bringing the problems in the first day. The teams are going to work for a while and then they're going to throw up some potential solutions, which hopefully will get developed into major apps at some point.

The initial issues look to be ranging from reducing rural crime to transportation logistics, to food safety, to a host of other issues. So my question to folks like you is, what could your organizations do to help support these types of activities? We had a hard time actually getting this off the ground, although, it seems like kind of a no brainer in some ways. But what could you do to help with this, and what kind of issues do you think these young farmer ranchers coupled with these hacker teams ought to be looking at and trying to find solutions to?

Robert Fraley, Monsanto

First of all, congratulations. You're moving fast and in the right direction. You know one of the things that we think about comes really back to the STEAM/STEM education. We need more kids in science, and we need them [engaged] at a much earlier age to make that happen. So I think taking everything you're doing and now stepping that back into grade school and literally K through 12 and exposing folks to the incredible opportunities.

I was teasing earlier when we were getting ready that as I go around and talk to folks in universities, probably the two biggest things that have brought a whole new wave of young people into science, one of them is my favorite television program CSI. Literally, I have talked to heads of universities who had expanded their criminal science department and all those kids are taking science classes. The other one has been the incredible robotics competition and their just bringing folks into it so there is a huge untapped opportunity. That's why I list it as my number one goal, and as a company that's probably our biggest area of charitable contribution is --- how do we get more kids in STEAM and particularly more women and minorities?

Cory Reed, John Deere

The only thing I would say is I think you're hunting in the right place going with students. I can tell you even for us in application development work, we start inside the universities asking for student help to help us write those. It's amazing --- we've been at code writing, embedded code for a lot of years creating internal control systems for machines. Some of the best and brightest anywhere in the industry are 17, 18, 19, 20 year olds sitting in our university system today that have this incredible skill. So I think it's a great objective and getting more people understanding those tools, because as I mentioned earlier it's inverted, our industry needs the best and brightest from everywhere to come in and do that work.

I think the more open you are bringing people in and exposing them to agriculture as an opportunity not just, and certainly there's great opportunities as a producer, but all of the industry associated with what's enabled in this technology space, a lot of the tools come out of the universities and it comes from kids who don't have a background in agriculture today.

Secretary Tom Vilsack

Farm Bureau has a very new and interesting program in terms of elementary school kids. You may take an opportunity to talk a little bit about farmer in the class.

Mary Kay Thatcher, American Farm Bureau

Yes, the Ag in the classroom. So we spend a lot of time, especially our women's program spends a lot of time with Ag in the classroom trying to get in there when they are young with different things that teach them not only the math and science skills but teach them in an agricultural way.

I'm not sure if this is true in California, but another group that you certainly can add to your young farmers is many of our Farm Bureaus have started collegiate chapters. That seems like something that a lot of our collegiate folks would be very interested in -- so happy to share whatever experiences you have in California with other states and say hey maybe you want to try it.

Robert Fraley, Monsanto

Not to pile on, but it's so important -- I mean the number of startup Silicon Valley companies that are interested in agriculture is mind boggling. This is always dangerous to do with Secretary here, but if you look at USDA labor statistics, if you think about agriculture and the food industry, they probably contribute around 17 million jobs in the U.S., there's going to be a lot of turnover. I figure there will be north of three million jobs in this industry over the next decade and a big part of those are going to be STEM positions. I think it's absolutely the place to put your effort --- it will make a huge difference.

Audience Member Question

I'm Nina Federoff, Penn State Professor and Senior Science Advisor to OFW Law here in Washington. I have a question for Robb and a question for Corey.

Robb you pulled out your cellphone and indeed that's the vehicle you can imagine in Africa closing the gap in the equipment more readily than closing that last mile gap. What are your ideas about that?

Robert Fraley, Monsanto

Well, I can't overstate how important I think the mobile technology is going to be for Africa. Because the...if you look at the...

Audience Member Continues

It's the networks that right now, just getting texts is the problem.

Robert Fraley, Monsanto

But it's happening so fast; like I said four out of every small-holders in Africa has access to a cellphone today. The importance of the cellphone, just to belabor a second, is it does so many important things. I mentioned the agronomic device. For someone who has never had a weather report getting intuitive knowledge on wind or water or rain or pests is gigantic. But the other big challenge is how do they create markets? How do they create aggregation? The cellphone becomes the organizing principle for farmers to connect to be able to understand which market is paying the higher price or which outside vendor; and then the last piece that's so important, and we know we've seen this around the world is one of the biggest challenges that small-holders face us, what I would describe as middle man or loan sharks that are loaning money at exorbitant rates suddenly now the swipe of the credit card and micro

credit become feasible. I would just say that the combination of better seeds and mobile technology is going to be game changing for Africa and small farmers around the world.

Secretary Tom Vilsack

And that's going to drive the network, that's going to drive the ability to connect.

Audience Member Continues

But that's really the weak link right now because people have to carry two cellphones just to be able to get on a network, so that's really the weak link.

Robert Fraley, Monsanto

I think it is going to move fast, you're seeing huge investments. I think Corey is exactly right. I have been stunned at the rate of technification.

Secretary Tom Vilsack

That's not an issue that's just in Africa, it's an issue in rural America as well, which is why we're attempting to invest through Rural Development in wireless technologies and so forth, satellite technologies. It's a more difficult role for government, I think, and hopefully, we're trying to figure this out with the universal service fee and some of the other stuff the FCC is doing, trying to push the private sector to do what it can do, but in situations where the private sector can't do what it needs to do, then government needs to step in because we've got to make sure everybody is connected.

Audience Member Question

Thanks. My name is Paul Sude. I'm an analyst at the Steval Financial Group. I was wondering if you could touch a little bit more on the topic of ownership of the data. You address trust and...(Indistinct)...talked about his concerns that are out there that some of the data might be used with regulatory agencies, but there's also concerns out there on the commercial side. So I was wondering if Corey and Robb could talk a little bit about how you're talking to perspective technology doctors and working through some of those concerns.

Robert Fraley, Monsanto

Sure, and again, I give Mary a lot of credit for fostering that. We've worked with Farm Bureau, we've worked with the Open Ag Data Alliance, and we try to keep it really simple. So our belief starts, I think, as do most companies that first of all, it's the farmer's data; they own the data, and that's really clear. When we use that data to turn it into an algorithm or a Value Added, that's what we do with it. If we would use it for anything else, we would go back and get the grower's permission. The last thing that's always important is if a farmer wants to work with a different entity. Our... philosophy is then that data then gets returned to the farmer, and that's it. Then the other point the Farm Bureau added was a simplified contract. The only other thing I'd add at the top of it is we really believe that in the end the

grower is better served if all these systems are interoperable so that they can move and carry their data and get the benefit of service wherever they want.

Secretary Tom Vilsack

Corey, in your response to that, maybe you can touch as well on the cyber security piece of this because it may very well be that somebody gets access without permission. What are you doing to prevent that?

Corey Reed, John Deere

Let me answer the first part --- we think about it a lot of the same ways. We actually go back to three core principles. Number one, this information is highly valuable, and there are insights that you can derive from it that it makes sense to be able to go out and work with the best in the industry to drive those insights. You should ask anyone first of all --- and one of the conversations we've added with Farm Bureau for the last couple of years is first -- education on ownership. Obviously, it's the producer's data, but they need to make sure it's theirs. There are a lot of relationships throughout the cycle of how they produce a crop that can change that. Think landlord, tenant, service provider or customer; there's a huge opportunity for education. First of all, in the concept of ownership to make sure they understand when they're signing contracts what they are signing and how they manage that relationship and that understanding. It starts with a lot of value, and to unlock that value they're going to need to share it. They should ask everyone they're working with for transparency in how it's used.

Internally, I tell our folks, if you wouldn't be willing to go hang what we're doing with it on the wall of a church or of a John Deere Dealership, you shouldn't do it. And by the way, we only do it if the producer says I want you to do it. You can use it that way, so value, transparency and then even and probably more importantly, control. There's a lot of data being generated [around] the notion of control and being able to put your arm around what gets generated in your operation, which gets back to the security. First and foremost, it has to be secured. We know that every week there's a new article that comes out about someone who has been hacked into. Security is at the baseline of everything that has to go on.

There are people, our industry so far hasn't been one of the biggest targets, but there are people waking up everyday around the world trying to figure out how to get into this data. You need to make sure that who you're working with has very strong policies for how they manage cyber security and how they understand where those threats are coming from and how they're dealing with them. So security, open access, Robb mentioned it has to be open because you have to be able to share. Today there's standards in place through organizations that allow that sharing to take place personally. We're sharing with dozens, upwards of 100 companies today, but only when the producer says I want my data to go from here to there. It has to be accessible to them, they have to be able to have their information from whatever device they're on, their mobile device, their iPad, their home computer, but most important is insight. It's not good enough just that we move data around; they have to be connected to systems that allow them to drive insights back into their operation.

Mary Kay Thatcher, American Farm Bureau

I don't think it's a question of if a company is going to get hacked, it's when. Ag companies have already been hacked, and we tell people that there is nothing we can do. We can't stop outlaw hacking. You know Monsanto doesn't want to get hacked, John Deere, nobody wants to get hacked. But it will happen, and so farmers have to know that.

I think that Cory makes a great point, every company will tell a farmer, the farmer owns the data, but the fact is, if I'm the landlord, and Corey is the tenant, who owns the data? If it's a crop share agreement, who owns the data?

I bet I could ask farmers in this room who have local co-ops spray their fields, if there's anybody who has a contract or provision that says who owns the data, if you do, you'd be one of very, very few. So I think one of the biggest problems we have is that every company says farmers own the data, and that's just a little bit misleading. Farmers have got to go out and make sure they know who has that and put it in place. One of the other things that I think is a huge issue for farmers, right below the EPA Mr. Secretary, is that we do have companies where you send your data off, they write you a little prescription that says this is how you're going to plant the corn plants, closer together in this part of the field and the fertilizer over here, but unfortunately, they don't send you that to me, the farmer. They send it to my local seed dealer or my local equipment dealer, and if that guy happens to be competing against me for cash rent, he's got a lot more information than I wanted him to have about that data. So there's a whole lot of issues like that, that still haunt us and add to the fear that we have in farming that we have to indeed work through before this is going to be very accepted.

Secretary Tom Vilsack

Good point. Sir?

Audience Member Question

Good morning, and thank you. Eric Crawford, I'm an analyst with UBS. I guess just following up on Robb, your comments on the daily text messages in India. How adoption of the cutting edge, your latest cutting edge data offerings, compare across geographies? I guess for Corey, and you too, and more broadly, I mean no one is sounding any alarm bells, but I'm just curious what the level of innovation is like in more developing agricultural economies. If the model is for them to emulate us or if it's a breeding ground for perhaps more disruptive change.

Robert Fraley, Monsanto

Well, I think it could be a little bit of both. I can tell you that farmers all around the world share the same passion for innovation and for doing more with their land, even supporting their families or creating growth and economic and security. I've traveled to rural India and talked with farmers who've ridden in on garden tractors and elephants, carrying cellphones, wondering what the next scientific advance will be. I've seen the same thing in Africa, where we're working with the Gates Foundation on making better corn seeds; corn is really important to that central Africa diet. It's kind of like rice for Asia, and I think they're going to be fast adopters. I think they're going to do it in different and

surprising ways, and in many cases they'll follow and in some cases they'll leap frog. The cellphone example is really powerful, and we're not going to hook villagers and small holders up with copper wires, they're going to go right to cellular. They're going to use improved seeds in ways that are important to their operations. I think the important thing is that they have access to those tools, and that we're not pre-judging what they can do, can't do or don't benefit from, and that's really an important part of their right to choose technology for the future.

We will see tremendous production gains across the Americas. I believe that by 2050 we'll see doubling the yields of the major crops that we produce in North and South America, but even that will not provide adequate food security unless we see dramatic yield gains across Asia and Africa as well. It will be really critical that Africa has the capacity to feed itself in the future and I see that opportunity. I see Africa today much of how I would have viewed Brazil 30 years ago in terms of its potential, and I think innovation will make that difference happen.

Audience Member Question

Hi, I'm Kirk David from the University of Maryland and MDA Information Systems. We've heard a lot of very ambitious and visionary discussion of what's going to need to happen to crop yields over the next, say, 35 years, of doubling yields over that time, which is reasonable extrapolation of what's been going on to date. I'm wondering if we were going to have the same sense that we would have a grounded baseline assumption that say over the next 15 or 20 years nitrogen runoff was going to be cut by 75 percent because that's where as yields [we] have been increasing steadily for decades; nitrogen run off where the Mississippi runs into the Chesapeake has been pretty steady over that time. If we were going to have a baseline assumption that was going to be cut by 75 percent in the next ..., in a similar period, 20 years or so, would there be any differences in your thoughts about products you should be offering or business operations generally? Thanks.

Robert Fraley, Monsanto

I think the remarkable story of U.S .agriculture over the last 30 years has been how we've been able to do more with less. I left my dad's farm in 1970, central Illinois, the average corn yields in the country in 1970 were 72 bushels an acre. This year it's 171, right? So we've seen a hundred bushel increase in yield in 30 years without basically any incremental rainfall, so we're producing a lot more with less water. But we're also producing it with about the same amount of nitrogen that was used back in 1970. So that opportunity for what I call sustainable intensification, to take the land that we can farm and drive productivity at the same time, that we're enhancing sustainability is absolutely paramount for me that's the common ground that brings agriculture, food, and the environment together because it's key for all of those. I absolutely believe that as we breed better and better genetics that are more effective at utilizing nitrogen, as we understand more about soil health and the microbes in the soil, and as we get more and more precise with our tools on when and how we apply nitrogen, that we can drive that sustainable intensification and manage the environmental ramifications as well. So [I'm] very excited about the future. This is a great time to be in agriculture. I just wish I was your age.

Secretary Tom Vilsack

I would add to the list that Robb outlined, an additional commitment on the part of farmers and producers to conservation. We are beginning to measure the impacts and affects of conservation, and we're able to basically suggest that certain conservation practices, and particularly combinations of conservation practices, are more effective in terms of soil erosion, in terms of avoiding runoff, and that's why we're so excited about the Regional Conservation Partnership aspect of the Farm Bill; because we are seeing a greater societal interest as well investing in conservation, record number of acres enrolled, record expansion of cover crops, better nutrient management. I think there is a sensitivity to this, and I don't think it necessarily equates to reduced productivity. I think it's a new day for conservation.

The last thing I would say is that since you can measure and verify and quantify a conservation benefit, there are market opportunities to market that benefit, that might create additional investment in conservation. That will make it easier for producers to take that non-productive land and use it for a very constructive purpose.

Audience Member Question

Yes, good morning. I am Andrea Rivera. I'm a Data Scientist from Dayton, Ohio. A refugee from the Department of Defense, now in agriculture. With the risk of recording the Secretary's own data, one of the things that has motivated me to be in this field of data and agriculture is the last USDA Census information. Basically, the Secretary said, and I quote, "That the top four percent of agricultural producers are responsible for 66 percent of the outputs, and on the other hand 75 percent of the producers are responsible for three percent." So I asked myself, how'd this happen? And one of the issues, of course, is the ability of the farming community to embrace technology and innovation; no doubt about it that is the big thing. So everybody had the very nice combine and the very good equipment, so the question is not the lack of access to technology, but the issue would be if it's not a technology innovation, then what this will be? And I will submit to you that it's a social innovation --- what is in front of us. So if you had said that had focus, and for a moment that we're not talking about just technology but integration into the fiber of agriculture, what would be your suggestions then for the reduction of barriers to entry when we look at the way the farmers will integrate the data into their way of living? Thank you very much.

Cory Reed, John Deere

I think we've touched on one of the barriers that the industry faces and that is to take what is behind the scenes, very complex set of understanding related to genetics, related to machine operation and health, related to importance of placement, and all of the things that go into improving the total production system for a producer and making it easier to integrate. In the years past, the variable rate is a good example. Variable rate existed for a lot of years. Even the largest of those producers you refer to --- there wasn't a high percentage of them --- that were actually using the technology up until recently, what's changed? The resolution of information that they get back from those operations today to understand what worked and what didn't has changed and it's gotten a heck of a lot easier to integrate the technologies that they can use to actually go do the work.

I mentioned earlier, the system has changed for companies like John Deere, from the component or the vehicle, so now the system goes wider into each of the jobs on the farm, and in many cases across the industry. Companies like John Deere are working with Ag input providers, working with Ag retailers to make it easier to integrate all of these tools at the local level. Our business is still inherently local, whether you're a large producer or whether you're a small producer, they each farm a certain way, every one of them are unique. We have to be able to work together to open up the system and be able to make it easy to integrate at the local level and that will require not just great machines, not just great technologies, but services from a lot of companies that can go help that integration occur. And in the end back to the question about the drivers ---the drivers are simple, it's environmental, it's economic, and every one of those producers just wants the ability to compete on an open market. They want the ability to compete on their efficiency. It's my belief that the biggest thing we can do is make it easier to integrate.

Secretary Tom Vilsack

One of the challenges with agriculture is the definition of who is a farmer. We have a fairly expansive definition, anyone who produces more than a thousand dollars worth of product constitutes in our Census a farmer. So that means that we have 2.3 million folks who do that roughly, 2.2, 2.3 million. Of that number 1.3 million are folks who have something in the back yard or in the back forty that they do because they want to do it. Maybe they're retired, maybe they enjoy it, maybe it's something for the grandkids to do. That's farming, but it's not the kind of farming I think we've been predominantly talking about here today, so that leaves about a million; of that roughly 700 thousand producers or so who produce less than 250 thousand dollars worth of merchandise, and those are the people that I have deep concern about because to Mary Kay's point about consolidation, those are the people who are greatest at risk from that standpoint, because they have smaller operations and they're trying to compete in a commodity based market where it's very, very difficult. That's why we have made a local and regional food systems a priority; it's why we see the value added proposition of organic being something that should be available. So you're really dealing with commercial sized operations --- a balance of the 2 to 300 thousand, and they do produce 85 percent of what we grow. So it is important for people to understand that.

We're focused on a couple of issues at USDA as it relates to sort of barriers generally, one of which is obviously credit and the ability to access resources to get started. That's why we established the Micro Loan program; that's why the Farm Bill creates new opportunities for beginning farmers and ranchers to get credit at a more affordable rate. We'll do roughly 42 thousand loans and the majority of those will go to beginning farmers and socially disadvantaged producers.

It's also about expanding crop insurance and risk management tools so that those producers are not at a disadvantage if Mother Nature doesn't cooperate. It's also about creating new market opportunities and that's why I emphasized that in my remarks earlier today. It's about expanding export markets. It's also about expanding domestic markets, and it's also about the innovation of using agricultural products differently. We were talking about food, obviously, but there's a lot of waste products associated with agriculture, there's a lot of corn stover there's a lot of woody bio mass there's a lot of stuff that we

produce when we're producing all these crops and this has value. This has value as a fuel source, it has value as an energy source, and even now today a value as a new chemical or new material. To me what is really exciting about the innovation, about the science behind all of this is what creative people are doing with that waste product. It opens up manufacturing opportunities in rural areas, it opens up that opportunity for smaller producers, so if you expand credit, if you expand crop risk management tools, if you expand new uses for what used to be of little value, it makes an opportunity available that may not have been available before, and if they're particular high value added propositions.

One of the challenges is this whole issue of land and access to land, and one of the things that we've now tasked to the Deputy's leadership [is] our Beginning Farmer Advisory Council. What about land tenure? We are faced with a fairly significant generational shift here that's going to take place in agricultural land. A lot of it is owned by people that look a whole lot more like me than the young people here today. Who is going to own that land in the future and is that going to accelerate the consolidation that Mary Kay talked about. To me that is a very significant barrier, and we need to be talking more about how we remove impediments to transferring or making that available to young and beginning farmers, otherwise you're going to have a massive consolidation, because only a few people are going to be able to afford that land.

We have just a minute or so left, let me go to the last person that I think is available and you get the last question.

Audience Member Question

Thank you. Christy Townsend. I'm a Geospatial Analyst with Grow Intelligence. Satellite imagery is something that we use to monitor agriculture, and it seems like every time you turn around a satellite is being decommissioned or just plain old, getting old, and there's not always a plan on how to ensure that there's data continuity there to support the whole concept of Big Data analysis for agriculture. What are we doing to ensure that we have enough satellites up there to provide data so we can get the support for the agricultural community?

Cory Reed, John Deere

Let me just make a comment on the importance of it and re-echo something that we already said, but I mean today a lot of the core technology used to enable what we're doing in this space comes from satellite technology, [where] there are two things going on. There are a lot of countries around the world investing heavily to bring new networks into place that will benefit actually a lot of us. So every new network that goes in creating new satellites that are out there, they do networking in China and gone are systems, and all of those are all systems that American producers actually benefit from by being able to track and understand and use the satellites for a lot of the core technology that we have. But more and more the question is what are the other technologies? What we're finding is that it's exploding for a number of the technologies that are available to be able to do imagery type of work. For 20 years people have been using aerial imagery other than satellite. Today UAV, UAS systems are a major part of that, so to me, it's not an either or situation, it's a both. Satellite-based technologies are

going to remain extremely important, and you're going to see them augmented by a series of additional technologies along the way.

Secretary Tom Vilsack

Do drones have any effect on this at all?

Cory Reed, John Deere

Absolutely, drones and UAVs are major components going forward of what will happen with imagery, different kinds of imagery they allow for increase in frequency and they allow for individuals to be able to go out and do some work on their own property using their own system. Obviously there's a lot going on in that space from a regulatory perspective that's extremely important but imagery and the use of imagery and sensing technology will only rise going forward.

Robert Fraley, Monsanto

I'll just add that it's kind of a race between the satellites and the development of sensors. The average new car that you buy has between 4,000 and 5,000 sensors in it now, telling you everything from speed and how the equipment is running, to are you running over the white line or yellow line. The same thing is happening with farm equipment, and we can see a world where the planter or the cultivation equipment has sensors that are detecting soil moisture, nutrition, microbial health, and etc., and those are going to be a great addendum to the imagery available from satellites.

Secretary Tom Vilsack

Let me take this opportunity, you can gauge the interest of an audience by the number of people who leave during the presentation and not very many people left which is a testament to the great job that the panelists did. (Laughter). Please join me in thanking everyone. (Applause).