

GETTING TO ZERO HUNGER: RESEARCH FOR RESILIENCY

Panel Moderator: *Paul Schickler*

October 18, 2019 - 9:00-9:55 a.m.

Introduction

Margaret Catley-Carlson

Council of Advisors, World Food Prize

Usually at nine o'clock in the morning if people aren't in their place, you accuse them of having slept late in bed. At the World Food Prize you can accuse them of having been to already two sessions on something else and that some of these went on a bit long. So it's been a busy, busy morning, and I know that a number of you that are coming in and getting settled are coming in from other sessions. But we do have our panel assembled. We have two other panels coming up this morning on really exciting topics, but I think we probably had better get started.

I'm Margaret Catley-Carlson. I'm a member of the Council of Advisors to the Board, have been so for a number of years, a very proud member of the Council of Advisors. And so they give me the task of introducing some of these panels, which I'm very glad to have. So this is our event to begin getting to *Zero Hunger*, obviously, *Research for Resilience*. The whole theme of the morning is *Coping with Climate Change with Resilience*, and so this is *Research for Resilience*. And we've got some people who know a good deal about this topic, who lead organizations that work in this area and who you will enjoy very much listening to.

Okay, so would people like to move onto the stage, please? Our panelists are Professor Louise Fresco, who is the... You will have seen her before. She is the president of Wageningen University. She has become an amazing part of the World Food Prize. We even planted a tree together to mark this great friendship. And then we have Administrator Ken Isley, who is the administrator of the USDA-FAS, and then we have the Administrator Dr. Chavonda Jacobs-Young, who is the Administrator of USDA-ARS. Now, they didn't tell me what these mean. I can guess, but I don't think that's a good idea. And so therefore probably the best thing you better do is explain these initials. And then we have Tom Thompson who is the Associate Dean and Director of Global Programs, Virginia Tech College of Agriculture and Life Sciences. You have in your books bios of these very eminent people, so I'm not going to spend our time doing that, but do read these, because you will see exactly why these people have the knowledge and the wisdom and why they're sitting in front of you this morning, sharing that knowledge and wisdom with us.

Paul Schickler is the chairman, and, Paul, you're going to chair this?

Paul

I'm going to try and moderate this group, yeah.

Margaret

You're going to try to do that, okay. He's our chair of the World Food Prize Council of Advisors, a very good chair, I feel, and we're handing it over to him. Over to you, Paul. I don't know if they're going to stand up or sit down.

Paul

I will be here. Thanks, Margaret.

Margaret

Very good, thank you.

Panel

Prof. Dr. Ir. Louise O. Fresco	President Executive Board Wageningen University & Research
Hon. Ken Isley	Administrator, USDA-FAS
Hon. Chavonda Jacobs-Young	Administrator, USDA-ARS
Dr. Thomas Thompson	Associate Dean and Director of Global Programs, Virginia Tech College of Agriculture and Life Sciences

Moderator

Mr. Paul Schickler

Member, Board of Directors, The Chicago Council on Global Affairs

Margaret, thank you for taking over this morning and organizing us but also for your service to the Council of Advisors. Thank you. As Margaret said, we do have a great topic today to address and maybe to put this in a little context, because we are at a symposium focused upon food security. And if you look back at the last hundred years or so, I think you can recognize the great strides that have been made. In the early 1900s, for example, maize yields or corn yields were less than two metric tons per hectare. And where we stand today, 100 years later, it's somewhere around ten metric tons per hectare in the United States. So tremendous advancement in productivity and in the introduction of technology and equally important is the transfer of knowledge through extension activity.

And what we have on the stage today are four organizations that were part of that tremendous contribution to public research and the contribution that that's made to farming in the United States and throughout the world. So what we're going to do first is hear from each of the four organizations, the individuals, and they'll also define their acronyms that are behind each of the names. But they'll take about three or four minutes to do that. They we'll have a discussion. And I will try and save about five or ten minutes at the end for questions from the audience, so you might be thinking of that now if you have questions, and then we'll take that time at the end.

So I'm going to go straight from my left to right, your left to right and start with Ken Isley. So if you would take a couple minutes and provide an introduction, Ken.

Ken Isley

Very good. Well, thank you, Paul, and it's my pleasure to be here with you today. And FAS means Foreign Agricultural Service. I have the great privilege to lead the USDA's Foreign Agricultural Service Agency, and we're an agency that's focused on trade and dealing with agriculture trade policy, agriculture trade promotion, data gathering and analysis from around the world, and implementing the food aid and capacity-building projects within USDA internationally. So it's my pleasure to be here representing the great women and men of the United States Department of Agriculture, along with my colleague, Dr. Jacobs-Young, representing Secretary Sonny Perdue, and particularly the women and men of the Foreign Agricultural Service.

I grew up about 25 miles from here on a family farm, and my perspective of trade at the time was hauling a wagon to a local elevator or pulling a stock trailer to a local cattle market – and that to me was agricultural trade. Boy, has my perspective changed over my career, 29 years in the private sector in agribusiness and now leading an international organization located in 95 posts around the world. Trade is needed in agriculture to connect where food is grown to where food is consumed. It's also needed in agriculture to provide one of those key sustainability requirements, and that's sustainability of rural communities, whether in the United States or anywhere around the world.

At USDA we go by a simple motto that's coined from Secretary Purdue, and that's, *Do right and feed everyone* – not just everyone in the U.S. but everyone in the world. We're blessed in the U.S. with an abundance of natural resources, infrastructure, and resilient farmers necessary to produce food that can be consumed all throughout the world.

What's needed to continue that in my mind and based on my background, it's innovation – and it's not just innovation. The creativity of our scientific community is second to none. The possibilities in plant and animal technologies are almost endless. But what's needed really in today's world in innovation is connecting that innovation with honest dialogue about the various attributes and impacts of that innovation. I'm a strong believer that we need to have more open and transparent and accurate communication about production agriculture and about food safety. And how we come together as an agriculture and food community to facilitate that, I think, is critical to solving some of the biggest challenges – not just food security but also environmental impacts from production agriculture and all the things that go with it.

So I'm unashamed in my support for innovation that's reasonable, that's been researched and determined to be safe, and how we can get those innovations to the market. And every day I'm more than happy to try to address the Fear Your Food Movement and try to clarify myths versus truths. So I'm looking forward to talking more on these topics and how that links to solving hunger around the world and providing that sustainability deep into the future.

Paul Schickler

Thank you, Ken. Thank you. And, Louise, would you make some remarks? And I should mention also in addition to Louise's responsibility at the University, she's also a member of the World Food Prize Council of Advisors.

Louise Fresco

Thank you, Paul. Indeed, resilience is of course about the capability of an agricultural system to deal with the fluctuations of climate or the fluctuations of what happens in the soil or of markets. We want farming to be stable, to be stable also in the lives of adverse conditions in whatever way.

And so if you look back at the Green Revolution, which has been so tremendously successful, there are a number of lessons to be learned for resilience and for stability. And one is of course that at the time we did not know that there were many negative side effects of the inputs we were providing, side effects in terms of environment, of water pollution, of overdosing on some of the chemicals.

So the first lesson for resilience in terms of research for resilience is—How can we do more with less? How can we optimize the influence to optimize the outputs, take account of the environment but also take account of the social conditions, of not pushing people out of agriculture if they want to stay in agriculture, to give adequate support also in socioeconomic terms?

The second lesson from the Green Revolution is of course that it's about more than just the basic grains. It's not just wheat and maize and rice but it's the variety of crops. And we now know better than before that in diversity is a lot of resilience, the fact that you have more crops, that you can rely on more crops.

The third lesson from the Green Revolution that is really a driver for research, that this is not just about production, it's about a whole food chain from production all the way down to consumption. And the consumer diets and nutrition are an essential part of the way we look at resilience today. And doing whole food chain research, I think, is really one of the areas of the future.

And that means, by definition, that we should look broader, that we should look at how consumers perceive things and why perhaps so there's so many misunderstandings about the role of genetics or the role of chemicals or the role of regular, what food safety really is. It's an enormous communication effort that is hidden behind the word *resilience*. And that is, I think, something we only start to discover today. It also means that we have to look at scientists more and to... citizen science, for example. How can we involve citizens in understanding some of these processes?

All those are great challenges, but fortunately we are helped by major advances in research in the last ten years, and I expect them to resonate for the next ten years at least. Those are advances in genetics, such as CRISPR-Cas, a much finer and better understanding of genetics. There are advances in detection methods through digitalization. We can know exactly now how a piece of a carcass or a piece of meat has been exposed all the way down to the consumer. We can monitor safety. We can monitor through satellites what happens on our land.

So if there's one word you want to remember in relation to resilience and research for resilience, it's the word *precision*, precision in understanding the processes, precision farming, precision design of food, but also precision for the consumer. Quite soon all of us will have a little chip either in our watch or in our wrists that actually tells us about our nutritional levels in our bodies. And that will happen to plants, it will happen to animals, it will happen to the soil. So precision and resilience go hand in hand when it comes to creating agricultural and food

systems for a future world with all these climatic stresses, with all the demographic stress that we have.

Thank you.

Paul Schickler

Chavonda, please.

Chavonda Jacobs-Young

Thank you. Good morning, everyone. So I'm Chavonda Jacobs-Young, and I'm the administrator for the United States Department of Agriculture's Agricultural Research Service. So ARS is the largest in-house research agency inside of USDA. We partner with our extramural agency, the National Institute of Food and Agriculture to provide much of the innovative research for agriculture from the U.S. government. And so we are about 8,000 people on a good day – 2,000 of those are PhD scientists, and we are located in 90+ locations across the country.

We also have four overseas laboratories, one in Australia, one in Argentina, one in France, and one in China, and a worksite in Besson Aliko, Greece. So those are hardship trips if you have to do that. And in those overseas laboratories we do a lot of biological control work. We go and we are on the hunt for native enemies to some of the pests and diseases that we face here in the United States. So we have a large collaboration with our global partners.

So in the United States ARS does the full scope of agriculture research. We have seen in history how important innovation and discovery have been to helping us meet those big challenges. We talk about the work of Dr. Borlaug and how critically important that work was – and we can't stop there. We have to continue.

And so I want to start my comments by saying that we need a constant influx of talented, skilled young people, some old folks, too, like myself, in agriculture. This is truly a high-tech industry. This is not our agriculture from the 1930s and 1940s. We are using tools like artificial intelligence, like machine learning. I remember the days when just getting the data was the success – if we could just enough data, we felt successful. And now we need to figure out what to do with all of that data that we've produced, much of it not produced to be interoperable. And so how do we use tools like artificial intelligence to layer those datasets together to give us the information we need to put decision tools in the hands of producers.

My vision and most of our visions is that one day a farmer, he or she, can stand with a smartphone in their hand and be able to manage their production facility precisely with the right type of information and be able to be super-productive. I know that food security and getting to zero hunger is a huge challenge. It can seem overwhelming, but I believe together, all of us taking on this challenge, that we can meet it.

We have long-term infrastructure in the United States. ARS is home to long-term infrastructure. We carry on the original mission of the Department of Ag, and that's to bring together all the important information for agriculture production and make it accessible to the people who need it, in our view, those people, whether in the U.S. or around the world. And so we've been working very hard to digitize much of our collection. Any information we have, we want to put it on the Web at the National Ag Library, full-text publications, peer review publications, our

raw dataset. We're trying to make as much information available... If you have internet access, wherever you are in the world, you should have access to the data and the information that we are providing. And so we're working to do that.

Just one last thing I'd like to share with you about long-term infrastructure. Being an intramural agency, we have the ability to develop and maintain long-term infrastructure. In ARS we have ten ARS climate hubs, so we have climate hubs around the country where we're taking data that's been generated inside of the laboratory and translating it into information that people can use. We have 18 agroecosystem sites. It's LTAR, Long-Term Agroecosystem sites across the country. But we have those sites across the country, and they are equipped with sensors and the high-tech information so that we can study techniques like rotation, like no-tillage, like grazing animals. And so we can do this so that by the time we give that information to the producers, we've tested it ourselves.

And so we also have six nutrition centers, because nutrition has been a huge point of conversation this week, studying from gestation to the grave. We study from the time that that baby is formed until folks like me are in our retirement age hopefully soon and what we should be eating as we age, for a high quality of life and to minimize the impact of health issues.

And so I'm really excited to be here to talk with this group of wonderful representatives from different organizations but all with one goal – to get to zero hunger. So thank you.

Paul Schickler

Okay, Tom, would you wrap up our opening comments, please?

Thomas Thompson

Yes, thank you, Paul. And it's a real honor to be here with such a distinguished panel. My name is Tom Thompson. I'm with Virginia Tech on Wednesday of this week Virginia Tech launched here at the World Food Prize the Global Agricultural Productivity or GAP Report. This was the tenth iteration of the GAP Report, which is launched annually here at the World Food Prize and the first one launched by Virginia Tech.

The GAP Report is a call for innovation and action to increase total factor productivity in agriculture. And total factor productivity is a measure of the efficiency with which agricultural inputs are converted into outputs. And so the message of the GAP Report is that increasing productivity in agriculture is the best way to achieve food and nutrition security and sustainable agriculture and also sustainable diets, which have been so much in our conversation in the past few months.

In the GAP Report we advocate for six strategies for achieving sustainable agriculture and sustainable diets. And I think two of these are especially relevant to our discussion this morning. First is investing in public agricultural research and development, extension and consumer education. And the second strategy that I'll mention is embracing science and information technology-based solutions for enhancing resilience, sustainability and competitiveness for growers.

You know, here in the U.S. public research expenditures for agricultural R&D have decreased both in absolute and in inflation-adjusted terms since about 2005, and that's despite the fact that

according to the SoAR Foundation, there's a 20 to 1 return on investment for those expenditures. So despite that, our expenditures are decreasing, and we need to invest in public agricultural R&D here in the U.S., not just for the U.S., but also because much of that technology is transferred elsewhere in the world and helps to increase productivity in many parts of the world. And so money spent invested to increase productivity, including such steps as diversifying production systems and improving post-harvest management, and many others can increase resilience and sustainability.

Now at the same time here in the U.S. private agricultural R&D investment has increased as well, in fact to the point where private ag R&D expenditures are about two thirds of all R&D expenditures here in the U.S. And this is good news. But we need strong public ag R&D as well, because the purposes, the objectives of public expenditures and private expenditures are not necessarily the same. And at the same time public expenditures in the U.S. have been decreasing they've been increasing in China, and now we're behind China. We're also behind Western Europe and the Asia Pacific Region in public ag R&D expenditures. In Africa, public expenditures on ag R&D have actually increased, beginning in about 2000 to 2014, a 50% increase, but half of that increase occurred in just three countries, Nigeria, Kenya and South Africa. So much of the continent continues to lag behind.

So I hope those are relevant to our panel. I just want to mention two other quick things. Along with public ag R&D expenditures and private, part of that ecosystem needs to include strong extension advisory systems as well. So all of these innovations will not make an impact if we don't give farmers the tools, help them understand how to use them, and adapt them to their situations.

And then finally, as has been mentioned, consumer acceptance is going to be very, very important. And that is a struggle that has been noted, I think, in many of the panels here, is there are a lot of great innovations out there, but we have a lot of work to do to gain consumer acceptance of some of those.

Paul Schickler

Great. Thank you, Tom. And I'm going to follow up your comments with a question first directed to Chavonda and then next to Tom. You know, as I described in my opening comments, we've moved in the United States from less than two tons per hectare for maize to now ten tons, and public research contributed greatly to that. But as Tom just mentioned, we've seen a shift here in the last years to much more larger and aggressive private research funding. So has USDA adjusted in that shift from dependence upon public funding to now research being led by private?

Chavonda Jacobs-Young

Absolutely. So recognizing that shift in funding, it's been critically important to really foster public-private partnerships. In the last Farm Bill, so the Farm Bill before this one, the Foundation for Food and Agricultural Research was created, or FAR. And FAR was created to advance the mission of USDA by bringing together public-private partnerships. And so it might be a unique situation in having a foundation created by congress with a corpus. The corpus was \$200 million, \$200 million to match with funding that was brought to the table. So \$200 million of public funding to be matched to corporate or philanthropist funding. And so we've been successful. I'm an ex-officio member of the board for FAR. We've been successful in bringing

together and facilitating those partnerships. It was reauthorized in this last Farm Bill because of the success it had in the first Farm Bill. And so that foundation was created to build this gap.

In ARS we depend on private industry to take our technologies out of the laboratory. We don't commercialize. And so if we develop a product, sometimes it's patented, most of our varieties are just delivered free of charge to the public. But if we deliver a product that requires a patent and a license to disseminate, we count on the private industry to take it to the next step.

So I see the increased investments in private funding as a plus for all of us, because there's no way we're going to meet the challenge without all of us being on board.

Paul Schickler

Right, right. And so, Tom, you mentioned the shifting funding. And so how have you at Virginia Tech adopted to doing more with private industry, given the lower funding that you have at the University?

Tom Thompson

It's been an interesting shift that I've seen in my almost 30-year career in the Academy. And when I started out, the focus was mostly on public funding, whether it's from the federal government, state governments, etc. But with this shift has come, I think, at the same time in the Academy and especially at land grant universities, an increased interest in and focus on potential commercialization. So I think it's actually helped us as academicians to be more cognizant of and more focused on potential commercial applications for the research we do—which is a good thing. But we don't want to leave behind the basic research that helps to build that foundation.

Paul Schickler

Louise, please.

Louise Fresco

Exactly. I couldn't agree more. I think a good balance between private and public research is of great importance, we obviously have a complementary to there. But there are two things. One is that the academic community should make very sure that they have very clear rules about independence, autonomy and critical mass, so that in the end, for the greater good of society we know that this is true, trustworthy and honest research. I think that is very important, especially because of the acceptability of research in society.

The second one is, it's very important that there is room for fundamental research. If we do not have that, we are going to miss enormous things. And the very best example of this is the work that has led to CRISPR-Cas. What most of you probably don't know is that CRISPR-Cas work, which is now all really revolutionized plant breeding and animal breeding and will do a lot more, has actually started out as a very obscure line of research of some bacteriologists looking at how bacteria, which were two billion years old, actually tried to defend themselves against viruses. That technique has led to CRISPR-Cas. And so fundamental research in all fields is going to remain essential.

And one of the things I think we need to discuss in the context of food security and resilience and so on is—How can all countries, including developing countries where the pressure on doing things quickly and rapidly, remains in balance so that fundamental applied private and public are the right mix.

Paul Schickler

Good, thank you. Ken, you know, clearly the issues we're talking about in agriculture are global in nature. But over the last decade or so, we've seen some countries, some regions of the world back away from trade and focus more on national issues and in some cases even restrict trade. So what can the Foreign Agricultural Service do to ensure that we have the right focus upon trade where it makes sense?

Ken Isley

Yeah, well, we're very focused on free, fair, and reciprocal trade. But one of the big challenges—and it kind of ties to the discussion on innovation—is the harmonization of regulations around the world that enable trade to actually flow. You know, part of the challenge... I'm a big believer in the diversity in terms of how innovation is done, whether it's in the public sector, private sector, academia. And even within the public sector, having that diversity of big company, medium company, small company, you see a lot of anti-big corporate dialogue out there. But you can't have... You've got to have big companies that are able to invest in the amount of resources it takes to bring these innovations from the laboratory through the regulatory process and out into the marketplace—you know, \$340 million for a new crop protection product, 150 or whatever for traits and others. We've got to get that efficiency based on predictability of what the end target is and countries being able to regulate those technologies in a similar way. Otherwise, you're going to have inefficiency and disruption.

Foreign Agriculture Service is about trying to break down trade barriers where they exist, through bilateral engagements with governments but also supportive international standard-setting bodies that can provide an umbrella framework for those very regulations. So we're all about promoting sound science, data-driven, regulatory decisions in organizations like Codex, IOE, IPPC that can provide that input across multitudes of countries on how our food should be regulated and provide those import tolerances necessary for free trade to flow.

So it's all about trying to break down, whether it's protectionist, tariff, non-tariff trade barriers, into also some of the incongruity with how we're regulating production in ag but also food safety.

Paul Schickler

Louise, you have been personally focused upon regulatory issues and also with your work at the University. How can you and the University play a greater role in harmonizing and making regulatory issues more transparent and predictable?

Louise Fresco

I think we're hitting indeed the nail on the head here when it comes to one of the important barriers for the future. I think taking one step back, in 1989 after the fall of the wall of Berlin, it's been clear that free trade has had tremendous benefits also for the poor in developing countries.

That's not to say that there weren't some negative side effects, but generally speaking free trade, of course, has enormous benefits.

However, we now live in a world, and I have to say this openly here as we are among friends where notably Europe and the U.S. and a couple of other countries don't see face to face. This is a serious problem in many, many ways. And one of the nutshell issues here is the regulatory issue on intellectual property rights. We have a variety of systems. The Europeans have always worked through something called plant breeders' rights, and the UPOV which is a way of actually keeping a lot in the public realm, whereas the American and other countries' approach has been far more to patent traits and varieties and so on.

My concern is today that we have two basically different regimes and a couple of other countries around us that lean either way, and we do not see face to face. So I'm making a plea here publicly to review that situation, to get UPOV trips to trait-related intellectual property rights, international treaty on plant genetic resources and a couple of other of these regimes and actually sit around the table and see – how can we maintain the best possible part of what we want to keep in the public realm because it's important especially to work for poor countries to have access for poor farmers and for breeders in different situations, but how can we also not paralyze innovation in private sector by not recognizing at all intellectual property rights.

Obviously, we need to find a balance. And to me one of the key issues of the future is to combine the different regimes that we have and take a free look. I think all of us – and I'm really looking at you also – we should have the courage to say, we have a system or a multitude of systems developed in the past that are not functional anymore. And they're particularly not functional because science is going too fast. It's going so fast today, thanks to CRISPR-Cas, for example, that we are not only talking anymore about varieties or traits to be patented but even individual molecules. It's going too fast for any regulatory regimes to follow. So we must have a system that is internationally acceptable to all United Nations countries and that guarantees both the access as well as the innovation.

Paul Schickler

Good. I'm going to shift here to Chavonda and Tom for a moment and also shift topic but remind the audience first that we've got about five or six minutes left of this dialogue here on the stage. So be thinking about questions during that last ten minutes that we do have. Chavonda, again we've talked about agricultural productivity, great success over the last hundred years. But most of that success and most of that focus has been on ensuring that we've got the right caloric availability from commodity crops around the world. So the focus has been – how do we make sure calories are sufficient in this food security objective. But of late there's been more shift towards focus upon nutrition, ensuring that those things that we do produce have the right nutritional components. How is the USDA making that shift?

Chavonda Jacobs-Young

Thank you. That's a great question. So one of the jewels of the USDA is our National Plant Germ Plasm System. The USDA has, I probably would argue, the largest germ plasm collection of a federal agency in the world. And that germ plasm collection that goes back many, many decades allows us to go on treasure hunts for traits. A lot of times we focus on the abiotic and biotic stress sort of perspective of looking for traits. However, nutrition, nutritional quality for some of the commodities or the plants and vegetables that we breed are critically important too.

I think about the work of Dr. Ed Buckler at Cornell University, who's an ARS scientist, co-located on the Cornell campus, whose work in maize and cassava has been critically important to increasing vitamin A levels in maize and being able to address some of the deficiencies that are occurring around the world. And we have that work going on now in specialty crops. And so Dr. Buckler has volunteered. He is giving back to the agency, and we're working on trying to use some of the genetic and genomic tools that were developed in his very well-funded work of maize and cassava, for some of our specialty crops – things like sweet potatoes, like blueberries, alfalfa, grapes, looking at aquaculture like trout and salmon and trying to shorten the time from discovery to the dissemination of those discoveries.

And so depending on that germ plasm collection to really help us with increasing the nutritional value of those fruit and vegetables. And then we have the nutrition centers that can actually do human subject testing. And the science behind nutrition is critically important, so we have a role to play with the policymakers in providing the evidence and data for some of the decisions that we'll make.

Paul Schickler

Wonderful. So, Tom, much like the discussion just now of that shift from calories to nutrition, we also have had a shift from agricultural productivity to making sure that climate change is addressed. And that certainly has been identified as an issue within the GAP Report. So how at Virginia Tech are you making that shift from productivity being maybe the singular or most important issue to now having climate change as a consideration?

Tom Thompson

I think it's important first to be sure that we clearly distinguish between production and productivity. Production being essentially the gross amount of output versus productivity, which is a measure of the efficiency with which inputs are converted into outputs. I'm a very strong believer that increases in productivity are climate smart as well, because increases in productivity allow us to do more with less, allow us to take land out of production.

If you look at sources now in sub-Saharan Africa that increased agricultural productivity, the large majority of that comes from converting lands to agriculture. Most of the time those are marginal lands subject to soil loss. We lose carbon when we convert non-agricultural lands into agriculture, very often. And so increasing productivity helps us prevent that, helps us keep lands out of agricultural production and in forest or grazing lands or range land. So I think that productive agriculture that's focused on increasing productivity is climate smart as well.

Paul Schickler

Okay. Ken, before we turn it to the audience for questions, I wanted to have your thoughts. You've been in production agriculture your life, whether public or private. As you look today and on into the future, what are some of the most exciting innovations that can really move agriculture and food production forward.

Ken Isley

Well, great question, and I'll keep it brief so we have plenty of time to get a couple questions from the audience. But it was touched upon earlier. Precision agriculture, the ability to take

information that we gather through satellite imagery, through drones, through other sources, and convert that information into smart production decision to get at that productivity to increase that efficiency, decrease inputs, increase outputs. That has great potential, and that one is not as controversial in terms of the adoption of that technology. There's some issues we have got to sort through on data rights and things like that, but that ought to be fully embraced and continued to push.

Genetics continues to be a huge opportunity to gain, whether that's plant genetics, animal genetics, to get more productivity again with less. And time is important as well to do that in a more compressed timeframe to advance. And that's where some of these technologies like have been mentioned with CRISPR-Cas, other new breeding techniques are vital to be able to get those adopted and accepted around the world.

Of course biotechnology we're believers in, in terms of how that can be used, used in a very safe and controlled way. So there's endless opportunities. And people often think of biotechnology on the input side, which has advantages, but I'm really focused on the output side and gets back to the nutrition and the ability to develop in plants and in animals the ability to get some of those key gains we need to reduce the impact or the footprint of agriculture but yet increase the total nutrition output to solve some of the key issues we have – not just hunger. Hunger is the key fundamental one but some of the environmental and other impacts.

Paul Schickler

Right. Okay, very good. Okay, so we have microphones on both sides of the room. Anyone ready for a question addressed to our panelists? Yes, thank you.

Q Hi. Good morning. I'm from Colombia and from Penn State University. I'm a graduate student, and I'm involved in a project funded by USDA and USAID. The project is a Cacao for Peace in Colombia. And my research is related to socioeconomic factors that influence technology adoption in cacao farms in Colombia. And I would like to ask you what would be the approach from your perspective that we need to develop in terms of the socioeconomic factors. In the case of my project, I found that smallholder farmers spend most of their time surviving, so they have to go out of their farms to work to get the money for daily surviving. So they don't have the time to make the culture activities of cacao.

Isley I can take that one quickly because I've been to Colombia and had a review of that very project. It's a Food for Progress project that USDA-FAS is implementing, and we're doing that with USAID and some of the other organizations we're partnering there with. And there's other objectives, and we're trying to replace production that we don't want occurring and having end up in the U.S. with production that we do support fully. And what we recognize first and foremost is what you were touching on, and that's the economic sustainability of those farmers and those rural communities, not just farmers – it's also all the jobs created down that distribution stream. And there's challenges there with some of the transportation and things to get the cacao to the market and here. A big benefit to the U.S. – we're huge consumers of chocolate, and we have lots of chocolate companies. So we're very focused on providing the technology, assisting with the production practices, to convert to the cacao crops, provide security to enable that to happen, and then partner with those farmers in the local communities to be able

to provide that economic sustainability so that crop can continue year after year and provide money back in the community so it's sustainable long term. So we're very committed to that project and projects like it. That's capacity building – that's the way to expand the pie and increase production agriculture around the world for the benefit of everyone. So great question. Glad you brought that one up.

Schickler Okay, I see we have Pedro up, so I'm sure he's got a great question for you.

Q Thank you. I'm Pedro Sanchez, one of the seventeen laureates hanging around here this week. My question is to Ken Isley. Unfortunately, we are engaged in a trade war now. The U.S. and China and many other ones. What has been the effect of this trade war on agriculture, on the farmers around here, on the future, and how can we go back to a free trade, freer trade environment.

Isley Yeah, that's a good question. Trade war or trade dispute, whatever you call it – and it's back to my terminology of free, fair and reciprocal trade is the drive of the administration to try to treat each other fairly in how we trade. That's the objective. There obviously were impacts in terms of retaliatory tariffs back in agriculture. None of the agriculture tariffs were initiated by the United States, but the retaliation clearly focused on that area.

First and foremost we focused on trade mitigation, but, you know, all through that process, and we had two of those programs, we clearly heard, and it clearly is in our DNA – we want trade, we don't want aid. So we're trying to go back to a completely open and free trading system – let's take tariffs down, let's take non-tariff trade barriers down. And progress is being made, you know. In terms of the U.S. specifically, you've got USMCA waiting for approval. You've got the U.S.-Japan agreement done, which puts us back to roughly TPP. And U.S.-China, those negotiations are ongoing. You saw a recent announcement on that. Hard to predict, so we will see where that evolves. But we're monitoring, obviously, very closely the impact on production agricultural. And it's not just about replacing the money, it's also about promoting agriculture products around the world in other geographies as well to try to restore trade the best we can in terms of volumes and revenues and all that. But work in the international organizations, the WTO and things like that, I think are critical as well to reestablish a more efficient global trading system.

Paul Okay, we have two minutes left, so this is going to be a rapid-fire point here. Louise and Tom, I'd like you to respond to this. You've each got one minute. We've talked about first the dependence that we have all had on public research over the last hundred years. It's shifted a bit to a partnership or a balance – private and public research. But now we have a new player coming in, and that's the startup community, entrepreneurs, private equity. What are the universities doing to address and connect to the startup community? Louise first?

Fresco Around our university, in an area of about say a ten-mile radius, we now have 170 companies, but they're small and big. They are startups and very large, established international companies such as Unilever. And that actually creates what we call the campus ecosystem. We call ourselves, or we have been called, "Food Valley" in analogy to Silicon Valley. And it's attracting talent, interdisciplinary talent. We

have 150 nationalities on our campus. And in fact when you say, Wageningen, we have both the university and all the applied research institutes from USDA under one umbrella and around that all the companies. And that has proven to be a very, very attractive environment for companies, for individuals, and also for engagement with society. I believe that the best way forward is to open up the doors, to engage in a dialogue with society about the kinds of innovations we want. It's not just about technology push, it's about the balance between what technology and science can bring but also what society wants. And you can do that best by having a diversity of partners, startups and making sure also that the venture capital doesn't go only in the quick wins but also in the intractable things, in the difficult things, like environment, like biodiversity. We also need startups there. We're not just about production, we are about the future quality of life.

Paul Tom

Thompson I like two things at Virginia Tech. first is, as many universities do, we have offices – ours are called Link and Launch – that are specifically tailored to connect with industry, including startups and small and medium-size enterprises. The second thing – in our College of Agriculture and Life Sciences, we are developing what we call the “Smart Farm Innovation Network,” a network to link all of our research and extension centers throughout the state. And one of the objectives is to create test beds for new technology and innovations that will attract industry, including startups to come test their innovations at our facilities.

Schickler Great. Okay, well, the panel – thank you very much for your contributions today. But more importantly, thank you for what you do in public research and extension to get it out to the farmers. Thank you very much.