ROUNDTABLE #1: *RESEARCH & INNOVATION*

Barbara Stinson - ***Moderator***
October 20, 2021 | 9:15–10:30 a.m.

Roundtable Participants

Aneesh Chauhan	Expertise Lead, Agro Robotics, Wageningen University
Elliott Dossou-Yovo	Borlaug Field Award recipient; Agriculture and Climate Change Specialist, Africa Rice Center
Sam Eathington	SVP / CTO, Corteva Agriscience
Mike Graham	Head of Plant Breeding, Bayer Crop Sciences
Julie Howard	Senior Adviser (non-resident), Global Food Security Program, Center for Strategic and International Studies
Greg Jaffe	Biotechnology Project Director, Center for Science in the Public Interest
Amy Kaleita	Interim Department Chair, Agricultural & Biosystems Engineering, Iowa State University
Lindiwe Majele Sibanda	Director and Chairwoman, African Research Universities Alliance Centre of Excellence in Sustainable Food Systems; CGIAR System Board Member
Pamela Ronald	Distinguished Professor, Dept. of Plant Pathology and the Genome Center, UC Davis
Claudia Sadoff	Managing Director, Research Delivery and Impact, Executive Management Team Convener, CGIAR System Organization
Joachim von Braun	Director of ZEF, Department of Economic and Technological Change

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Roundtable Moderator

Barbara Stinson
President - World Food Prize Foundation

So now I have the honor of launching our opening roundtable session—Research and Innovation. We have esteemed leaders here to discuss technology innovations and successful programs that need scaling in order to move towards our goal for 2030. Thank you so much.

Policy action alongside great strides that need to be made in providing accessible, affordable technology innovations. We must provide safe, nutritious diets for everyone; and these remain out of reach, unaffordable for one third of our global population—that's 30 billion people. We improve agricultural production every year around the world, but we also must increase the sustainability of our food systems. We have to be able to do more with less to increase food security.

So throughout the week we will be looking at: What is working? What needs to be brought to scale that's already succeeding. Today our speakers are going to talk about economic policy environments, especially those needed to address climate change impacts on agriculture and

from agriculture. We're going to talk about innovation programs and projects that are going to be scaled for impact, especially those that have big success stories to build on. Genetically modified organisms and gene edited crops, these are controversial, but they are crucial to boosting climate-smart agriculture and advancing sustainable food systems. So we're going to talk about the regulatory challenges associated with them and what's needed to advance. And, of course, everyone has their attention on our young innovators and research scientists, especially in developing countries. What more can we do for them?

Barbara Now I want to introduce our esteemed roundtable speakers, and we will start with Aneesh Chauhan. Aneesh is a Agro Robotics Specialist from Wageningen University. Welcome, Aneesh.

Aneesh Good afternoon, and thanks so much for having me. This is a privilege to be present here—and a little bit of fear.

Barbara Thank you so much. Elliott Dossou-Yovo. He is our Borlaug Field Award Recipient for Agriculture and Climate Change with Africa rights in Côte d'Ivoire, I believe, yes. Elliott, hello.

Elliott Thanks for [inaudible].

Barbara Sorry. Sam Eathington is here. Sam is the Senior Vice President and Chief Technology Officer for Corteva Agriscience. Greetings, Sam.

Sam Good morning everybody.

Barbara Dr. Julie Howard. She's a Senior Advisor in Global Food Security from the Center for Strategic and International Studies. Julie, welcome.

Julie Thanks, great to be here.

Barbara Mike Graham is head of Plant Breeding. He is from Bayer Crop Sciences. Hello, Mike.

Mike Good morning, everyone.

Barbara Dr. Amy Kaleita is an Interim Department Chair for Agricultural & Biosystems Engineering, and she's from Ohio State University. Welcome, Amy.

Amy Morning, from Iowa State.

Barbara Lindiwe Majele Sibanda. Lindiwe is coming to us—Director of African Research Universities and a board member for CGIAR. Greetings, Lindiwe.

Lindiwe Greetings from the University of Pretoria in South Africa.

Barbara Yes. Pamela. Pam Ronald is here. She's Distinguished Professor of Plant Pathology at the Genome Center in the University of California-Davis.

Pamela Hello, everyone. It's an honor to be here.

Barbara Thank you, Pamela. And Joachim von Braun is here. He's the Director of the Center for Development Research in Bonn, Germany. Joachim.

Joachim Hi. Greetings to Iowa from Bonn, Germany.

Barbara Thank you so much. We have in person two guests today, and it's just such an honor to be able to be in person. We have a small, limited participation here in Iowa this year, and I am so pleased to welcome Greg Jaffe. Greg is a Biotechnology Project Director for the Center for Science in the Public Interest.

Greg Glad to be here.

Barbara Great, thank you. And Dr. Claudia Sadoff. Claudia is the Managing Director for Research Delivery and Impact and a member of the Executive Management Team of CGIAR.

Claudia Great to be in Des Moines with you, Barbara.

Barbara Thank you. Okay, you can read of the full biographies of all of these amazing speakers on Whova just below your video screen.

Roundtable Discussion

Barbara So with that, we are going to turn to you, Joachim. Please offer some opening remarks and set the stage for this discussion.

Joachim Thank you, Barbara. Colleagues, it's good that research and innovation are put first in the Borlaug Dialogue. So I am missing being over the in Iowa. It's a wonderful and very important annual event.

Let me talk briefly about food systems and the Food System Summit that happened last month. It was an urgent summit and an unusual one. One unusual aspect is its scale of global dialogues; more than 150 countries had structured dialogues. Another unusual aspect was the deep involvement of science facilitated by U.N. leadership. We never had a U.N. Food Summit that had such a deep involvement of science—it's a good sign.

We talk about food systems. What do we mean when we are talking about food systems? And as we will be talking about food systems throughout the dialogues, I want to briefly touch on that. Food systems do embrace the entire range of actors

and the interlink where you're adding activities evolving as production, aggregation, processing, distribution, consumption of foods.

Food systems have four important components of equal relevance. Production and processing; income and employment; consumption, nutrition and health; market services and infrastructure. We need to address the connections of food systems with the science and innovation systems, now in our panel. But also with the health system, with the economic system and the government system. And we need to keep the interconnections where these political systems hide, as hunger and violent conflicts are more and more interconnected.

Norman Borlaug connected the dots in his Nobel lecture. I quote, *If you desire peace, cultivate justice.* That's what Norman said. But at the same time, he said, *Cultivate the fields to produce more bread; otherwise, there will be no peace.* (End of quote.) So Norm was a systems thinker. While focusing on production, he was a systems thinker.

The scientific groups that advise the U.N. Food Systems Summit has produced and put forward seven innovation areas, which were contemplated and acted upon at the Summit. Then we just mentioned the headaches. A bundle of context-specific policy and institutional innovations to end hunger increase availability and affordability of healthy diets and nutritious foods. Secondly, a de-risk food systems. Third, innovations for efficient and fair lend credit and labor arrangement. Fourth, bioscience innovations for people's health systems, productivity and ecological wellbeing. Fifth, the innovations for productive soils, land and water and to protect the agricultural genetic base and biodiversity. Sixth, the innovation for sustainable fisheries, aquaculture, protection of oceans. And last not least, the digital innovations for efficiency and inclusiveness of food systems and rural communities.

We must seize these seven actual areas with science agendas interconnected and not be single-issues focus. The Borlaug Dialogue has a great opportunity to follow up on the Summit at country and at global levels with governments, business, science communities, and civil society. Thank you.

Barbara Thank you so much, Joachim. Excellent remarks. So important to reflect on the Food Systems Summit and the tremendous deliberations went on the action areas that were defined so clearly. We have a tremendous amount of work to do in understanding how to translate those economic and policy environments to shape deployment of the innovations. Now we must move to that. In the next several years we have to continue to address climate change impacts on agriculture and really address the challenges that we're facing, especially for our smallholder farmers. So let's turn first to Pamela. Talk to us a little bit about some of the innovations that you see as most pressing.

Pamela Well, hello, everyone. I'd like to give an example, which I think is really instructive as we look forward to the future, as this is an international project with tremendous collaboration from many groups. And just to preface, we know that the climate is changing and the Intergovernmental Panel on Climate Change predicts that environmental stresses will accelerate in the coming years.

And one particular environmental stress that's very challenging to farmers is flooding. So in many parts of the world, flooding is predicted to occur more frequently and with longer duration. And rice is particularly susceptible to flooding. So although rice grows well in standing water, most rice varieties will die if they're submerged for more than three days. And this has been recognized as a problem for quite a long time, and there has been a tremendous impact on smallholder farmers. It's estimated that 70 million farmers grow in flood-prone regions, many living on less than $3 a day.

So about 50 years ago scientists at the International Rice Research Institute began screening their enormous collection of genetic diversity for rice varieties, land rices, species that can tolerate submergents. And they were successful to identify one particular land rice that had an incredible property. It could withstand two weeks of flooding, and then the plants could regrow. Now, to make a long story short—when using conventional breeding, breeders tried to bring this trait into varieties grown by farmers, but the varieties were rejected; because when you use conventional breeding, breeders bring in many traits unknowingly. So my colleague, David Macill and I, decided to try to isolate this gene with the goal of introducing the gene precisely into locally adaptive varieties, primarily in Eastern India and Bangladesh. We isolated the gene and were able to show it conferred robust submergence tolerance. And research at the International Rice Research Institute introduced this gene very precisely using marker-assisted breeding and many years of field tests, with the result that the new varieties can withstand flooding and have a 60 percent yield advantage compared to conventional varieties. Last year more than six million farmers grew this submergence-tolerant rice. And I want to point out that the partnerships between the International Rice Research Institute, the Bangladesh Rice Research Institute, and the Cuttack Rice Research Institute were instrumental in scaling this innovative variety and getting it in the hands of farmers. Thank you.

Barbara Thank you, Pam. That's just a tremendous example. That's exactly what we are hoping to focus on in these discussions. Elliott, you're our Borlaug Field Award winner this year, and you also have been working on rice varieties and smart valleys. Take a couple minutes to tell us more.

Elliott Thanks, Barbara. _ ___. The common geography in sub-Saharan Africa are estimated to cover around 190 hectacres. __ and is considered the region's food basket. However, only 2% of the total ___ is used for agricultural production mainly due to _ control. Droughts and flooding are common crop production __ and this will amplifying the __ climate changing conditions. Africa rice and our national partners developed this __ approach for improving water control in __ valley. The approach consists of __ and development plan constructing water control structures so __ irrigation and _. It is based on the farmers' knowledge of the inland valley soil ___. And the vegetation is now adapted to the physical conditions. The approaches adopted are about 50,000 hectares in ___ West African countries. And adopters of the approach are seeing their yield income more than double. And food consumption cost has increased by more than 10%. The yield increase with the smart valleys approach is a bit higher than drought yields. Sometimes in 2008 in Burkina Faso in good years such as 2009 in planting in Liberia. By improving soil water control the smart valleys approach enabled the introduction of vegetable, and they go ___. We have seen this in central Cote d'ivoire. A lesson that we learned from the smart valley approach ___ introduction is that farmers want

to be part of the technology advance, and that considered just as recipient. So the use of a ___ approach has increased, but it's specific is of the smart valleys approach. Farmers ____ in West Africa. Thank you very much.

Barbara Thank you, Elliott. Really both of these sets of comments are so relevant. I mean you hear 50 years of development for a hybrid variety that's now planted on millions of acres. And the cooperative approach that it really takes to make farmers part of the solution and not just recipients of the technology. Does anybody else want to offer comments on technologies that you see being implemented in particular, who might like to highlight something else? Yes, Aneesh. Aneesh and then Julie. And just try to take a couple minutes.

Aneesh It's just a short comment on that. I think it's very, very impressive what is being. Also it stands out really well that it took 50 years of work for a variety to be identified and deployed and making an impact for millions of people's lives. In recent years, especially in the last decade, there is a lot of work being done on phenotyping, and I think that is something that is greatly affecting the speed at which the genes could be identified, genes thatcould be edited and brought to the people that are affected. I think this is one comment that I would like to give.

Barbara Thank you, Aneesh. Julie, you've been working on scaling, scaling agriculture for so long. And then we'll come to Greg.

Julie Great, great. I just wanted to comment. So these innovations that were discussed by our colleagues on the panel are so important for maintaining the productivity and increasing the productivity of staples under increasing threat of climate change. But I think the Food Systems Summit also challenges to think about how policies are affecting the composition of the food system and if we're comfortable with that going forward. I think we maybe should not be as comfortable as we have been. So for example, right now, the current policy ___ the environment really heavily favors production of just a handful of staple crops and animal products that are quite vulnerable to climate change impacts, as we've been discussing, and also contribute to poor health and environmental incomes. So the subsidies are worth half a trillion dollars a year, according to the U.N. So I think a big question for us is—what do we want to debate around? What does that basic system really need to look like going forward? And perhaps get away from our staple fixation and start to transition to a more diverse crop and animal system, including fruits, legumes, wheat crops, and, yes, fish.

Barbara And fish, yes. Thank you. Yes, we are hearing so much more about the diversification in diet. It means the diversification also in the research and study and development of foods and getting beyond the staple fixation. Thank you for that. Greg.

Greg Yeah, I wanted to pick up… One of the things I took away from both what Elliott and Pam said was the need for partnerships. And Elliot specifically talked about having farmers involved in the process early on. And so I think when we talk about the policy environment, one of the really important things is engagement by different stakeholders, that you really have to bring different stakeholders together early in that process. We have to build on shared values and look for mutual understandings

about the science and data. And I think if you do that, then you get much better buy-in for these new innovations, and you get a reason for people to adopt it. And I think that's really important.

And the other aspect, I think, of policy that hasn't been mentioned as much, and I think it's very important, is transparency, that you really have to have transparent policies around…. You're not going to get public or private investment unless there's transparency around that policy environment in these countries. And similarly, without transparency, there's going to be little uptake of innovation and little comfort by consumers and confidence about those innovations. So I think the science that we heard about is great, but we also need to think about what kind of policy environment we have for that.

Barbara Thank you, thank you. And this is of course an area close to your heart and a huge practice. Let's go to our second question and give others a chance to offer some opening remarks. So much of our ag research and innovation programs are already tested. These projects are proven around the world, and really what's needed is to be scaled. We have some good examples, we see how that's happening; but we need to scale and identify those success stories so much further and so much faster. And we need to be mindful of the cautionary tales and the challenges that have been faced. What are the lessons? So let's talk about scaling a little bit. What are the innovations that we want to see scaled most to the future? And what is it that we have learned that we know we need to account more of. Julie, let's come to you on that.

Julie Right. Thank you, thank you so much. Well, first of all, I think it's important to be clear what we mean by scaling. So let me just put out there—"scaling" means expanding, adapting and sustaining success for innovations in different places and over time to meet a greater number of people. And scaling is important, because so few of our tested and proven innovations ever really go to scale. Some estimated 1 in 20 innovations go to scale. And those that are successful take an average of 15 years. That's just too little progress. It's too slow to meet the great challenges that the Food Systems Summit has set before.

So, Barbara, I've been working at scaling food systems and thinking about it for the past decade, and I want to share four lessons. The first lesson is: We've just had too much focus on perfecting the technology and not enough on addressing non-technology constraints. And in order to think about the non-technology constraints, you really have to start thinking about scaling at the very beginning of research and innovation development and not at the end. We're used to thinking of scaling as a linear process—you just perfect the technology, and eventually at some point somebody sees the merit and takes it up. It just doesn't happen like that.

So I'm going to give you a couple of examples. So in Senegal improved rice varieties were developed and released in the 1990s—great rice varieties just taken up by a handful of people, really. It wasn't until the 2000s when a USAID-funded project called the PCE Project came in and took those same rice varieties but then put them together with good agricultural practices with certified rice and also, really importantly, with support for local rice companies, rice processing companies, many of them women owned. So you had the great technology, you had good agronomic practices, but you also had someplace for the farmers to sell their rice, and demand

for quality of rice; and then the rice company provided also stores for consumers to come. So all those pieces came together.

Another example is the famous, I think, the PICS bags, the wonderful innovation from Purdue. These are triple-layer, plastic sealed bags that protected, did a great job of protecting cowpeas in storage from pests. And so those were developed in the 1980s with USAID funding, and they sat on the shelf for 20 years. They were too expensive, and farmers couldn't get them. So fast forward to 2007. The AIDS Foundation and other donors decided to see, well, can we commercialize PICS bags. And so began a process of as Greg was saying, working together with different partners, with the private sector and farmers and shopkeepers and manufacturers. So what would it take to get a product that's accessible through agri dealers that's affordable and that works? And in talking to farmers, she found that, well, they wanted the bags for other purposes, not just cowpeas. So innovation evolved along the way—it looked different from when it was invented at Purdue. So all those things—not linear process but the engagement of stakeholders in thinking about, what could be those constraints that keep people from adopting the technology at the beginning and at the end.

A couple more points.

Barbara If you don't mind, Julie, just to wind up pretty soon. Go ahead.

Julie Sure, sure, sure. Both government and private sector—important to engage them in the scaling process? Why? Because they, and not projects, are able to go to scale. So you think about private sector, hardwire, government hardwire, it's important to get them engaged. Greg already mentioned the importance of multi-stakeholder partnerships. And thanks for that. I mean unfortunately I think people's eyes glaze over when you talk about that, but it's such an important part of the process, as we saw in Senegal, Purdue.

And finally the last thing I'll mention, Barbara, here is—if we want to scale, we have to measure the right things to ensure that we're doing the right things. So what does that mean? In monitoring evaluation it's so tempting to focus on counting outputs and direct beneficiaries—how many people adopted, by how much did firm income increase—and actually that's exactly what we do in the first phase of Feed the Future? But what's the problem. By definition, scaling places a premium on effects and impact beyond a project's direct and duration. So you really have to focus more on indirect rather than direct beneficiaries—and we are not so good at that. So to what extent is the project preparing the ground for the next generation of adopters and for sustainability? Is the project engaging stakeholders with powerful networks? Does the project have a strategy for building the capacity of local partners? I'll end there.

Barbara Thank you so much, Julie. You have such broad experience, not only examining so many systems but also trying to bring them to scale. So thanks for those words of advice. Mike, talk to us from Bayer's perspective. I know there's so many programs and projects for you to highlight but just a bit on scaling?

Mike And I do thank the opportunity to be here today, and this actually is one of the areas that I've been most passionate about in my career—How do we take those innovations and how do we scale quickly into the markets in which we're working. And I've been so passionate about it that I actually, about six months ago, took the opportunity to look back and do a retrospect of those projects, renovations that we were able to scale quickly and those that we for a number of reasons were not able to scale quickly. And you see a very common theme in those that were scaled quickly and had a big and broad impact in the marketplace. And it really starts with something that Julie highlighted, which is the space of really understanding upfront—what is the question or the outcome you're trying to achieve? And then using that to build and understand the connectivity of that question to various parts of the organization. Now, those could be connectivity through technical areas. It could be connectivity through organizational areas. So how will this impact the commercial organization as they think about deploying this new product? Or they could be thinking about how and what we need to do from an IT perspective to build out the capabilities to enable this innovation to be scaled broadly across our programs.

Now, this obviously gets you into the next point, which is, do all of this and these projects that are successful, have not only thought about the technical component but also the organizational component. So how do you create a culture where people are exchanging ideas both internally and externally? How are you thoughtful about exchanging talent between different teams so that that talent can be used in a very different way to really advance some of those differently? And we frequently move people from our R&D organization to our commercial teams so that we can share some of those best practices and those learnings so we can accelerate these innovations.

But then it's really how do you iterate and how do you iterate quickly? I would say, looking back, we've iterated in our biggest markets. More recently we've been more thoughtful about what markets have smaller pipelines but also enable us to experiment at scale, enabling us to get multiple generations within a climate season to end with understanding of how that innovation can be used and then use that data to actually impact some of our bigger markets.

And then lastly, which is something that Greg and Julie also mentioned, which is the importance of partnership. It is clear where we're going with the technology that sits in front of us, that we will not be able to build and develop and deploy some of these innovations without key partnerships outside of our organization. And I always like to highlight the example with IATA and the ___ breeding program. This is being a partnership really focused on several crops. It has been an open and sharing process where we have highlighted some of the areas that we're working on, sharing those with. But I would tell you through that partnership that our employees and our colleagues in Bayer have benefited as much or more in really understanding the customer and how our products can be delivered and developed and enabled quicker than what we have done in the past. So thank you.

Barbara Thank you so much, Mike. So much there. I mean it would be great to learn more about your perspective. It's so important, people developing these tremendous careers of experience, providing the connectivity and talent management that you're

experimenting with, and it'll be really great to learn more about all of that. We're going to turn to Lindiwe Sibanda and then come here to Claudia for a couple remarks on this same topic. Lindiwe, you're calling in from, I think, Zimbabwe.

Lindiwe Yes, I am calling from Zimbabwe [inaudible] with the University of Pretoria. So in terms of scaling up I was trained as an animal scientist. I work as a farmer in part of my time, and I moved into policy space through ___ deliberately, because I believe that upscaling required a conducive policy environment. I've now gone back to the research environment, because I find what we are taking to the policymakers is not strong enough in terms of evidence-based, to influence policy. I want to pick a couple of examples to sort of bring to life what I mean. And being an animal scientist, I couldn't find any better examples than what we've done through livestock research at ILRI and also in our national agriculture research programs. You are familiar yourself with the livestock insurance for pastorilists. You awarded a prize to one of our scientists. You're also familiar with the smallholder dairy technology that's been generated. And of late there's been a big program on improving smallholder pig and poultry enterprises through genomic selection for both poultry and dairy. When you look at these, these are wonderful projects particularly for Africa, because when it comes to animal-sourced foods, we've become the museum for stunting. This is a stubborn problem—we have failed to move the needle.

So we need the animal-sourced foods, because it's been proven that they have the higher nutrient value compared to plant-based foods, and it's a game of quantities. And currently Africa per capita consumption is just at 11 grams of kilograms of meat, which is one third of the global average. So we need to push in terms of consumption. So ILRI has come up with wonderful projects which have been proven to work where they're introducing high-breeding materials into the smallholder farmers both in terms of chickens and dairy. This has not been taken to scale. We have done farmer to farmer upscaling, but the point is the environment is still not responding.

Where are we getting it wrong? I think when we do our research, number one, we now need to engage more on transdisciplinary research. What is the societal problem we are solving Most of those, as Julie is saying, are not technology constraints. We are looking at the household environment. How much labor do they have for them to take up the technology? Do they have solar energy for their drying, for their processing of their meat product and storage? What do you need for us to take to scale these technologies that have increased quantity and quality but have not looked at the sociology and the economics of the household taking up these technologies?

So my recommendation is—let's do transdisciplinary research. Let's define the societal problem that we seek to solve. It may be stunting, but stunting cannot stand on its own, and introducing high-value breeding chickens will not solve the problem of economics, will not solve the problem of hygiene and water at household level and will not solve the labor constraints. So when we look at scaling, let's look at the society and its setting. Let's look at the constraints, the soft constraints at household level, but also push the needle in terms of the policy—so that there's an opening up

of multiple ministries, not just the agriculture sector ministry but all those that are relevant to the societal problem that we want to solve. I'll stop there for now.

Barbara Thank you so much, Lindiwe. How important is it to connect our research to policy, our system? That's how our system works and drives down to implementation, and it has to be addressing the sociology and economic issues as you do that. So thank you for your wisdom. Claudia, the CGIAR has issued the next 50-year research strategy, a tremendous amount of work ahead, a three-year strategy. Please tell us a little bit from your perspective on scaling.

Claudia Thanks so much, Barbara, and it's great to be able to share some examples, both of scaling successes from CGIAR and also some of the insights that we've gained in looking at this 50-year history that we have had of seeking to introduce innovations and scale them up. I think a great, proud example of scaling successfully is the orange-fleshed sweet potato that we all know, now grown and eaten by 6.8 million households in Africa and in South Asia. More than 20 varieties have been developed, biofortified with vitamin A and heat and drought resistance, and adapted to more than 20 different country conditions. And this speaks to Julie's very important point, which is—if we want to scale, we need to adapt our innovations to the spaces in which we need them to be scaled out. Another really important and exciting example of scaling has been certified seed production. For example, the stress-tolerant, CG-related maize varieties across sub-Saharan Africa now. These varieties this year in 2021, we believe that some 64.8 million people living in 13 countries are benefiting from these CGIAR-related seed varieties. In these sorts of innovations around seeds and scaling, we often see the CGIAR focusing on the development of the elite parental genetic materials. And working with and empowering NARES, the National Agricultural Research and Extension Services, to breed and test the final varieties. Private-sector partnerships have also been extremely important to us, particularly in terms of seed delivery systems. And the fact—and you've heard it over and over again on this panel—the fact is that these partnerships are fundamental both in the research but also quite, quite fundamental to scaling. CG has built around about 3,000 partnerships worldwide, and this is where you really see the leveraging. We have important, and particularly important, collaborations with National Agricultural Research Institutions that help us focus on the most urgent issues nationally and regionally and work through very local challenges as well as working with extension systems and NGOs and scaling out and private sector in developing products, products like Aflasafe, or the delivery of equipment like solar irrigation.

But importantly, in addition to partnerships, what our research shows us is the power of bundling different interventions for impact at scale. And we heard this in everything that Lindiwe was saying. We heard this in Elliott's description of smart valleys. We see that, for example, research suggests that combining seed innovations with innovative agronomy can more than double the impact of seed development alone, as we try to push towards scale. And we also recognize that the economic incentives are essential. If economic incentives are not aligned, if value chains are disrupted, then we won't see uptake of innovations at scale. So we work also very much on the policy side in terms of policy reforms that are needed to align incentives

that are needed to have perhaps control over regulation or to engage in other policy goals like gender and inclusivity and equity across food systems.

But what we see across all of it, really, is that these strategies for scaling are something that we need to do mindfully and that we can do in partnership very successfully. And if we all do these together, and mindfully, we really can benefit hundreds of millions of small farmers by 2030. Thanks, Barbara.

Barbara Thank you, and that is the goal, without a doubt, reaching those millions, hundreds of millions the goal. So let's just take a couple of minutes to see if anyone else has other comments. The idea of bundling—we know we see so much of that and agronomy and seeds—but the partnerships, the bundling of projects, the multidisciplinary approaches: Who wants to comment further? We can take one or two maybe. Lindiwe?

Lindiwe I think one of the things we really need to be intentional about is finding an opportunity for the youth to be active players in the upscaling game. We've always looked at policymakers, but I think finding those business opportunities, finding those incubators, finding big business that can mentor, provide support and incentives for the youth, will take us a mile further than we've been in terms of trying to push the needle on scaling up. I think it's important.

Barbara Thank you, thank you. Does someone else have a comment? Sorry. It takes a minute to get back to the full screen. Joachim?

Joachim Let's not forget about finance. Finance is absolutely critical for scaling. We need to revisit agriculture banking, value chain banking, together with the corporations and the financial institutions. [inaudible].

Barbara Thank you, thank you. We're going to talk about finance absolutely. Let's turn now. Julie, we'll come back to you in a minute. Let's turn now to genetically modified organisms, gene-edited crops. We know they play a crucial role; they are controversial. There is an entire system of examination of the social systems that are needed to be able to promote and utilize effectively and safely these technologies. We want to talk about that and the regulatory challenges that we're facing. What are the emergent technologies that really do need to be supported to accelerate transformation of the food system? And we have a few folks that would like to address this, probably everybody, actually. But, Sam, let's start with you.

Sam Great. Hey, oh, thank you, Barbara, for the question, and thank you for the opportunity to have this wonderful discussion here with the panel and group. You know, I've spent the last 25 years working on—how do you bring sort of technologies to farmers around the world. And I've had the opportunity to see what genetically modified plants have done on our own personal farm but also on a lot of farms around the world. It truly has been an amazing technology and transformation of our food system and what enables farmers to do. If you just think about U.S. production, the growth in no-till and the advantages of that—really not possible without biotechnology being part of that solution.

But when I look at gene editing, I'd actually go and say it's going to have a much bigger impact long term around the world across more crops than biotech has had to

date. And it's very clear to me that technology like this really is part of the solution for our future agriculture, for a smarter agriculture, for more resilient food chains, and really how we think about a change in our production systems, and the sustainability of that.

I've had a chance now at Corteva to look at some of our gene editing work and activities, and again the technology has done some amazing stuff across multiple crops, whether it's enhancing disease resistance, quality improvements in both the seed and plants, at producing changes in plant adaptation, architecture—a tool for discovery, right? We talk about trying to get to the gene level, understanding regulatory mechanisms and understanding how genes interact. And gene editing is such a powerful tool. It lets us get to that research but then go ahead and translate into a commercial product. And even what we talked about here today and what I grew up in, in the world of plant breeding, which has just tremendous improvements in our plants around the world, and you look at gene editing and the ability to enhance our plant breeding program—it is really game-changing going forward.

So it's not about the technology. It's not about what the technology can do. It's not about the power of it. It's not about where we're at in the understanding of the capabilities and all the components we need. This really comes down to regulatory uncertainty and specifically global trade around our grain at the end of the day. So some countries have gotten very clear policies about regulatory on gene editing, and in other places you have absolutely no knowledge about what the policy and process and programs are going to look like, even to the point where things are nonfunctional in a lot of cases.

And so I really would stress that, for scientists around the world working on solving one of these grand challenges we're facing, we need regulatory certainty. We need to be able to operate. We need to have systems that let us do research and conduct field trials and do experimentation well before we can commercialize stuff. And I really applaud, actually, what happened recently in the UK where they made some real clarity on how to do research and gene editing in wheat. They started outlining a path forward and how one can maybe commercialize this, and really started thinking about the outcome—all right, what are we creating? Is it really fundamentally different than what a plant breeder can do and not so specific about the methodology or the how but really focused on the outcome? And I think we've really got to drive that and see that framework show up around the world so scientists can be successful in this area.

And I just would end with—we can't afford to wait. All right? We can't afford another 10 to 20 years of discussion about how ___ starts and stops, given some of the challenges and claims that we see. So we really need to push to get a system that lets us work and use this technology—and it really will be part of the solution for agriculture going forward. So thank you.

Barbara Great. Well, thank you for those reflections. New position as CTO of Corteva, so really appreciate it. Greg Jaffe, you're the perfect person to follow on from those comments, I think, and maybe you can speak a little bit to the UK decision yourself.

Greg Well, thank you, Barbara. You know, in my opinion, genetically engineered and gene edited crops, plants will definitely have a role in climate-smart agriculture and sustainable food systems. If we think about the impacts of climate change on agriculture, we heard from Pam talking about flooding, but what about drought, salinity changes and insect pests, animal diseases? You know, genetically engineered and gene edited crops can be developed with traits that address those conditions. If we think about postharvest lost, food waste genetic engineering and gene editing crops can also address those concerns.

And near and dear to my heart, coming from a consumer organization involved in nutrition, we can also use biotechnologies to improve the nutritional content of foods or to make crops that are already very nutritious easier to grow or more appealing, appetizing to consumers to eat. And one of the reasons I like these technologies is they are scale-neutral. The trait is in the seed or in the animal, so you don't need a lot of technology investment from smallholder farmers to utilize this. Once the trait is developed, it can be utilized in lots of different markets. However, I don't think this technology is sort of a be-all and end-all that address all of our agriculture or food system issues. And I think it's important to remember that, even when you use it, we may need to still deploy it in a sustainable way—so that might mean using it with integrated pest management, using it with tillage, reduced tillage, or even agroecological practices, utilizing those.

So what are the challenges? And I think there are three that I'd like to quickly talk about. The first one I'm going to… And I think it goes back to even your initial statement, Barbara, is information and misinformation. The debate over these products has been intense, and both proponents and opponents of these technologies are guilty, in my opinion, of stretching the truth in providing misinformation about benefits, about risks, about control of the technology. And so I think we all need to come together as stakeholders, NGOs, industry, government, national governments, international organizations, to really review the scientific evidence in these areas to talk about the products that are really out there and provide accurate, neutral and understandable information about it.

The second is—I think we need to develop publicly funded projects. And I appreciate Sam and Sam talking about, you know, private industry has done a good job with this technology, and they've done a lot of products that meet their customers' needs. But they don't always address the issues of smallholder farmers nor consumers. And so I think we really need the development of public-sector products. And I believe if we get those, then consumers are going to be more willing to see these technologies in a favorable light and adopt them. And that may help that first issue around the debate around them.

And third, I'll come to the issue of regulatory oversight. And I appreciate Sam saying—you know, regulatory certainty is really important. But I'm going to go further than that. I agree with him on that, but I think we also need regulatory systems that are efficient, that are transparent, and that are science-based. And my view is that many agricultural products, if not most, from these technologies will be found safe. There are some that could have adverse impacts on the environment, agriculture and human health. And so we do need regulatory systems to ensure that safe products are brought to market. But at the same time we've got to make sure

those regulatory systems don't cost so much that they're a barrier to entry. We've got to make sure that they don't take so long so that we can't get products out there that address pressing agricultural issues. Regulations shouldn't be all or nothing—and I think that's the discussion a lot of times out there. We have to make them proportionate to the products, to the traits, and to the technologies utilized. To do this, I think we need to build capacity and training. And I think Sam talked about some countries not even having any policies there. And more importantly, we need government officials who are empowered to make science-based decisions and politicians who will back up those decisions, based on that science. So I think if we start to address some of those challenges, there will be a roadmap to utilizing this technology. I agree that it's had many benefits to date, but I think its potential is really great if we can address these issues.

Barbara Okay, great. Thank you. Well, there's so much to address in the private sector and the public sector, public-sector projects to build consumer confidence and to take the science base that's developed and existing and test it out in the consumer's mind. It seems like good advice. I think, Aneesh, you're probably going to take us in another direction for some of the other emergent technologies. You work in robotics. Just a couple of minutes if you don't mind.

Aneesh Thanks, Barbara. Well, I think all the points that are being addressed, I hear technology multiple times and in many different pictures. So it's not my place to address all of them, but the one that I want to highlight is the role of the data economy, what we can do with the data, the data that we're collecting and the sources of that data. So the complete supply chain—or I want to call them value chains—the value in food systems has been captured in many different ways. And one of the ways they could be extremely useful is in terms of connected data and the transparency around the data. I think that should bring a lot of value to I think to the consumer as well as to the producer.

Another thing that I want to highlight is the role of technology intervention itself. So when you talk about a technology like robotics, so artificial intelligence, there is a clear disconnect between the producers who are usually the most vulnerable ones, who do not yet know what the technology can provide them. We are talking about genetics, but we can also talk about artificial intelligence and robotics in the same manner. And on the other hand, there are the consumers who are currently worried about the quality and nutrition, and they might not be getting what they require. And we have to think how technology can assist in bridging this gap between the producers who are quite vulnerable and the consumers who are quite interested in the nutritive value.

One example that I want to give you—and this is a robotic example—is what happens when you build something excited? You do years of research and you build something exciting, and you bring it to the farmers. It has all the stars that you wanted to see, but it is not applicable to the context. And as an example, one of the things Wageningen did is one of the first harvesting robot for sweet pepper. Right? There is nothing like this in the world, so it was quite a ___. And when you bring it to the farmer, you realize that in all the existing farming systems, such robots are not applicable. That means you may solve the problem that is scientifically solvable, but it doesn't apply to the current farming context. The conversation that resulted from

it, I think this is something that is very generic and that it's applicable to other technologies as well: When you bring together the farmer, the producer, or the consumer and you talk about the technology to them, you have to realize that the impact of this technology on those people requires them to change their behavior as well. Right? That the farms cannot remain in context. The farms have to change also, so that the technology could be more valuable. And I think this is a lesson that could be carried over too—yup, I think all the technologies that we are talking about.

The final talk that I have is on the role of digital economy, which is asking for ___ carry a mobile phone in your hand. I think this is a game-changer to have information, to have knowledge on your hand is a game-changer. Right? And this is one of the places where a lot of innovation is happening all across the world, including many innovative entrepreneurs that have finally got an access to the Internet, got an access to this mobile phone. The dark side of that is the accessibility is not equal, and in many countries in the world, especially developing economies, we have noticed that… Just to take an example of gender equality—the smartphones, the smarter phones are usually in the hands of mostly male, while the female, while women have access to the less smart phones, like the Nokia phones, the more rigid, the purpose of them being just to be used for calling. I think just inequality and access to technology, it also makes the access to the knowledge much reduced for the people that don't have access. And this generates, maintains the inequality that already exists in this side of the world.

Barbara This is such an important point that we're going to talk a lot about gender equality and access to technology being one of the huge ones. Thank you, Aneesh for all of that. Pam, we're going to give you just one minute to add a comment here, because we want to talk about young researchers and the youth that are moving into…, that we know we need to support in the system so much. Pam—and we could just stay in this view maybe or get the multi-person view up on the screen now, and turn to you, Pam, for a moment, and then we'll go to our fourth question.

Pam Thanks. I'd like to just echo Greg Jaffe's comments on misinformation and disinformation. I think this is really a key challenge. We have been using genetically engineered crops for nearly 30 years with not a single instance of harm to human health or the environment—this often gets lost in reporting. Every major scientific organization in the world has concluded that these crops are no more risky than conventional crops. And I was hoping that, now that everybody is injecting recombinant DNA into their arms, that there would be some more openness to genetic technologies for agriculture. Now, I think it's really important that, similar to the resistance to vaccination, we continue to have discussions on genetics and genetic engineering that are outdated and not science-based. So I really hope that we can, as a scientific community, really engage the public with the science behind genetic engineering and the importance of this for smallholder farmers around the world.

Barbara Well, very interesting to draw the analogy to vaccination. Unfortunately, not everybody is receiving it or open to receiving. But it's the same question—why not? So let's turn to our fourth and final question and give a couple of you a chance to respond, and then we'll kind of open it up and see if you want comments on anything that's been said so far. So we know that young research scientists and

innovators are our future. World Food Prize has invested heavily in developing this pipeline of practitioners so that they have meaningful work. And we know smallholder farmers all over Africa, all over developing nations around the world, need support, especially these developing countries. Joachim, talk to us just a little bit about what you think is most needed for the next generation.

Joachim Great, great discussion, great point, Barbara. Actually, the developing countries and emerging economies are fast catching up in science outputs, at least ___ science publications. China today publishes in the field of ag and the environment about the same level as the U.S. and Europe does, not per capita but in total. So that calls for more partnership. But let me emphasize the young scientists, young entrepreneurs, young innovators must have a seat at the table. They had that in the context of the U.N. Food Systems Summit. It's a science days which were organization. There were more than two thousand participants, and many of them were young scientists. And I just had a meeting with the producer organizations, farm producer organizations, which have become very knowledge-intensive. Again, lots of young leaders there.

Lastly, I find it important that digital access, knowhow, training for entrepreneurship— not just laboratory—entrepreneurship in economics is part of the training of young scientists. Back to you, Barb.

Barbara Thank you so much. Amy Kaleita, you've been waiting. This is your area of emphasis.

Amy Yes, definitely. So I just want to echo all of the mentions that have already been made of the development of partnerships. So a couple of great examples from my institution that we're engaged in, Iowa State Center for Sustainable Rural Livelihoods in Uganda, the Consortium for Innovation in Post-harvest Loss, and Food Waste Reduction, which has many partner institutions around the world, is active in innovations for smallholder farmers. Julie mentioned earlier the PICS bags of developing technologies and approaches that are meant to reduce the waste and food loss. So some of those powerful partnerships who provide opportunities for students in developing countries to get involved in projects that provide them access to a range of mentors that can provide support and guidance, but also traditional graduate school placements to connect with education and high-resource institutions where the infrastructure is generally more available, so that they can augment their education with additional hands-on training that can really help those students take their skills and knowledge to the next level. And then they return to their home country with not only that additional skillset but also an expanded network of colleagues and mentors—those are people who can give feedback, exchange ideas, discuss results with those young scientists and innovators. These partnerships also provide opportunities for students for more resourced backgrounds to build skills and global collaborations so that we're enhancing the next generation of partnerships on all sides. But you have to be willing to play the long game and build those partnerships. Start small around a particular area focused on the local experts, build an additional expertise, and expand out from there—but be willing to look at it over a longtime horizon.

I do think that educational access and mentoring aspect is crucial, but many of those successful partnerships also have no network ways to support young innovators,

don't have strong K12 components, and teacher training and schoolchild programs to prime that pump early. I'm so excited about those students and teachers who are joining us today, so welcome to all of you. The Food Waste Prevention Consortium I mentioned earlier hosted online recitation sessions this past year that were extremely well-attended, great conversations among learners and experts from all around the world, leveraged by the same type of technology that we're using today.

All that is not to say that universities are the only place where these partnerships can be rooted, because they're not; but university engagement does help make these partnerships more sticky when they're part of the long-term vision of the institution, because they're rooted in a fundamental quest for knowledge and innovation and the development of human capital. That's what the core of these institutions of higher education are about.

I also think it's important to approve mechanisms to recognize the achievements of early career scientists and innovators celebrated, and draw attention to the achievements of scientists and the exciting things that they're doing. One thing I am particularly adamant about is improving support in the scientific and research community for open access, publication outlets at a low cost. Aneesh talked about technology enabling accessibility, but we need for that great research work to not be lost behind ___ walls and barriers—so low-cost open access, and give young innovators a way to participate in this very traditional but also very powerful mechanism for learning and sharing results.

Barbara Great, thank you, Amy. Thank you for those insights. Julie, let's turn to you for just a couple of comments, and then we'll open it up.

Julie Great. Thank you, thank you. So I want to push back a little bit. I think we're really just not doing enough in terms of developing post-country research at capacity, both individual capacity and institutional capacity. I think it's been far down on the list of priorities. But we heard at the Food Systems Summit discussion, they repeatedly stressed the importance of contextualizing and localizing; different solutions are needed for different contexts. We really need local scientists from the NARES. They are in the best position to work locally with communities and other stakeholders to make sure the technologies and innovations get adopted.

But I think really in the past 20 years we've taken our eye off the ball of that priority of developing local capacity. Underinvestment in ag research and sub-Saharan Africa is widespread; 33 out of 40 countries, according to IFPRI, spend less than 1% of the ag GDP compared to 2 to 4.5% of ag GDP in higher-income countries. And the problems are compounded by the fact that a very large share of PhD qualified researchers in sub-Saharan Africa are getting ready to retire. So, no, we don't have the horses, we don't have younger horses, and we don't have well-equipped laboratories, we don't have data systems, we don't have computers. So how can they possibly… They need to partner, we need to partner, but they need then tools to do that with. So it needs to be a higher priority, actually, I think, a movement to build that host country ___.

Barbara Great, thank you so much. Let's go back to gallery view now, open it up to everyone. I'd like to turn to you first, Elliott, honestly, to follow up on the importance of young

researchers. You've just won the Borlaug Field Award. Talk to us a little bit about what really led to your ability to win this award to be this recipient. And then others, you can just let me know what your final comments might be, by raising your hand, and we'll get to everybody. Elliott.

Elliott Thanks. I think there was one [inaudible], and that's really something that's [inaudible] do like you to see that in any situation that we should never get up, that there are other ways of opportunities and that we should always [inaudible], of course. There are no [inaudible]. There are disciplinary needs to set goals and then to take actions and to be open. And I think [inaudible]scholarship from Germany [inaudible], according to really improve the level of education in sub-Saharan Africa, and that's very important for the [inaudible]. Thank you.

Barbara Okay, thank you so much. Others, other comments? Who'd like to go next? Claudia?

Claudia Sure. Thanks, Barbara. I'd love to just draw a thread between this discussion and what the youth need. And the points that Aneesh was making about digitization. And I think that we're dealing where we are blessed with a generation of technological natives, digital natives in this next generation that have a greater vision for what technology and digitization can do for ag—the way in which we can use technologies to boost productivity and resilience, the way we can use data to better target what we plant, where we plant, when we irrigate, when we harvest, how we can track the movement of pests and the changing climate that challenges us so deeply.

And I think one of the really exciting opportunities here is to open up a generation of really technical savvy researchers that can democratize the data that are out there and can gain much more knowledge direct to farmer through digital connections. And I think it's exciting to talk about here at the World Food Prize, because I think Norman Borlaug was quite ahead of his time in making all of his IT open access. He had such a vision for simply sharing information, knowledge, data, and innovations. And I think that we in the next generation, I hope we'll see so much more of that leveraged by the technology that can take these gems, these assets straight to the farmers.

Barbara It's a great opportunity, no doubt. Thank you, thank you for that. Who else would like to make some final comments? Lindiwe, and then we'll come to you, Joachim.

Lindiwe Thank you very much, Barbara. And having listened to my colleagues in the panel, for me the string goes like this: For us to achieve impact and scale using research and innovation, we start with addressing the societal problem. Then we look for technology bundles—what have we generated out of our researches, innovations that we can group together. I gave the example of the insurance has to be bundled with the poultry breeding, with the nutrition knowledge, so that we take that as a package in addressing agreed societal problems. The next thing is space for the youth, space for the youth talks to digitalization, it talks to business, it talks to new ways of modernizing our food systems. Number four, it's private sector. SMAs and big business have to be part of our upscaling journey. And then, finally, the

government, policy and regulate. All these partnerships have to be around the table—then we can talk the business of ___.

Barbara Thank you so much. Joachim. Then we'll come to Greg and go to you, Julie.

Joachim Thank you. You know, we are now in the critical phase of follow up to the U.N. Food Systems Summit. It is great that the U.S. Government has pledged $10 billion, 10 extra billion for the implementation of actions, five domestically, five internationally. I hope that for the five international billions, a lot will go to science, because it has a long-term effect.

Secondly, now we implement at the country level. We need to do the implementation at the country level of the Food Systems Summit actions. And for that we need to mobilize the science landscape country by country. Again, that calls for partnership, and at the global level I think we should have something what the climate agenda has—an International Panel on Food, bringing the thousands of scientists around the world together and not just some committees. Back to you, Barbara.

Barbara Thank you, thank you so much. Julie, and then I think Amy was up. Oh, sorry.

Greg That's okay.

Barbara Skipped Greg, right here with me.

Greg That's okay. As a representative of a consumer group here, I just wanted to reiterate a couple points. I wanted to relate the importance of transparency, of stakeholder engagement and partnership (I think we have all talked about) and really the need to increase communication. I think we need to make agricultural science, innovation and technology understandable to all stakeholders and especially to consumers. You know, I'm a true believer that if in the end we have products that meet the needs of consumers, whether in developed or developing countries, and address their values, then innovation will be adopted. That involves making sure that products are sustainable, that they're nutritious; don't forget taste—consumers care about taste—safety, and of course affordable at the rice price. And if we can do that, then I think we are going to get these innovations into the marketplace and have the impact that we want.

Barbara And that of course is the main driver of CSPI and what you're trying to advance, so thank you for that. Julie, coming to you next and then Amy.

Julie I just wanted to say we can't make progress on the food systems agenda without much, much more attention to scaling impact. And what does that mean? To facilitate scaling, we're really going to have to fundamentally change the way investments are made in the food and agriculture sectors. Investments are still largely private-driven, which means they tend to become siloed. And what we really need is more incentives and resources to encourage collaboration across projects and sectors and to fund countries on priorities. Donors and governments are going to play an outsized role in shifting from this project mentality. Really in a project mentality the reward for a successful project is another small project. That's not going to work. We just have to institutionalize the focus on scaling in a different way.

So that's going to require us to reimagine projects. They have to be seen as ways that we could catalyze, de-risk or otherwise advance systematic change by governments and businesses. This is going to require major changes in strategy, metrics and incentives to move the scaling agenda from where it is now, pretty much on the periphery, into the mainstream of organizational operations.

Barbara Great, thank you so much. Amy, let's turn to next, and then maybe Sam and then Mike. That would be great.

Amy So I just wanted to offer a little bit of encouragement to any of those young innovators you make you join us on the call today, sort of in the background there behind the ___—you can only see her elbow right now— but these are like famous Iowans, Iowa people who have been involved in ___. And so one of them is Jessie Field Shambaugh who is ___ founder of 4-H system. This is a club for student young people who are interested in ag and technology, and it's a great… But form a club in your community or in your institution. Clubs are a great way to build a community of likeminded people. Use your technology to figure out who else in your community is passionate about the things that you're passionate about and who are they networked to, and what partnerships might they connect to. And use the technology that you have and your passion for improving your community to use your great skills to make an impact. So just a little thank you to the young innovators who are out there and a little bit of encouragement.

Barbara Great, thank you so much. Sam.

Sam Yeah, just two quick points. One, the conversations we're having about scaling and in training the next generation, I'll just reiterate the private sector is a great place to collaborate, and we're very open to those collaborations, so looking forward to any opportunity there where we can play our role in that process. And we do a lot today with next-generation scientists, training and education and making opportunities available to them.

But my last point is—I come back to one of Dr. Borlaug's phrases that always resonated with me, which was—*Take it to the farmers.* And I think it's important we keep that front and center. We have to get our improvements and our innovations to farmers, or it just doesn't matter. Right? I mean we do great science and it sits on a shelf somewhere. And the only we're going to change our agricultural systems and our productions and however you want to do it is really enable this to get out there. And so we all agree we want science-based approaches—you know, no one's going to debate that—but I think as an industry we really have to start demanding a regulatory system globally that lets us solve problems, lets us bring innovation to the markets. And let us do it in a way that isn't so slow and bureaucratic and costly. Right? We talked about why we don't have some of these solutions for smallholders. It's the cost in the private sector and the cost we have to spend to bring some of this to market.

So I think as an industry, if we could really focus on how do we get to a place where we're all comfortable with the regulatory system that lets innovation really work, we can solve a lot of problems, and we can do it together.

Barbara Thank you for those comments. I mean we've heard so much about the importance of the partnerships, and private sector, we know, plays such a role, public sector, the consumer organizations. Everyone has to be involved, and there's a lot of great progress going on, but the barriers have to come down for sure. Mike, did you have some thoughts for us as we close?

Mike Yeah, just really quickly, and I always appreciate these panels, because you certainly gain different perspectives, different views, and you meet new colleagues. It's just great to have the opportunity to be here. You know, interestingly, Sam and I started out in the same lab about 25 years ago, so we've been in this space for many years. And I think both of us would say that we've never seen the technical confluence of _____ that are coming together today than in any part of your careers. And that is an extremely exciting opportunity that sits in front of us. But when you think about the challenges that we're trying to solve and the needs that we have, to not only think about how those technologies come together, but how do we bring them to our customers, to our farmers in a very different way than what we were enabled in the past. We have some massive challenges in front of us. And so my perspective in this is we need to continue to think bigger, we need to bolder in how we work and what we tackle, and we need to think how do we drive new partnerships that enable us to solve some of these big problems in a way that has been very different than what we've tried in the past.

Barbara Thank you, thank you for those comments. Aneesh, I think you have the last word. One final minute.

Aneesh I think, well, if I have to say something that I want to add beyond the experts, is that we have to make food cool again. I think in order to attract the ___ that is necessary to solve the challenges, we should have in mind that it's approximately a hundred months left to 2030, so SDG is about to finish. And are we close or not? I think we need the right people not just who are here now but the next generation that is coming up. We have to make this feel cool again, so that people who… Yeah, food is absolutely necessary, but it's not good enough. I think we need to attract more talent to solve these challenges.

Barbara Excellent point. You hear a lot about the time that remains, the number of growing seasons, but we have 100 months. Thank you for that. We've heard so much from all of you today. Thank you so much. Highlighting the importance of local involvement. We have to get to the ground. *Take it to the farmer*. Partnerships everywhere—everyone's talking about partnerships. Scaling by defining the outcomes that are sought—that has to drive our forward decision-making. And consumer confidence in gene editing and GMOs—how do you gain that moving forward? Our young leadership and mobilizing them with digital technology—that's going to be at least part of our answer. Thank you, all, so much.

Up next we have Paul Schickler and Beth Ford. They're talking about the rural renaissance. And then you'll hear a group of incredible partners working together on the Global Food Security Index. Corteva Agriscience has a work with the Economist Global Intelligence Unit. Thank you,

all, and keep tuned in, and get ready to move to your next Whova button. You'll get directions about it. Thank you.