

TACKLING HUMANITY'S GREAT CHALLENGES — A PATHWAY FOR RESEARCH TO 2030

Panel Moderator: *Elwyn Grainger-Jones*

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Introduction

Margaret Catley-Carlson

Council of Advisors, World Food Prize

Wasn't that an amazing panel? My goodness, we had wisdom, experience, some good thought-provoking ideas on how difficult peace issues are, but then peace-building is even more difficult, so we were very well treated by our first panel this afternoon that combined wisdom, experience, some good philosophical thought. And I'm glad towards the end of the answers we actually brought in a little bit more about what the international community and other countries are doing, too. As important as this country is, there are other players out there, too. So thank you very much.

My name is Margaret Catley-Carlson, and I'm sort of a transition person between the panels that you're going to be seeing this afternoon. I am a member of the Advisory Council of the World Food Prize, and I have been a proud and happy participant in these events for quite a while.

So we'll move on as quickly as we can to the next panel. This panel talked to us about threats, peace, war, how all these fit together. We're now going to move on to Tackling Humanity's Great Challenges that fit within that tremendous set of challenges. And the first one we're going to be looking at is looking at Humanity's Great Challenge — A Pathway to Research. How do you research within the complexities of the world that we have been describing here? But we've got some good people to talk to us about finding the answers to these things. But they're going to be focused on research here. Obviously, anybody that's talking about agriculture, food and research will be focusing on the CGIAR system, one of the world's largest global agricultural innovation network.

And we have as our moderator Elwyn Grainger-Jones. Elwyn, wave, yes, so we'll know who you are, yes. And he has the very difficult task of being the Executive Director of the CGIAR system organization. They often say that herding cats is difficult. I think that his job, you're herding cats and buffalos with the same leads — it's not easy at all.

He will be joined by Noelle Cockett who is the Utah State University's first female president, and she finds the job so easy that she is continuing on with her own research. She probably has a family, too, and stuff like that. I don't know how some women are so incredibly talented and well organized that they can do all of that.

Dan Glickman (Dan, there you are) is a very well-known name. He served as the chair of the Foundation for Food and Agriculture Research upon its foundation under the appointment

from the then-Secretary of Agriculture, Tom Vilsack – a well-known name here. But then Glickman is more than that. He’s been a voice for causes popular and unpopular for years, and he’s said what he thinks, and he usually knows a lot about it. So we’re enormously glad to have you here, Chavonda Jacobs-Young – yes, there you are, Chavonda – is the administrator of the Agricultural Research Service of the U.S. Department of Agriculture, USDA’s chief science in-house research.

Now, the reason that you didn’t get all of this is that if you go to the Web you will see pictures, demonstration, background. And I'm not going to repeat this for every panel, but if you want more on these people, and you should, then go to the Web, because that has all of the background.

Now, you’re in one of my lists but not on the other one. Okay, Marco Ferroni is the chair of the System Management Board for CGIAR. Before that, he was the Director of the Syngenta Foundation for Sustainable Development where we worked together. So all you have to do in 45 minutes, Elwyn, is figure out how to get the research going to solve the problems that were raised by the first panel, so you’ll take on this task – jolly good. Over to you. Thank you very much.

Panel Members

Noelle Cockett	President, Utah State University
Marco Ferroni	Chair, System Management Board, CGIAR
Hon. Dan Glickman	Former U.S. Secretary of Agriculture
Chavonda Jacobs-Young	Administrator, Agricultural Research Service, USDA

Panel Moderator

Elwyn Grainger-Jones
Executive Director, CGIAR System Organization

Thank you. You stole my joke. I was going to make a joke about how in 50 minutes we can tackle humanity’s great challenges through research, which is the least modest title I've ever seen for a session, so apologies for that. But we do want to get advice and ideas and thoughts. And part of the reason for selecting this subject was that the CGIAR is about to embark on a big discussion about what its next portfolio of research should be and how it should organization itself to 2030 and meeting the Sustainable Development Goals. So we’re going to be taking notes here, and we’re going to be taking advice on how we should be framing, reframing, thinking differently about what we do.

Let me just say a couple words of introduction, and then I really want to involve the discussion with our panel. We spend a lot of time, and I spend a lot of time in CGIAR talking to government officials and trying to explain why it’s important we do what we do. And in most cases some of the technicalities of the number of varieties being released or the latest irrigation technology doesn’t communicate very well. So what we’re trying to do is frame and reframe what we do that speaks much more to what most or many people care about. And so we’re

talking much more about how food and the food system is really at the driving center of most of the global challenges that preoccupy policymakers in the North and the South, everywhere.

And without going into great depth, of course, is the issue of sustaining food availability. We're going to need to produce more food in the next 33 years than the last 10,000. We've got immense challenges. And that's going to need to come through increased productivity rather than cutting down more forested land. We've got to live within planetary boundaries. Food is at very much the center of climate change, the center environmental degradation. We've got to own that and think about how we can do things differently.

The food system is at the center of issues around equality of opportunity. There's huge gender issues within the food system in terms of access to land rights, the condition, recognition of different roles in the community and the home. It's fundamental to jobs. If we look at the jobs availability, we look at the risk of mechanization, the opportunities, the fact that 85% of the world's 1.2 billion youth live in driving countries where meaningful opportunities are in many cases quite limited, is really important. Public health—we looked at the... I mean, it's shocking to see that the rates of malnutrition have actually been going up the last three years.

So we've got some huge challenges, not just on malnutrition but on obesity. And food is essential to all that. So in essence we talk about the SDGs—and all of these have a number of SDGs related to them. The food system, food systems are absolutely essential to that. How do we get that message out? And I'll be asking the panel for advice on that.

But it's not a recipe for despair. If you look at what's going on out there, there's some really exciting challenges, real exciting transformations taking place. If you look at how when CGIAR was originally created, just think of the Green Revolution where we were looking—and this is a gross oversimplification—we're looking at increasing the volume of calories available. What we're trying to do today is exponentially more complex. We're trying to solve these multiple challenges all at the same time. We're trying to think holistically, and yet this chain is immense, and it's all interconnected. We have to solve many problems at once when we divided the world up into all kinds of silos. So how do we get around that?

Well, we see five really exciting transformations, and our challenge as CGIAR collectively is how do we harness these transformations to solve those global challenges and address the SDGs. And without going into any depth on them, there's the genetics revolution, incredibly important, incredibly exciting. There's social and economic transformation going on. Markets are evolving incredibly rapidly. The evolution of online marketplaces is really changing economies as we speak and social transformation just as quick. The information revolution—it's hard to keep up with how that could reshape the operating environment even for smallholder farmers where we're seeing all kinds of tools potentially within reach or actually within reach to many of those communities. The sustainability transformation—the technologies and thinking around sustainability evolving.

And of course nutrition—we're starting to think very differently about why we're doing this, the values that we're aiming to create, whether it's in breeding work or in other areas. So lots of exciting stuff and lots of exciting transformations—if we can harness that in the right direction, we might be able to tackle those global challenges. And that's what CGIAR is trying to do with our partners, not working alone.

So I want to talk to the panel, so I'll just transition. Let's broaden this discussion, and we're going to try and include the audience, so we'll have a little bit of discussion amongst ourselves and then open this up. So we've got a great panel. We want to talk about the why, the what's and the how, all in relation to—How can we shape the global and national agricultural research agenda to 2030 to help us tackle these challenges and meet the objectives behind the Sustainable Development Goals. So there's a whole bunch of stuff around why we're doing it, how we communicate that, what should we be doing, how should that evolve? And of course the all-important "how."

So let's start that discussion. Dan, you're first on the list next to me. Given your huge experience, I would love to hear more from you about how we can communicate better the importance of agricultural research, because I'm not sure we're doing that as best as we might.

Dan Well, thank you for having me. And, look, when it comes to the NIH and new drugs for cancer research, the public is 100% behind it. Everybody in this room has somebody who's had cancer, multiple sclerosis, heart disease. So we could double the spending in those areas, and people would support R&D in medicine. And to some extent the Pentagon—people would support increases if our national security was threatened.

But in food and agriculture it's been a lot tougher, because people don't see the impact instantaneously. And food is ubiquitous, and it's reasonably priced, at least in the developed world. So I just want to make a couple things.

The first thing we have to do is we have to demystify science in order to have consumers feel confident of what they are putting in their mouths. Consumers are not the enemy, even if they disagree with the science, which we've found in recent years. It's like I used to be the chief lobbyist for Hollywood. Believe or not, I got from the agriculture and food to the movie industry, and I used to tell people I used to grow popcorn, and then I sold it—that was my qualifications for all this stuff. But if a company made a movie, it didn't matter how good it was, and the people didn't go and see it, then it was a total failure. And the same thing's true with what the science is doing. So we have to demystify it. Our history of not addressing consumer concerns has led to things like rejections of GMOs. While they are used readily in the biomedical field, it's been really difficult to get them in the food and agriculture field. So much work is left to gain consumer confidence. A whole bunch of new technology such as gene editing—and I know there are greater experts in here. So I guess that's my first point, is figuring out how to really get that. And I don't think the scientists talking to each other is necessarily the best venue for that to happen. I think we need to engage the public in a much more open, fair and transparent way.

But you asked about the why as well, so I'd give you three basic things on the why. One is demography. So you talked about the increase in growth in population, and that demography is largely focused on younger people. So the African Continent will largely be people under the age of 25 years old. So we'd be at between 10 or 11 billion people over the next 30 or 40, 50 years. We've got to feed them. We've got to feed them sustainably, we've got to feed them nutritionally, and we've got to do something to allow them to have lives which are stable, so they don't cause the kinds of problems that we just heard in the first panel. But the demography is everything when it comes to food and agriculture.

The second issue is climate. But talking about climate in the abstract doesn't really do much for people, because talking about weather is a little better, but climate has just... It's so general, and even though we've seen a lot more hurricanes maybe this year, it's still difficult. But climate as it relates to water availability and water utilization in agriculture, climate as it deals with the ability of plants to deal with stress, for plants to grow, for animals to be healthy, for the air to be clean, does impact agriculture virtually more than any other area of human productivity – that is farming and agriculture is really impacted by all the things we talk about weather. And that's a big part of the "why."

And the third thing has to do with nutrition, food and health. You mentioned this a little bit, but the fact of the matter is the French scientist – and you work in France now... I forgot his name, but he said, "You are what you eat." But for years and years we have felt that food, nutrition and health have nothing to do with each other. Recently I attended a conference, and the conference was on non-communicable diseases in the developing world. What are those diseases? Type 2 diabetes, cardiovascular diseases, hypertension. And you know what the experts wanted to talk about? They wanted to talk about exclusively tobacco control and vaccines. Now, I'm not saying those aren't important, but the fact of the matter is – what you eat has probably as much to do with your ability to survive and cope with those and all the other non-communicable diseases than anywhere else. And those diseases are becoming rampant in the developing world as they become rampant in the developed world. So somehow we have to bring physicians, medical providers, people in the healthcare professions, along with food and agriculture people to recognize that this is all part of how long we live and how well we live, whether we're in the developing world or the developed world. So that in my mind is the why this is so important.

Elwyn So we've got a lot of extra work to do, and we've got to do it better in how we communicate and explain why we need to do this. Marco, you've been on the road a lot the last year, talking to governments, talking to clients about the CGIAR, why we do what we do. What's your reflections on this?

Marco Right, so if one travels the world, you find a lot of good response to the question of food security, that whole narrative about the need for sustainable food security for all. But it varies, depending on where you speak with people – and by people I mean perhaps opinion-makers, members of the press, policymakers, members of governments, parliamentarians and so on. I think that the notion of sustainable food security for all resonates. And if I say, by the way, "sustainable," then I don't need to say forever, because it will imply each other.

But people understand that we have part of the world where we have achieved deep and lasting food security in terms of enough food. But even in those parts, we don't necessarily have the right kinds of balanced diets or the knowledge on the part of consumers of how to procure themselves that access to balanced diets with corresponding nutritional shortcomings.

And then of course in addition to enough food and balanced diets, we have the whole sustainability question, which now comes in with much more urgency than even has been the case in the past. And I'm finding out in [inaudible] the world over

quite concerned about such reports as the recent IPCC report that came out that has major implications for agriculture, as well as a certain paper that came out *Nature* or just I think last week that talks about the lack of sustainability of going about achieving food security up until now. So the sustainability question, whereas in the past it would be the productivity question, the generation of enough food was the driving, overriding theme, I think that going forward the sustainability and the balanced diets/nutrition question are going to come to the foreground. But that emphatically does not mean that we can afford to abandon the productivity dimension. As far as basic staples are concerned, by which I mean the basic grains, oil seeds and pulses, they are going to be forever the basis of human diets, and they're going to have to be produced, and that there are issue in terms of yield growth fatigue, as we know at the global level with respect to those classes of commodities that need to be addressed. And also we need to be prepared – and this is a key role of CGIAR, because gene banks and the plant breeding and associated scientific skills surrounding that particular asset, we need to be able to have an insurance policy that works and can kick in at any time there is a emergency, such as at the present time, the fall armyworm. You can do a lot about fall armyworm, and we will hear about it in the next panel, I understand, and there is now a broad global coalition being formed to address it, but one of the indispensable aspects of it in order to, if we want to deal with it is recourse to CGIAR gene banks, because that's where we got the genetic diversity that will inform plant breeding of crops that are resistant to this particular pest, in this case.

So I'm seeing a very broad range way of reacting on the part of stakeholders. And for us we need to get better perhaps at communicating what it entails and why we need to get back to the basics, and we cannot, we should not take things for granted. The world has now fed itself for 45 years on the basis of yield increases. In most instances, that is the result of ag research – ag research, plus delivery of the research results to their accounts, the fields or into food systems. This cannot be taken for granted. And if you explain it in this way to people, then I think that it resonates. It is true that of course the past ag research embodied into our food systems has led to what Dan has mentioned, mainly an abundance of cheap food. But it is possible, and I think that's what we are of course doing at CGIAR to remind the global community of the fact that there is something there which is a major achievement, but it cannot be taken for granted – we need to continue doing ag research. And of course there's literature in terms of economic analysis on the rates of return to ag research in terms of productivity, production and other development outcomes, including poverty reduction in poor countries, that is there for everyone to consult. And while earlier generations of that literature may have suffered from some methodological problems including selection biases, the current, more-refined analysis shows that investing in ag research is still a very worthwhile investment.

Dan And the only thing I would just add is you say “ag research.” We really need to say “food and agriculture research.” If you just talk about agriculture research, people will think it's just the land grant colleges – and, pardon me, because you do a lot of great work there at Utah State, but it's nobody else. It has to do from the farm to the table to the stomach, and that involves the whole kit and caboodle as it relates to the ability to digest and thrive as a person.

Elwyn Let me just quick follow up, and I want to bring some others in. Let me ask this. It's an unscripted question, so apologies. I mean, we seem to be telling a story around one planet interrelations between society's interconnectivity, and yet the global discourse appears to be somewhat moving in the opposite direction. Right? We're talking about the global public good, the need to work together across countries. And we're showing, putting a lot of facts about why is that so important – we're talking international agriculture research, for example. We're not winning the argument, though – right?

Dan Well, look. We've made some progress, so I don't want to... You know, you do this amazing work at the Department of Agriculture laboratories. I mean, as you talked about, Marco, the yields have gone up rather dramatically. We know more than we used to know about what foods are good for you, what's bad for you. Farmers know a lot more about conservation practices and how to plant. So it's not as if it's been a total failure, but in this world today it's beyond just agriculture. You know, former Senator Moynihan once said, *You can have your own opinions, but you can't have your own facts*. And we are kind of in this world now where people... (No, it's not meant to be a political statement, by the way.) But one thing that the scientists and the policymakers have to do is just do their best to strive towards good decision-making and fact-based decision-making. And, yeah, there will be differences, but this is just a constant battle, and I don't think it's lost, to be honest with you.

Thank you for that message of hope. Chavonda, let's hear from you. We've discussed a lot about the "why." Let's talk about the "what." What should we be doing differently? Your sense – you know, you're in a leadership position. What's your sense of how agriculture and food research should evolve to 2030?

Chavonda So, thank you. My colleagues here have certainly put a lot of food for thought. This conversation could go in lots of different directions at this point. What I want to share with the audience is that I've been the acting chief scientist for the Department of Agriculture and acting Deputy Undersecretary for Research Education and Economics for a bit over a year now as well as the administrator for Ag Research. So I get a lot of exposure to a lot of different conversations. We're all here today because of the great work of the founder for the World Food Prize, Norman Borlaug, and he had both the foresight and the presence to envision the need for a Green Revolution and also to lead it. And I will personally argue that it's time for another revolution. It's a time for a sense of urgency. It's time for us to have a fundamental change in the way we think about how we move forward to meet these challenges. This is time for a change in the paradigm. And I think that we need revolutionary research to feed everyone.

And so I would argue that we do – we've seen lots of evidence of how science and technology have helped us advance agriculture, especially in the productivity area. And now there are challenges that we face around nutrition, around stunting, around the ability to meet the challenges from pests and diseases around the world. Each of us in this room have shared goals, and it's going to be impossible for any of us to meet those challenges alone. And so partnership is an, extreme way, an extremely different way in which we need to work together.

What I've found in my interactions around the world, we can talk feeding our people. When we can't talk about anything else, we can talk about how to meet the challenges around agriculture. Fall Armyworm, for example, we found we have one scientist in the ARS who was still familiar with the Fall Armyworm research, because we had not faced it in quite some time. But we put that scientist right on the forefront to help lead in the global challenges that we're facing.

I think that there are three things, three items that are going to be important to us as we move forward – and of course this isn't comprehensive. But our solutions need to be connected to the farmers, connected to the consumers. Because if they see that all of our research is just to help the farmers, that's another way we're not communicating in a way that shows that we're benefiting everyone.

Our research needs to be risk-accepting. It needs to be audacious. When NASA set out to put a man on the moon, I mean, certainly they weren't going to do it tomorrow. We really need to be more audacious in our thinking. And I found that even with working with scientists that I know, just moving past the incremental gains or the incremental changes, we really need to break the box, and we need to get rid of silos; and we need to work across disciplines, work across institutions, work across organization types. I think in the U.S. we're very fortunate with the partnership that Abraham Lincoln put in place with the land grant university system, with the intramural research agencies such as the Agriculture Research Service, the Economic Research Service and NASS who does our census of agriculture, and then our extramural research. So all three of those come together to really make up the public sector of agriculture research. And then our private partners are so critically important; because while we've seen some challenges of funding for agriculture research, I'd say specifically for ARS, but we're doing okay. For agriculture research, the private industry has invested more in agriculture research, and so it's going to be so important, the public-private partnership. Dan and I serve on the board for FFAR. It's so important to help move our challenges...

Dan The Foundation for Food and Agriculture Research.

Chavonda The Foundation for Food and Ag Research – Pam Johnson, it's good to see you. And then the last thing – it has to be innovation driving. You know, we get caught up on one technological. Today, you know, the words of today are "gene editing." But there's so many other wonderful technologies. I would say, *and* there's so many other wonderful technologies out there. Let's not put all of our eggs in one basket.

Just for an example, we eradicated the screwworm in the United States about 35 years ago, so this is back to another Fall Armyworm story. We eradicated the screwworm almost 35 years ago. We've won awards for that, for a number of other things. However, as a government agency, we've continued to invest in that research because it's a public good research. So while we don't have screwworm problems in the U.S... (Well, we didn't until last year) We've been doing that research to help our partners around the world, because the screwworm... If you don't, if you aren't familiar with the screwworm, I want you to go and Google it, and once you see the images, you know, just don't each lunch right before you see what they can do to livestock. But because we're a public organization, we continue to invest in our research to be able to help our partners around the world. And so when we saw it

again last year in the United States, we were prepared and ready to respond to it, but we hadn't been invested in that solely for the United States' purposes but for our partners around the world.

And so I think it's going to be important for us to be on the cutting edge of innovation. And Green Global is one of our ARS platforms. We share almost 200,000 germplasm samples a year around the world, and that's just not the plant side. And so the germplasm collections sit behind the curtain. There's no media for the germplasm collections. There's really even no line item for germplasm collections. I'm not sure about in your case. But it's something that we keep resourced as a public agency, because it is a resource for our international research. It's for all of us. And so when we're looking for a trait on how to deal with a disease, we need to go back to that collection and find it.

And so we've created Green Global, which is an internet-based mechanism for anybody around the world to have access to what we have. But we keep that, we resource that and other mechanisms so that we can make sure that all the data that we have available to us is available to anyone who has internet access. PubAg – we have 500,000 full-text digital peer review publications available to anybody around the world.

So we're doing research for the public good, and we can't do it alone. With the shared challenges, we have to work together.

Elwyn Thanks so much, Chavonda. You very much took us into the "how" as well as the "what," which is critical, because that's what makes the difference on impact. Noelle, could we turn to you? Recognizing that we can't put all our eggs in the gene editing basket, you are an international expert in this field. We'd love to hear from you about – to what extent do you see that technology enabling us to more directly tackle some of these global challenges that are out there. What's your exploration in this space, and then what are some of the key challenges for you?

Noelle Right. So my background in research is with genetic editing. Prior to that, though, it was just looking at genetic variations. And so we really are in a time where we can capture that genetic variation and put it to work, and that's really what genetic editing allows us to do. So I see a need for continuing the research and developing technologies and plant forms for inserting those mutations into the DNA of an organism. But we also need to continue to identify those variations in the DNA, whether it's looking at wild species, genetic selection lines, or specific breeds and strains – so continuing that.

I think for me one of the most important things is the message that we need to be strong in funding research. As the president of a land grant, I have access to four pots of money. I can get money from the state, from tuition, from research funding, or philanthropy or private funding. States are moving more and more strongly to think their dollars and the tuition paid by students should go to student education, not research. So that means that we need to keep pressing, that research is incredibly important in agriculture and food and that, whether it's through private companies, through philanthropy or the federal governments, we need to keep that going.

I think one of the concerns that we have for research in agriculture and food is that we know as scientists there's usually about a ten-year gap from discovery to actual implementation. In biomedical research, that's easily accepted – we don't expect those discoveries to be immediately available to us in the doctor's office. But in agriculture and food research, there is more of a pressure that everything we work on must be implemented immediately or is in some way a waste. And I think that's a disservice to the type of research we need to keep doing. It may not be implemented in ten years. It may be seeming very futuristic. But that gap needs to continue, and the investment in that discovery research needs to continue.

Dan I just want to say, this cross-collaboration is really important. So those of you in this room know that penicillin was ultimately discovered by a scientist in the UK, but it was commercialized by the Department of Agriculture in the laboratories that you now manage. And it was before the second World War, and because of that use on animals became ubiquitous, and it saved millions and millions of lives.

Until recently, the National Academy of Sciences, which is the primary science... What would you call it? Not regulatory authority, because they don't do regulations, thank God. But the overview did not have an award for agriculture. They had it for engineering. They had it for physics. I think they had it for mathematics. We at FFAR decided that this doesn't make any sense. So now we have it. We got it through the help of the Gates Foundation and the FFAR. I want to point that out, because if the leading scientific organization in the United States did not believe agriculture was important enough to have an award for a brilliant scientist, then how do you think the public is going to feel about what you in this room or we are doing?

So Napoleon said, *War is too important to be left to the generals*. And agriculture and food research is too important just to be left to the agriculture and food people. We've got to have some cross-fertilization, some cross-germination of ideas, because they do meet across the board. And I think the penicillin example is a pretty good one. You did that at your place.

Chavonda Well, I didn't personally do it, but I would tell you that there are a number of innovations that have come out of agriculture. So I would just tell you just a quick story. When I joined the Agriculture Research Service (which traces its beginnings back to the creation of the Department of Agriculture; it still carries on the original mission of the Department of Agriculture), they had a saying that we're the best-kept secret. And I could not understand that for the life of me.

When I began to learn all of the discoveries that have come out of agriculture research and often not alone just in ARS but in partnership with some land grant university, I was just amazed at the magnitude of the fields that we have influenced. Our war fighters who are out there fighting for us every day. DEET came out of agriculture; Dextran came out of agriculture; Xanthan gum. There are so many things. And just those little apples that you get in your Happy Meals at McDonald's, that's an ARS discovery. You know, the ability for young people to be able to have apples instead of French fries – you have to go to McDonald's. At least you're having healthy option.

And I know that's not around the world, but it's one of the things that we do. We might be our own enemies in terms of not having visibility that we need around the world. Because if people think food just happens, what are we doing to dispel that? It does take innovation and technology to move our area forward. And for developing countries it's a whole 'nother issue. For us it's about – do we have apples at McDonald's. But are we talking about people who have nutrition deficits, stunting, inability to learn because you can't learn when you're hungry. There are so many more serious issues that require our attention around innovation and technology. And I hope that we can continue to work together globally to meet those challenges.

Elwyn Chavonda, you just asked about the gene banks and genetic storage. I mean just to know, CGIAR has 11... And I was astonished by this when I joined CGIAR – 11 gene banks, 750 accessions being preserved... Excuse me – 750,000. Excuse me, I'm reading numbers here. Just from 2012 to 2016, more than 590,000 samples went to 120 countries. So the work is going on. The work is being done. It's not always being acknowledged.

Let's open this up. I came to hear from you. The task is... I mean, we've got all the right brains in this room. We need to see and move towards – is there a collective understanding of what the agricultural and food research priorities need to be to 2030. What should we be doing more of, less of, differently? It's really about the why, the what and the how. So let's get some comments, some questions. Please try and make it less than a minute. There's no time for speeches. So just advice, questions, and we'll bring the panel in as necessary. There's a roving mic somewhere, and we have about 15 minutes for this or less.

Q Good afternoon, I'm Rotash Mal from India. I run an agricultural services company. We are a nation of smallholder farmers, and the major factors that I see on research and technology around the world are in the large-scale farmers. For example, so the areas that India is going to need in the coming many years are going to be technologies in measuring soil health, early warning systems for weather, help to manage our residue problem. We've got a majority of our farmers burn their crops, turning it back into useful value. So essentially what I'm asking is a question that says – Where are we headed overall around the world when it comes to looking at technologies for solving problems in continents like India.

Elwyn Thank you, and that was within a minute exactly. Thank you so much. Brevity. Let's take a few more, and I'll bring the panel back in. Who would like to go next?

Q So Ted Shire with Jet PHC. Just wanted to ask a question about soil sustainability. And we're getting to the point where there will be a generation not too far away that can't lose any more soil and just wondering what your thoughts are on systems, like perennials, cover crops and other combinations that might be able to get us down to that level where we don't lose anymore.

Elwyn Yeah, that's an incredibly important point. I saw a hand somewhere around here. Please, gentleman.

Q Actually I'm coming from India, and we are also... I'm here for the Global Farmer Network Program and Global Farmer Roundtable meeting here. And you know we have a big problem of climate changes now, so we are growing wheat in our area – 1% temperature increase, decrease the yield also. So sometimes farmers don't know – today the temperature is too hot sometime in the winter. So the climate change, global warming is the biggest issue in the coming time. So decrease in the yield and also it even 2-4 quintile also the biggest issue so science and other things also fail sometimes. So I love that some here in the Global Food Prize to learn how we can mediate this problem. Thank you.

Elwyn Thank you so much. There's a line there, so let's keep this going. Be brief, please, sir.

Q Yes, Ralph Klem with Helen Keller International. My question is – How can we take discovery and shorten the time from discovery to deployment with respect to research? And particularly how does one invest in extension services that actually can take some of these new discoveries to the places and people that can benefit from them?

Elwyn All great points. Please.

Q I'll be quick as well. I'm with the Yield Lab in St. Louis. We're a venture capital fund. So I'd like to ask both about the role that you see private capital, like venture capital and even PE, playing in kind of commercialization of research. But also you guys touched on the need for pulling folks outside of just food and ag into this ag research. So just some ideas on how effectively we in the room can make that happen.

Elwyn Thank you. Why don't we switch sides? So the gentleman...

Q Andrew Muhammed, University of Tennessee and prior to that, the Economic Research Service. I just had a question about federal research particularly in the United States moving forward. You mentioned social science and economics as a pillar of that research. So my question is about the restructuring of the USDA and the removal of economic research from the research mission area. So what are your ideas about how do we move forward incorporating social science into agricultural research when that may no longer be in place moving forward.

Elwyn Thank you. Let's go to this side now. It's telling me we've got six minutes and 52 seconds, so we're going to have to draw to a close so these folks can say so and maybe let's just take a couple more, please, this side.

Q Davis de Moda from Kenya, studying at the University of Georgia. So research, investing in the science is really important, as we say, for developing countries. But it's really expensive, and it does not offer immediate returns sometimes. So how do you incentivize governments and also the private sector to invest in research?

Elwyn One more that side.

Q Hi. Addie Thompson. I'm a new maize research geneticist at Michigan State. So as a new professor, I've found that a lot of my time is spent doing resource management

so trying to find funding to fund my lab. Thank you, by the way, for all the germplasm repositories, because that's an incredible resource, and what an incredible thing that is. That was sort of more of a comment, I guess. But the other question I have is—How do I, first of all, find funding? There was a lot of comments about—here's the sort of things we should be funding, here's the sort of things we should be doing, here's the communication we should be having with consumers. How do we make that a priority? Are institutions requiring a scientific communications course? Because I don't know that they do it currently but I mean maybe. How do I mentor my students in order to do that? How do we incentivize that? Because currently none of my tenure decision comes from those types of activities. So, you know...

Elwyn Good points, good points. Not sure we're going to do justice... It feels rude to let people already standing there... Please, 30 seconds each.

Q Very quick. Hi. Beth Mitchem I'm with the Horticulture Innovation Lab at UC Davis. I would like the panelists to give me your best idea for how we can reach the consumer, the public and educate or convince them that food and agricultural research is just as important as medical research to their own personal human health.

Q Ms. Wombogo, Africa Harvest, I study in Kenya but working of across Africa. The biggest challenge we have in Africa, which is, it's poverty, is to me the dealing in the extension or dissemination of products from research show that they improved varieties, they just are taking it to the farmer, what Norman Borlaug—*Take it to the farmer*. That gap exists, and I believe it is not... There's no... It is totally underfunded. We fund research, research, but we don't fund dissemination of that research to the farm. How can this balance be created? As we are funding research, we are funding dissemination.

Elwyn Absolutely, from research to real impact. So we won't do justice to all those points, but it's quite illustrative the kind of questions being raised, which will help us certainly as we write our 2030 plan to CGIAR. Let's just bring in the panel—it's really about a minute each. Just choose one or two questions that sparked your interest and really as brief as you can be. Maybe let's start with Noelle and work this way.

Noelle So the one that intrigued me was—how can we shorten the time from discovery to implementation. I actually think that one of our problems is a constraint that's delivered to us through regulatory requirements. I think it is delaying the time to implementation, and it's also increasing the cost of the research discovery. And I throw out to you that many of the regulatory requirements that we are required to meet are sometimes directed to us because of public perception by a community that has abundant, safe and cheap food. And they are putting more requirements of regulation to ensure that safety of that discovery than maybe people in communities that don't have abundant, safe and cheap food would require. So I would like to see a conversation of what regulatory thresholds are actually needed appropriately for our discoveries.

Elwyn Thank you. Now Marco.

Marco So very briefly there was a question about the relevance of ag research for small farmers and what are we doing about that particular aspect. Well, I can assure the speaker that all of what CGIAR is doing is focused explicitly on small-scale farmers. And since you are hailing from India, I know that that is an explicit focus of ICAR also of course.

Now, farmers, how to improve farmers' welfare and empower them as farmers... And to get back to the Indian example, work to which achieving that prime ministerial goal of doubling farmer income by 2022 – it is in a nutshell. And this is a long story, but in a nutshell it's always about three things: technology, services of various kinds, and access to markets. And technology, of course, the good news is that much of the technology that ag research generates is divisible; in other words, it is not size specific. It works on small farms and large farms. And it turns around four or five themes that are recurring themes, and they have to do with genetics, soil health/fertility, crop protection of various kinds both through the management routes as well as the genetic routes, routes and mechanization and irrigation. That is what our technology is all about at the pre-harvest domain of things. Of course, then we can talk about the post-harvest domain of things, but Elwyn is not giving me the time for it. Services include extension; others will be possibly talking about it, or we can talk about it during the coffee break. We have a lot of thoughts in CGIAR and elsewhere about extension. And then access to markets. Access to markets are essential. There is no use increasing productivity and production without there being access to market, because you can shift very, very quickly through improved, for example, seed, to a situation where you are barely able to meet the household's food needs to one where there is a marketable surplus that meets the goal somewhere. Yes, and one more word about delivery – delivery, and you mentioned it also, and this whole thing is linked also to the question of public goods. Delivery must be through partnerships. The ag researcher as a species is not typically equipped to do delivery – right? But they are equipped to potentially developing solutions that can end up making the difference. So delivery through partnerships, and this is something that exercises a whole lot. And then the question of public goods, and my last statement that Chavonda mentioned – yes, but impact is never about public goods. Impact is about private goods. Public goods cannot be eaten. What I eat, the bar of chocolate I may be eating after this panel is a private good once I buy it and once I eat it. The seed in farmers' hands, whether it is given to them or sold to them, is a private good. So impact in terms of our world of ag research is also about how we can progress and be catalytically supportive of the necessary process of conversion of public goods to private goods in the hand of the actors such as farmers and other value chain operators that need those solutions.

Elwyn Thank you. Any last sound bites, as it feels rude to leave our last colleagues with no time?

Chavonda So just very quickly we had a comment about the Economic Research Service and behavioral economics and social science. I think that scientists are realizing now more than ever how important social science is to whatever we do. Because we can develop technologies and innovations all day long. If people never adopt them, we have not been successful. So understanding, a better understanding of how to transfer that technology is something I think is critically needed.

Dan And just along that point, and this is my own personal view –I think efforts to remove the Economic Research Service from the Department of Agriculture is a very bad idea, because it goes to the basic point...

Chavonda Just very quickly...

Dan This is my own opinion.

Chavonda It's not being removed from the Economic Research Service, I mean, from USDA. It will still be in USDA.

Dan It will be, but perhaps it will be in another part of the country that is very far apart from where the other scientists are. And it goes to the point that social science and the non-“hard sciences” are all part of a broad way of looking at the world. And so I think it will weaken it.

One question on soil health – this is a really important question. Understanding the microbial organisms within the soil is going to be in many cases the future of agriculture, particularly in the developing world.

And so the final point I would say is – Make the consumer your friend, not your enemy. He or she may not agree with you, but they're still the ones that are buying the product that we produce.

Elwyn We're done, thank you, with that final sprint at the end.