

## Welcome

Megan: Thank you for coming. My name is Megan Haidet. I'm a program specialist at the National Institute of Food and Agriculture. And, I'd like to welcome you all to NIFA Listens: Investing in Science to Transform Lives. This is a listening opportunity where NIFA has invited speakers from around the country to participate and let us know about your top priorities, challenges, and needed breakthroughs in science research, education and extension, that NIFA can address.

Megan: We want to hear from you. This is all about the participants here. So, given that, we are going to give a short presentation at the beginning about this listening effort, and then we're going to proceed, as if this was a public comment session. So, we have an agenda, I hope you picked one up outside, and that is our guide for the day. We have registered speakers. Some will be using PowerPoint, but we also have room at the end of our agenda for any unscheduled speakers. So, if you feel inspired please let us know and we can add you on at the end of the day.

Megan: This presentation is being recorded and webcast, so I ask that you stay at the podium here while making your presentation, so the viewers at home, or online can see everyone. We invite each speaker to talk for up to ten minutes. We have some reminder slides up here, we'll be letting you know when you have five minutes, and two minutes remaining. We hope, that you stay on topic and are respectful of everyone in the room. So, if you need to take a call, or have a private conversation, please step outside.

Megan: The video and transcripts from this NIFA Listens session as well as the others we are doing this month will be available on our website in a couple of weeks. We have refreshments. The bathrooms are outside. We will plan on a ten, or twenty minute break around 10:10 AM this morning. And, I think that's about it. Next, I would like to introduce the deputy director of the Institute for Bioenergy, Climate, and the Environment. Dr. Luis Tupas.

Luis: Thank you for coming. I am Luis Tupas the deputy director of NIFA for bioenergy, climate and environment. And, with me here in Minneapolis, from NIFA I'd like to introduce Dr. Randy Johnson. She is the division director for global climate change. And, you've all met miss Megan Haidet. She is our program specialist with the Institute of Food Production and Sustainability. I'd like to introduce also Dr. Lynn Khadiagala. Lynn is over here. She is with our planning, accountability, and importing staff. And, miss Felita Lyles with our communication staff.

Luis: So, we're really happy to host you here, and we'd really like to hear from you with regards to the different questions, that you have posed in our federal register notice. So, a little bit of a background about us. We are the extramural

science funding agency for USDA. We invest and advance agricultural research, education and extension. We collaborate with many individuals and organizations to address pressing local, domestic, and global problems, and it is through this process that we would like to make scientific progress to transform the lives of people, that we serve. And, that's pretty much the country, and to the extent that we can the world.

Luis: How do we prioritize what goes into our scientific portfolio? Well, we have four major sources of that input. We get, of course congress, through the Farm Bill and the Appropriation Process. We get input from the Secretary of Agriculture, down the chain to the under Secretary of Agriculture for our admission area, as well as from the White House through various means. The Office of Management and Budget, the Office of Science and Technology Policy, and many other places.

Luis: We also have our own internal stakeholders, which is really the intellectual capacity of our own agencies' scientific staff, who are subject matter experts in their own fields, and they have connections with the agriculture scientific community in the states, and the territories with the land grants and other institutions. We also have connections and we work closely with our other USDA colleagues from different agencies in the department. And then, the other source of input are yourselves, our external stakeholders. This process comes through listening sessions such as this, and as well as other areas where I will just ... I will reach upon in a few minutes.

Luis: So, this is one of the means from which we get stakeholder input from our external partners, collaborators. And, this NIFA Listening session for this year is focused on these three questions related to the greatest challenge, that should be addressed by NIFA in all of agriculture. One that is specific to your field. "What is the most need breakthrough, that is necessary?" And, the breakthroughs include changes in knowledge, technology, or behavior. And, the other question we're asking is "What is your top priority in this enterprise?"

Luis: And, we have a website here "<https://nifa.usda.gov/nifalistsens>", that you can access this information as well. We have an electronic opportunity for you to provide us input all the way until November 30th, 2018. Please go to that website and you will be able to have another opportunity to provide input all the way until November 30th.

Luis: This is the third of our in person events. We will have one more in Albuquerque, New Mexico on November 1st. So, your input is highly valued. We would like it to inform the prioritization of our science emphasis areas. We would like it to inform us about the gaps in our scientific programing, and also determine which of our programs are underperforming, or could be redundant. And, combined with the input from our staff and from USDA and all those other sources that I mentioned, we will create our current science emphasis areas to identify the gaps in our portfolios, and look at our potential future investments.

Luis: So, okay. So, anyway. What did we hear in 2017? Well ... Did I advance that? Just, excuse me. Yeah, sorry. So, what we heard in 2017 are two big areas. One involved systems where the input was focused on the big challenges facing agriculture, that require a systems approach. And, these systems include economic, social, and all those other systems involved. So, we're really looking for transdisciplinary systems, and that was the input we heard.

Luis: The other input, that we heard from a very large audience was regards to data and technology as solutions to manage agricultural systems. This includes data and technology, that will help extension, education, and community development, as well as those that need to strengthen communication between research and extension. So, those were two of the major topics we heard in 2017. About 40% of the input that we received were focused on each of them.

Luis: And, if we look at the demographics of those inputs, we had close to 600 responses in different forms. 383 were of our personal opinions and we received 216 from organizations. This is just a breakdown of the demographics. Universities were the primary source of our input during the 2017 Listening sessions, and then we also heard from other non-profit organizations. And, the "other", which is the third category in the bar chart. "Others" included research institutions, community based organizations, regional associations, and quasi state community commodity commissions.

Luis: So, those are the demographics of our last year's Listening session. And then, you will see later on as Megan indicated the results of our NIFA Listens for 2018 will be posted in a few weeks after we conclude the last one. So, the Top 20 Science Priority Themes with their percentage. I talked about Data & Technology. Plant Production was fairly high on the list. Sustainability, Agroecology, and we considered everything down the line to Controlled Environmental Agriculture.

Luis: But, all of these comments are taken into consideration. We just rank them here based on the number of comments that were received last year. So, on the first theme of Data and Technology, 124 organizations and 118 personal input, 40% of all the comments were on this topic, and you can see a graphic of how the different ideas under data were grouped together. The major areas included data itself, genomics, precision agriculture, diagnostics, all the way down to sensors.

Luis: So, we have, really a big mix of ideas under that theme of Data and Technology. Under the theme of Plant Production you can see here how its broken up, and you can see how the words that were used, that went into the graphic here "crops" and "crop" obviously, but we also were provided input with regards to soil health, eco system services, all the way to plant breeding. So, those were the common related areas under Plant Production.

Luis: But, as you can see there are many other areas aside from those two that were presented. I just presented the top two, but we have all these types of science

priority themes that were provided, and we'd really like to hear from you, your views for this year.

Luis: So, to find more about NIFA listens, this is last year's, so that's the website where you can go to last years, and we will have our 2018 information up after we end this listening sessions. And, really, thank you for coming. We look forward to listening to what you have to say. In order for us to have a transcript of this, we are recording this session, it's being actually broadcast live to our staff back in Washington DC, so we'd really like to hear from you, and thank you again.

## Kristina Hubbard from Organic Seed Alliance

Megan: All right. So, now we are going to begin with the agenda ... continue with the agenda. And, first up we have Kristina Hubbard from the Organic Seed Alliance.

Kristina: Good morning. Can everyone hear me? Thank you to NIFA for the opportunity to provide public comments today. I traveled here from Missoula, Montana. Mostly for the USDA's National Organic Standards board meeting happening this week across town in St. Paul, and I'm thrilled to be able to weigh in on the critical research priorities, that are in discussion today here.

Kristina: I work for Organic Seed Alliance. We are a mission driven organization, that aims to help organic farmers find the seed they need to be successful, through research, education, and policy advocacy. Our plant breeding work emphasizes farmer participation to ensure we're meeting the diverse and regional needs of growers, supporting choice in the seed marketplace, and helping farmers add economic value to their farms, and in return their rural communities.

Kristina: Organic Seed Alliance is involved in about a dozen participatory plant breeding projects. One example is the Northern Organic Vegetable Improvement Collaborative, or NOVIC. We are working with Cornell University, University of Wisconsin Madison, Oregon State University, and Washington State University in this work to breed new varieties of vegetable crops, that are appropriate for organic, and other low input production systems across the northern tier.

Kristina: This project has already released several new varieties to the organic seed marketplace. It has trained about a dozen graduate students in organic plant breeding skills, and the project has hosted 80 workshops for farmers in 19 states, focused on farm plant breeding techniques and organic seed production. Thankfully this project has received its third round of funding from a NIFA program, the Organic Research and Extension Initiative, or OREI, which will allow this project to have an even bigger impact.

Kristina: Access to seed that is appropriate for organic systems is especially critical for organic growers, since they rely even more on advanced plant genetics to support production challenges, given that their toolbox is smaller in terms of

limitations, and sprays, and other allowable controls. The demand for Organic Seed Alliance's research and education services grows each year. We can not meet the demand among farmers who are interested in engaging in participatory plant breeding projects, to expand choice and seed for their local climates and environmental conditions, in addition to demand to build their skills in growing seed for the commercial seed trade.

Kristina: It's important for me to note, that we couldn't do much of our breeding work without the support of our Land-grant university partners, which is why it's troubling that the infrastructure in many of our land grants has greatly diminished over the years, impacting the output of public cultivars, and new public breeders, and slowing the response to the diverse needs of farmers, especially at the regional level.

Kristina: As an organic research organization I want to emphasize the importance of prioritizing research funding for organic production systems to support this growing sector of agriculture. Many of you probably know, that consumer demand for organic products continues to grow nearly 10% annually, since the inception of the federal rules in 2002. US organic sales have reached about 50 billion with nearly 27,000 family farms and businesses represented.

Kristina: This growth I certainly encouraging, since organic farming has provided many growers the opportunity to diversify their production, take advantage of a more lucrative market, and improve the health of their soil and local bioregion, but unfortunately domestic production is not keeping pace with this demand, and increasingly we are relying on more organic imports. We view this as a missed economic opportunity for US growers and we think its important, that USDA helps to address challenges hindering growth in US organic production.

Kristina: NIFA plays and important role in this effort, because investing in organic research is central to supporting more domestic organic production. And, because of focus on soil health and alternative pest, and disease management strategies for organic growers, benefits conventional, or nano growers alike the benefits are much broader than just supporting the organic farming community.

Kristina: Unfortunately over the past five years, while overall funding for agriculture research has grown significantly, funding for organic research has stagnated. For example the OREI program that I mentioned earlier, that many of you are probably familiar with has been funded at 20 million annually since fiscal year 2010. In addition, according to USDA's own data provided to congress, funding for organic research within USDA's flagship competitive research program, the Agriculture and Food Research Initiative, or AFRI, has averaged about two tenths of 1% annually over the five year period of 2011, 2015.

Kristina: Averaged that percentage toward organic research. The AFRI program is intended to serve the agricultural research needs across all US agriculture sectors, but it's clearly falling short with regard to organic. The new farm bill being debated by congress right now offers hope, that there will be more

funding for OREI, but NIFA can, and should do more to increase funding for organic research across the competitive research grant program areas.

Kristina: In addition to prioritizing organic research more broadly, NIFA should also be placing a higher priority on the use of USDA competitive grant programs to fund projects that expand farmer access to more public cultivars, that are regionally adapted to their farming systems, soil conditions, and climates. Because, of the number of USDA research programs that can, and should be making public cultivar development a higher priority we believe that USDA should consider appointing a staff person to oversee these efforts across the many relevant research programs at USDA.

Kristina: The private "C" sector is doing many things well, but there are many more gaps in the way of underserved crops, and markets that the public sector is best suited to fill. There's a common sentiment from a wide array of farmers, not only organic farmers, that there is a need for more public cultivar options. Furthermore, access to more diverse and regionally appropriate cultivars supports larger societal goals as well, including food security, climate change adaptation, drought tolerance, biodiversity, and nutrient, and flavor enhancements for consumers as well.

Kristina: We also believe that USDA should track grants that result in finished public cultivars, separately from genomic and molecular genetics activities. We are supportive of genomics and molecular research. That often helps us better understand plants and traits, but we currently do not have data for identifying the public funding stream going toward farmer ready cultivars. This tracking system should provide a more accurate assessment of USDA's commitment to public cultivar development and can certainly inform public plant breeding research priorities as well.

Kristina: Cultivars developed with public support should also be kept in the public domain, that is we believe they should not be protected by restrictive intellectual property rights, that disallow further research, germ plasm sharing, and seed saving among the farming community. This will ensure broader access to improved genetics, and encourage more innovation in our public institutions, and on our farms.

Kristina: We have found in our own research program, that farmers are some of the best innovators. I also want to emphasize that public cultivar funding needs to be longer term to reflect the time required to produce improved cultivars. Cultivar development, unlike other types of research can not be started and stopped based on a three year granting cycle, which is one of the reasons why we are so pleased, that we got a third round of funding of the NOVIC project I mentioned earlier.

Kristina: Cultivar development is rapid only when programs are continuous. We also need to train and mentor the next generation of public plant breeders to continue the highly successful, and long history of public cultivar development,

and to better stabilize our Land-grant university base. I recently had the privilege to attend a student lead event, called the Student Organic Seed Symposium. This is a symposium that is initiated and organized by, and for plant breeding graduate students, who are interested in future careers in plant breeding, and who have an interest in supporting organic farmers.

Kristina: Many of these students will graduate soon and be looking for jobs, and a common theme in my conversations with them was very real concern, that public plant breeding positions will not be an option for them. Many want to conduct field based plant breeding in the public sector. Many want to fill gaps in minor crops, and markets, such as organic. And, many, already during their short time as students understand the barriers to doing this work in the public sector.

Kristina: I just want to close by mentioning, that the National Organic Standards board meeting, that I referenced at the beginning of my comments works hard to collect comments from the organic community to inform their own research priority agenda, so I also encourage NIFA to collaborate closely with National Organic Program advised by the National Organic Standards board to fulfill some of the highest priority research topics, that have come from the public comment period, and that have been organized, and again prioritized by the National Organic Standards board, which as an advisory board overseeing the organic standards. Thanks again for this opportunity.

## Peter Morrell from University of Minnesota

Megan: Thank you. Next up is Peter Morrell from the University of Minnesota.

Peter: So, I'm Peter Morrell. I'm a faculty member in agronomy and plant genetics here at the University of Minnesota, and my official job title is computational biologist, which I think will be evident in my talk. I have a relatively small number of slides, but I think it will help illustrate some of what I want to talk about.

Peter: So, I just want to talk about three topics really quickly. One is a research opportunity, and the others are sort of, in terms of opportunities for training and building a workforce, that can be involved in agricultural research.

Peter: So, the first topic is "Harnessing the recombination process" and as I'll explain, there are limits on selection that are quite important, and recombination is a process over which we still have relatively limited control and ability to manipulate. I will also talk just a little bit about data science and the opportunity for better use of inner disciplinary research opportunities, and an ability to attract students from other disciplines. And, finally I'll talk just for a moment about diversity of the STEM workforce and the chance to expand educational opportunities.

Peter: So, the recombination process of course has been a major part of plant breeding and genetic mapping, and other activities for a very long time, and it remains important. But, in an era where targeted genetic modification has become routine, the recombination process remains stochastic. And, crossover events are quite limited. They generally occur as one per chromosome arm per generation, and there are regions of the genome ... this is barley, chromosome 7, there are regions of the genome where the probability of crossover is very low, and there are limitations to the amount of crossover that occurs.

Peter: So, in one of the most famous results that applies to plant animal breeding, selection then ... the process of link selection means, that selection ends up acting on the aggregate of variants with both positive and negative effects on organismal fitness, and therefore yield. And so, the lack of ability to have some control over the rates of recombination and where recombination events occur, and the ability to separate individual genetic variants limits our ability to make genetic gains in plant, and animal breeding efforts.

Peter: So, in one application that my lab has worked on, and this is a relatively new area, that I'll talk about just briefly, there is the potential to remove deleterious load, or deleterious variants, genetic variants that have an impact on fitness and reduce organismal fitness. so, all of us have ... all of us have several hundred genetic variants, that if they were "homozy" ... I guess, meaning that we had gotten the same copy from mom and dad, we would be dead.

Peter: So, there is a reasonable question as to why aren't we all dead a hundred times over, and it's partly because mom and dad weren't that closely related. But, in plants and animals that same process occurs and in inbred plants, they can carry many of these variants in the homozygous state, meaning they have two copies of those variants, and so that eliminates, or it reduces yield.

Peter: So ... excuse me. In this example we looked at a barley genomic prediction experiment, and essentially lines that carry fewer of these homozygous deleterious variants have higher yield. So, as many of you know it's been very hard to find variants that positively affect yield, but we found a class of genetic variants, which when you reduce them actually lead to higher yield.

Peter: And so, we can readily identify these variants in the genome, because they are at phylogenetically conserved sites, places where amino acids don't change very much over evolutionary history. And, producing plants, and animals with lower deleterious load, or lower mutational load it's called sometimes, is a path forward for plant, and animal breeding. So, we have of course targeted modification, and targeted modification can be used as I'll mention on the next slide, in this process.

Peter: But ... so, this is CRISPRs talents, other techniques, but we still are limited in the total number of variants, that can be eliminated by targeted modifications, and by the process of recombination, and independent assortment. So, some of my colleagues also working on this topic, that were interested in targeted genetic

modification have recently published a pre print with a terrific title. "Removal of alleles by genome editing - RAGE against the deleterious load."

Peter: So, one way to remove harmful variants is actually to use genome editing techniques to edit them out. The challenge with that is, that there are thousands of these variants in an individual barley line for example. So, a more effective way according to this paper is, that performing truncating selection for individuals with reduced load can actually ... so, picking individuals, that we know have fewer deleterious variants is a practical approach to removing that load.

Peter: And, this is just an example from barley, where you see those red dots across the top of each of these chromosomes are the deleterious variants. So, even along regions of the genome like these edges of chromosomes, that have high recombination, there are large numbers of deleterious variants, that can potentially be removed, but there are limitations on how many can be removed in any generation.

Peter: The other area I want to talk about. To do the sort of work that I just showed you requires people involved in agricultural genetics and genomics, but even within my single laboratory it involves students and scientists with a wide array of backgrounds from biochemistry, computer science, evolutionary and population genetics, molecular biology, statistics, and we've had people from all of those disciplines in our lab, and there is an opportunity in a changing environment, where we're facing big challenges like climate change to recruit students, who are very talented from other disciplines, who find our area of research quite exiting, and they bring a lot of new energy. And, one mechanism for this ... I know NIFA is involved in this, but increased emphasis on undergraduate, and graduate interdisciplinary research funding is a real opportunity to grow these fields with people who bring a real serious skill set to the table a lot of times.

Peter: And, finally it's important to note, that ... and again, this is something that NIFA has been involved in, but there is a lot of untapped talent in our STEM workforce, that could be a part of our STEM workforce. This is participation of blacks, and Hispanics, a Pew Charitable Trust study. Black and Hispanic students, and communicates are still very much underrepresented in STEM, and particularly in the areas that are most important to the sort of work we're doing in math, the live sciences, and computers ... we're actually doing a little bit better than some other fields, but these groups are still ... for example Hispanics are still dramatically underrepresented compared to what they could be in those fields. So, there is a lot of opportunity to grow our areas by recruiting talented students from these communities. And again, through funding for undergraduate, graduate, and post graduate research. So, thank you very much.

## Adam Sychla from Genome Writers Guild

- Megan: Thank you. Next up we have Adam Sychla from the Genome Writers Guild.
- Adam: It's been almost a quarter century, since the first genetically engineered food entered the US market. Since then genetic engineering has become deeply rooted in the agricultural system. Thank you.
- Adam: Since then genetic engineering has become deeply rooted in the agricultural system. Hello, my name is Adam Sychla. I'm a first year graduate student here at the University of Minnesota and an executive officer of the Genome Writers Guild.
- Adam: I was the first in my family to pursue a post secondary education and I decided to continue on to get a doctoral degree focusing on the field of genome engineering, because I look around at the world that humans have created, at the impacts that we've had, and I can't help but be in awe. And, that doesn't mean we're finished yet, either.
- Adam: We can always continue to strive for better results, to change our impacts to be more positive. So, why genome engineering? Genome engineering has opened up possibilities, that we didn't even know existed. Just looking at the impacts it had in agriculture clearly demonstrates this. There are tried and true solutions like insect resistance, that have helped to bridge the gap between potential and actual yield.
- Adam: Aiding in environmental sustainability and economic returns, but the past two decades have seen unprecedented advances in the specificity, and the rationality by which we write genomes. The tools now available allow for genome engineering and agriculture to push far beyond just economic returns. I for example, was able to work on engineering a faster test for Foodborne Illness. Plant based pharmaceuticals, biofuels, and environment resistant plants are just the beginning too.
- Adam: Biofuels and environment resistant plants are just the beginning too. Even some of the most difficult limiting factors, like uncontrolled gene flow can be addressed. I've recently started working in this Mansky Lab here at the University of Minnesota engineering, synthetic speciation, a system that would allow for bi directional control of gene flow while also allowing the engineered strains to propagate. This would open doors to engineering new traits that are currently either restricted or completely invaluable.
- Adam: A little over a year ago, I joined the then nascent Genome Writers Guild. I see genetic engineering as a powerful technology that can help all of humanity and the world we live in, so any discussion about it should include everyone, scientists, government agencies, as well as members of the public. I felt that the Genome Writers Guild would be an organization that would be able to catalyze

this conversation. Early on, I led the writing of the mission statement and the bylaws, and soon became an executive officer where I've worked diligently to seeing the broadest impact possible.

Adam: I ran the first ever public outreach event as well as aided in registering the group as a nonprofit, creating the website, and running the annual conference. It's clear that people really want to have this kind of dialogue. The Genome Writers Guild has students who are willing to open discussions with politicians, artists, business woman, and people who are simply curious coming together to discuss genetic engineering because it matters to them. The Genome Writers Guild represents a future of responsible genome engineering, responsible genome engineering that's not only communicated to the public but occurs with their input, genome engineering that allows for advancement, reinvestment, and progress.

Adam: I wasn't really asked to speak here today, by anyone in particular, except maybe NIFA. I came here to advocate for genetic engineering because I believe in its potential to address some of the greatest challenges in agriculture. Human health, food security, environmental sustainability, and even the U.S. economy are all deeply tied together. It's not a matter of investing in one of these, but investing in all of them. Continued work in genetic engineering can aid in addressing these issues. Education, broad public outreach, and scientific investment around genetic technologies will bring students like me and others together to find the solutions to these toughest problems, bring their insight and help change the world.

Adam: Thank you.

## George Smith from Michigan State University

Megan: Thank you, Adam. I invite anyone that's come in in the last few minutes since we got started. If you have a presentation, feel free to stop by the AV table at the back of the room. Next step, we have George Smith from Michigan State University.

George: Good morning. I'm pleased to have the opportunity to testify to today's stakeholder listening session on emerging needs and opportunities in food and agricultural sciences. I have the pleasure of serving as both the associate dean for research in the MSU College of Agriculture and Natural Resources as well as associate director of MSU AgBioResearch. I have the pleasure of assisting an oversight of MSU's research portfolio in the areas of food, energy, and the environment encompassing the work of over 350 faculty and eight different colleges on the Michigan State University campus.

George: There is perhaps no more important time than now to be involved in unearthing solutions. We'll keep our food supply safe, secure, and sustainable. As a land-grant university, MSU remains committed to discovering practical, adoptable

solutions that address the challenges facing our food and agriculture industries in Michigan, in the United States, and an impact across the globe and certainly partnerships with the USDA and NIFA through capacity funding and through the Agriculture and Food Research Initiative competitive grants program are critical to future impacts of Michigan State University scientists in solving some of the grand challenges which we're here to discuss today.

George: With more than 300 commodities commercially produced in the state of Michigan, we're the second most diverse agricultural state in the country, only behind California. MSU College of Agriculture and Natural Resources, MSU AgBioResearch, and MSU extension work hand in hand with the state's commodity organizations to address issues and challenges facing our growers and producers in the State of Michigan with implications applicable worldwide. Key findings from our research have assisted facilitated growth in food and agriculture economy in the state of Michigan, growing from \$88 billion annually about eight years ago to over \$140 billion of annual economic impact in the state.

George: Again, we couldn't have done that without the support of programs from USDA NIFA capacity funding and help support our scientists and a host of competitive grants programs that provide the funds to help address practical challenges in the state of Michigan and beyond. As I mentioned, diversity is a cornerstone of agriculture in Michigan, in the United States now and in the future, diversity not only in commodities produced, but also in farm size, production systems, and operational goals. We believe it is paramount that USDA research agenda for the future reflect all of these different types of diversity.

George: We were tasked for this listening session to address three what you could call somewhat challenging questions. The first one I would like to address is what we feel is a top priority for NIFA and food and agricultural research, extension, and education. I'm considering the foundational principles critical to confronting challenges facing U.S. agriculture for the next 50 years and beyond. It's important to keep in mind programs and principles that have propelled advancements in productivity and sustainability of U.S. agriculture during the past decades.

George: Foundational to that is the USDA Agriculture and Food Research Initiative, the flagship competitive grants program at USDA NIFA that's benefited the nation by providing America's farmers and foresters with genomic data and biotechnology tools to expand food and fiber production, processing international trade, healthcare professionals with insights, interrelationships between diet and health, farmers, landowners and ranches with expanded knowledge about soil and water quality, university funding to train the next generation of food, agriculture and natural resource scientists and cooperative extension educators.

George: Basic research program such as the foundational grants program at AFRI we feel are the top priority for NIFA and Food and Agricultural Research in the future.

They're a paramount importance to scientific advancement and sustainability of U.S. agriculture. The fundamental knowledge generated through programs like this are critical to many of the advancement driving growth and increased productivity and sustainability of agriculture in Michigan and beyond. For example, in the state of Michigan, milk production per cow has increased more than 90% since 2000 milk production in general and per cow. Michigan now rates second in the nation average milk production per cow and about eighth nationally in terms of total milk production.

George: This growth is directly linked to improvements in reproductive performance, feed efficiency, genetic selection, and animal health made possible by an underlying foundation of basic research. That foundation of basic research is critical to solving the problems we face in the next decades. A rigorous basic research agenda, I said, remains critical to solving the challenges of coming decades and beyond. Some of those challenges I will outline. However, I also need to mention the applied research and foundational areas including greater emphasis on production and efficiency is also critical to the future of agriculture as we're certainly in a climate now economically where a lot of our commodities are produced in excess and we need to provide tools to help our farmers and ranchers look more closely at how to maintain production with lower input costs.

George: A balance of applied and basic research portfolios are critical to the future. USDA NIFA must also continue to support existing partnerships, and develop new and effective ones with other federal agencies as well as foundations and private industry to increase funding opportunities for agricultural research and significant leverage available funding annually for competitive grants. I'm guessing we get no arguments from anyone in the room that agricultural research is currently unfunded in the country, and certainly while we would all love for there to be to increase funding to NIFA for agricultural research, it's important that we also look at partnerships and ways to encourage other agencies to invest in agricultural research that's also a fundamental interest to the goals of NIFA and agriculture in this country.

George: That is one of the reasons why I remain deeply concerned about the proposed relocation of NIFA out of the beltway for the impact that it will have on existing and future partnerships. With that, I'll move on. We're also asked to address the greatest challenge to be addressed in agriculture. That's a really, really difficult question. In addressing that question, we need to look at the diversity of agriculture and its complexity and the numerous frets our industries face. In developing longterm research agenda for the US food and agriculture, it's important to consider both opportunities and overarching threats.

George: Technical, logical advancement, and big data provides an opportunity for innovation and rapid growth in productivity, production efficiency within the agricultural sector, and it should be paramount for future research agenda focused on addressing challenges in the next decade. Fundamentally, I feel there's a pressing need to train the next generation of scientists who can

effectively work at the intersection of agriculture, engineering and computation, and a need for a greater recognition overall of agriculture as a stem discipline. In terms of threats and major research priority linked to many significant challenges facing US Food and Agricultural production is understanding resilience.

George: More specifically, mechanism confer resistance to abiotic and biotic stress in plants, animals, and microorganisms. In my home state of Michigan and for the Michigan Agricultural Industries, climate change is real. For example, prolonged, very early periods of warm weather followed by rapidly decreasing temperatures can wipe out our significant specialty crop industry in a matter of days with little to no alternatives or viable ways to combat. The same is true for agronomic crops when we look at prolonged periods of drought or heavy rainfall. Accompanying such variability in weather, it's not only weather, is emergence of new invasive pests such as spotted wing drosophila, which is having a huge effect on our specialty crop industries in the state of Michigan.

George: There's very, very limited tools at best to combat these new and emerging threats. Key to addressing these problems, and that relates to the third question about most needed breakthroughs in technologies is development of new, more resilient varieties of specialty crops and agricultural commodities in general, plants and animals with resistance to abiotic and biotic stresses. I feel that's one of the grand challenges facing agriculture that NIFA should address in the future that's critical to growth and sustainability of our industries and feeding a growing population worldwide.

George: Linked closely to the previous research priority is the need for new tools to combat resistance to commonly used herbicides and insecticides to control weeds and agronomic crops and to control pests and pathogens that threatened multiple aspects of food and agriculture production. Once just the topic for science fiction, antimicrobial resistance has now become a significant issue for agricultural, human and environmental health and animal and plant-based production agriculture in general. Combating this threat will require a truly integrated multidisciplinary approach involving scientists from diverse fields, including animal and human health, plant sciences, engineering, computational sciences, and environmental sciences.

George: Future efforts in antimicrobial resistance research should be focused on the following, development and testing of new production management practices in regimes to reduce the frequency by which antimicrobials are needed in both plants and animals. Development of new biosensor technologies to provide early detections, excuse me, of resistant microorganisms and framework for modeling of transmission on farm and to the environment and accompanying risk assessment, development of diagnostics to rapidly and accurately determine [inaudible 00:47:58] microorganisms mediating disease and their resistance status.

George: This will not only increase efficacy of treatments, but consequently reduce use of ineffective drugs, fungicides, herbicides and so forth, and prophylactic use of antimicrobials in general, which lead to the problem of resistance, and design of new alternative methods of treatment or prevention of plant and animal disease. Again, I appreciate the opportunity to testify today at this listening session. I want to thank USDA NIFA for our strong partnerships both in terms of capacity funding provided and committed if funds are available for research. They've been critical to the impact of Michigan State University scientists on agricultural sector in Michigan, the United States and beyond. Thank you very much.

## Jenna Davis & Theresa Reps from Midwest Dairy

Megan: Thank you. Next, we have Jenna Davis from Midwest Dairy.

Jenna: Good morning everybody. My name is Jenna Davis, and I work for Midwest Dairy. I also brought along my colleague, Theresa Reps. We are both employed by Midwest Dairy, which is the regional checkoff organization representing dairy farmers from Minnesota, North Dakota, South Dakota, Nebraska, Iowa, Illinois, Missouri, Kansas, and Arkansas.

Theresa: And Oklahoma.

Jenna: And Oklahoma, I can't forget them, but we also bring a unique perspective that we get to wear two hats. The hat that we are wearing today is for our state trade associations. With that, I represent our interest in Minnesota milk, Iowa State Dairy Producers Association, South Dakota Dairy Producers Association, Nebraska State Dairy Association, Missouri and North Dakota as well in those regards.

Theresa: As Jenna said, we're wearing two different hats. We know that there's a lot of great research that has been done from the checkoff side of things as far as dairy foods research, but we really feel there is an underserved area as far as our state trade associations are concerned in the six states that we mentioned when it comes to production research. Dairy is in a struggling state at the moment. It's not a great environment. We feel that there's a need to help serve our dairy farmers by finding more research dollars that helps our dairy farmers be more sustainable. I mean, as we talk today, we'll lose a few more dairy farms in the United States. I think there's a great opportunity because dairy has such a broad scope and encompasses everything to really put more emphasis on research related to dairy.

Jenna: With that, Theresa mentioned that that dairy is very broad in scope. In terms of research, things that impact dairy would be water quality, forage production, animal genetics, genomics, big data, and more. The list continues. As you can see, we really feel that dairy is the cream of the crop when it comes to a focus of NIFA. When considering the most needed breakthrough for dairy farmers, we

really first and foremost must continue to support the research that is related to sustainability. That includes any type of research for multiple types of dairy farms, whether that be big farms or small farms, conventional or organic.

Jenna: We need to make sure that that research represents all of those sectors in the dairy community, but specifically, where we see that science and technology can lead to breakthroughs, such examples include novel covers for silage piles. It seems silly, but if you drive by a dairy farm, you'll often see a huge pile of forage that will feed those cows for a year covered with a plastic. Is there a way that we can invest dollars that would find a new type of covering that allows for practically no oxygen filtration? Maybe it's something that's compostable, sorry. Maybe it would be using the new type of crop and a new biopolymer.

Jenna: Additionally, we see that direct-fed microbials would offer a great breakthrough for dairy producers. Currently, dairy farmers are very limited in the types of antibiotics that they can use to treat a sick cow. What if we step away from antimicrobials as a whole in our industry? What if we moved to direct-fed microbials? I think, the possibilities are limitless. By focusing research that allows for a greater database of knowing what microbials would be available in terms of direct-fed microbials, and unlocking their potential to see how it impacts the cow by promoting and protecting cow health and longevity is something that would really excite our industry as a whole.

Jenna: Finally, the third area of a breakthrough that we identified is focusing more on cover crop production. We really see a need for continued research in the area of cover crops with a focus on an increased crop that has a focus on a higher nutrient yield per acre, also focusing on the benefits of improving water quality, and just discovering new options that could also serve as forages for those of us who raised cattle in the United States.

Theresa: As if that wasn't complicated enough, the three points that Jenna mentioned, the one thing that we'd love to see tie it all together, which maybe leads to the partnerships that we have with our extension agencies in our six states that we've talked about, would be how do we communicate these advances in sustainability, particularly in those three areas with consumers? We know that consumers don't respond very well to science, but we have a lot of great science data to back up all of the stuff that we're doing and the stuff that we will be doing in the future. We would love to see an increased focus on finding those breakthroughs, but communicating those breakthroughs to consumers to help us increase trust.

Jenna: Finally, we just want to leave with this comment that really the top priority that we see is a focus on dairy, because any research, education or extension that connects to dairy is ultimately a win for our dairy farmers. We hope that you'll have another glass of milk, and continue to support dairy and all efforts by funding through the NIFA program. Thank you.

## Mitchell Hunter from University of Minnesota

Next, we have Mitchell Hunter from the University of Minnesota.

Mitchell: Good morning everyone. My name is Mitch Hunter. I'm a postdoc at the University of Minnesota. I want to talk to you today about a new vision for NIFA programs, especially when it comes to plant production systems that I'm referring to as farming with continuous living cover. We're here today to think about the big challenges or the top priorities for NIFA and its programs. I'm going to focus primarily on the environmental challenges that agriculture faces, but I think that this approach also applies to the productivity challenges that agriculture faces. I just needed to narrow down the talk a little bit.

Mitchell: We all know what these problems are. I'm not going to astonish anyone by saying that we have a challenge of soil erosion, greenhouse gas emissions from agriculture and nutrient pollution, but I think that we don't have a good sense often of the magnitude of these challenges and just how much our systems will need to change to actually get our impacts on the environment down to levels that you could reasonably call sustainable. We often talk about sustainability in terms of a marginal improvement over what we're doing now. Anything that's better than the business as usual scenario is called sustainable, but in reality, if we want to be truly sustainable, we have to get our impacts on the environment down to a level where ecosystems can continue to function.

Mitchell: Let's think about it in those pretty hard nosed terms. To do that, I'm just going to give a couple of examples. First, greenhouse gas emissions from agriculture, not surprisingly, these have been increasing over the last few decades. The projection is that going forward, they'll continue to go up. That's because we're farming more acres. We're using more fertilizer, et cetera, trying to feed a growing population and meet rising demand. If that's the trajectory that we're on, what do we need to do to hit the goal of actually slowing and avoiding the worst impacts of climate change?

Mitchell: Well, it's been proposed that we need to reduce emissions by 80% by 2050. If you look at the gap between where we're headed and where we need to be, it's pretty dramatic. You could even argue that we need to go below zero on that chart, because many other sectors are looking to agriculture as a way to actually take carbon out of the atmosphere. It could be even more dramatic than what we're looking at here. Another example is nutrient pollution from agriculture and its effects on water quality. Using here to illustrate the phosphorus load in the Mississippi River basin, over the last few decades, it's bounced around a lot, but maybe slowly ticking up despite a lot of efforts to bring that down, and to meet the Gulf hypoxia task force goal, which is designed to reduce the dead zone in the Gulf of Mexico, but not eliminate it.

Mitchell: We're not talking about a pristine Gulf of Mexico here. We're just trying to avoid a giant dead zone every year. It requires again, a really, really drastic shift in

trajectory, so a big difference from where we're headed to where we really need to be going. This to me begs the question, "How can we bend these curves? How can we change our trajectory?" I think, we need a very powerful lever to do that. This is where I'm trying to think beyond the incremental, beyond the small changes that we today would call sustainability because they're slightly more efficient but don't actually get us there.

Mitchell: The actual solution will need to be systemic, so that echos the comments from last year. It needs to be landscape scale because obviously agriculture happens across the entire landscape, and so these emissions and losses to the environment occur at a landscape scale. Ultimately, it needs to be profitable. Agriculture is a private enterprise, and farmers are not going to adopt willingly very costly and unprofitable practices. That's important. Finally, it would be nice if this approach had some co-benefits to it both for farmers for productivity and for the environment. To me, all of these different attributes of the lever that we need point in the direction of continuous living cover systems.

Mitchell: I'm going to explain a little bit about what that means, but basically these are agricultural systems, especially plant production systems and integrated plant livestock systems that avoid having brown periods in the landscape, so basically periods where nothing is growing. Today, there's a lot of these brown periods in our cropping systems, especially in northern latitudes, like we're in here where the whole winter is often brown, but also around the world, as we transition between crops, typically, the soil is left bare for a significant amount of time.

Mitchell: Just to talk about what this means, what's this difference between a brown period and a green period, and what happens when we shift from one to the other? Well, if you think about the different processes that are going on in the landscape, as we go from one to the other, it's really dramatic. As radiation falls on the soil, if it's uncovered, it simply heats the soil and contributes to global warming. If the soil is covered by a plant, it could contribute to photosynthesis, plant productivity, regenerative processes. When the rain falls in the soil, if it's not covered, it leads to leaching and erosion.

Mitchell: If it's covered by a plant, it can supply that plant with water and lead again to plant productivity. Microbial processes. When microbes metabolize organic materials in a soil that's not covered, they burn off carbon, put it back into the atmosphere, and free nutrients that are then available for leaching. In contrast, when that soil is covered, those nutrients again go into plant productivity which can stimulate fixation of carbon and return to the soil. This difference, this to me, is dramatic enough to potentially be a large enough lever to get us from where we're headed to where we need to go.

Mitchell: I would argue that most of the approaches that we point to as ways to be more sustainable, a better nutrient management, for instance, engineering approaches to controlling nutrient losses are just not dramatic enough to make the difference that we need to make. They're all important, and we need to have a systemic approach where those are included, but to me, this difference is

one of the few that I can point to that is of the magnitude of the challenge. We have a lot of different tools, luckily, at our disposal and more than ever I would say to help achieve this vision.

Mitchell: We have cover crops that obviously do a good job of turning brown soil green, and we can extend their benefits by planting green into living cover crops so that at the beginning of a cash crop phase, the soil is already covered. We can also extend their benefits on the back end of the cash crop phase by interceding into those cash crops and keeping it green after we've harvested that cash crop. We can do similar practices relaying between cash drops, and of course use our traditional perennials such as Alfalfa and pastures. Excitingly, we have new perennial options coming on board, including perennial grains. Here, I'm showing Kernza intermediate wheat grass, which is a crop that I work on.

Mitchell: This gives us many of the environmental benefits of perennials as well as yearly production of a grain crop for human consumption. We have a lot of these tools, and yet we also know that we can't just go snap our fingers and implement all of these practices on the landscape in a way that's practical and profitable at the current moment. That's why we need NIFA to prioritize this vision in their research programs to help us move forward. I'd like to talk about a model that we have here at the University of Minnesota of this multidisciplinary integrated research and development effort. It's called the Forever Green Initiative. Really, it takes the approach that we need to go from the very beginning of the process with genomics and breeding all the way to the end use to get this done.

Mitchell: On the genetics and breeding side, we do new crops and new cultivars that can exploit these different niches in the cropping system with a profitable crop that farmers have an incentive to grow. To do that, we need our geneticists and breeders to develop these cultivars with high yield, high quality and good hardiness and reliability. Then we need the folks who work on management to figure out how to plant and harvest this. These are the agronomists, agricultural engineers, pest management specialists. How do we fertilize and manage the pests in these systems, and then how do we link them all together through relay rotations that transition between crops without leaving the soil vulnerable and bare and brown?

Mitchell: Then we want to go into the end use. We need to understand the end use. How do you store these new crops? How do you process them? How do you develop food products that consumers want to buy using these crops that keep the soil covered with green plants, and then how do we market these and develop full value chains? As I said, there's an initiative at the University of Minnesota called the Forever Green Initiative that is really pioneering this model. We've got food scientists. We've got geneticists and breeders. We have agronomists like myself all working together on different teams, focused on a wide range of crops, perennial crops, including native woody crops as well as winter annual crops that are essentially cash cover crops that we can produce and get the benefits of cover crops, but also still sell and again, give that economic incentive to farmers.

Mitchell: I'm coming to the end of my time. I was going to talk a little bit about my work on intermediate wheat grass or Kernza, but I think I'm going to generally leave it by saying I see this as a real opportunity to start to bend those curves. It's of the magnitude. This change in the landscape is of the magnitude that we need, here a lot of the incremental approaches can be integrated into this approach, but on their own won't do the job. I'd encourage everyone to check out the Forever Green Initiative. I just need to acknowledge, the leader of that initiative is a professor at the University of Minnesota named Don Weiss. He's done a lot to put these teams together, so I want to thank him and also just all the different people at the university who are working on this initiative together. Thank you.

## Mary Meyer from University of Minnesota

Megan: Next step, we have Ryan McNeeney. Are you here, Ryan? How about Mary Meyer from the University of Minnesota? Wonderful.

Mary: Good morning. Welcome to Minnesota. All of you who are not from Minnesota, we're glad to have you here. Thank you for bringing us a normal a weather day. This is normal in Minnesota with our rigorous climate. I'm a professor at the University of Minnesota. I work in horticulture. Horticulture enters every home every day. You might be thinking, "Gee, does it really?" What'd you have for breakfast this morning? Hopefully a little bit more horticulture than the cranberries and the scones we had, but of course I appreciated those cranberries in the scones.

Mary: Let's see. Where do we move here? If horticulture does not enter our homes every day, we have people that are less healthy, more likely to become ill or stay ill or less likely to be able to work. If you are not close to horticulture every day, your life is less happy, less comfortable, more stressed, and in general, I feel most people would agree with this, less fulfilling and worthwhile. Do you have this view outside your home or outside your office window, or how about outside your hospital window if you're not feeling so good? How about this view? Do you like this view?

Mary: How about this one, or how about this one? This is close to the view outside my window. I have one of the best offices at the University of Minnesota, excuse me, at the Minnesota Landscape Arboretum. I also have an office on campus, and when I tell people I'm a professor, they say, "What do you teach?" But then when I say I work at the Arboretum, people say, "Oh."

Mary: I work at the Arboretum; People say, "Oh, wow. I love that place." So this is what horticulture does for us.

Mary: So you asked us to answer three questions. So the first question, what's the greatest challenge? This is what I feel our greatest challenge is: Efficient horticulture or agriculture production with no damage to the environment. So, thank you, Mitch, for all your help with talking about how agriculture and

horticulture does damage our environment. We know that agriculture is a necessity, we just have to learn how to do our production with the least damage to the environment.

Mary: What's our most needed breakthrough? I would say efficient, low cost, year round production of plants, especially food plants, in cold climates. So, stick around in Minnesota a little longer; You won't be seeing too many things growing outside without a lot of protection and a lot of care. So this is something that I feel we could change.

Mary: Yes, these are Minnesota peaches by a person I just happen to come upon who was bragging about his Minnesota peaches at one time. Above the ruler are the Minnesota peaches, below is a peach from California. So we really can produce a lot of great crops here and have made great strides in this, but we have a long ways to go.

Mary: And the top priority, I feel, affordable; Affordable, available, and sustainable production of fruits, vegetables, and other horticulture crops for everyone, regardless of where you live or what your income is.

Mary: So how 'bout a garden at every hospital? This weekend the Wall Street Journal, there was an article about this, food as medicine. So this is what we know in horticulture to be true. We know and understand that a plant-based diet is good for all of us. We're just beginning to really understand this. This is a quote from the Wall Street Journal, "Hospital patients are heading home with a sheaf of prescriptions, a bag of spinach, and spaghetti squash." And the article talks about having a garden at every hospital. But better than a garden at every hospital is a garden at every school, because if we had children that grew up gardening, we know that they eat more vegetables when they garden, and also, they garden for life, and then eat plants for the rest of their life.

Mary: So we have two wonderful initiatives across the horticultural field that are going on now and have come about in the last couple of years; This is the National Initiative for Consumer Horticulture, I urge you to look at this initiative online. This is consortium to raise the profile of horticulture, especially consumer horticulture, which has no voice in and of itself, to come here today and speak.

Mary: And the second one is Seed Your Future; Seed Your Future is about instilling horticulture into the lives of middle and high school students; So this is Longwood Gardens and Ball Horticultural Company, along with American Society of Horticulture Science, that I used to be the president of, started this a few years ago. So Seed Your Future will now reach hundreds of thousands of students through the Scholastic Program in high schools talking about horticulture.

Mary: So thank you for coming to Minnesota, thank you for taking the time to listen today. We certainly appreciate all the money you've put into horticulture, and

especially crops research funding. We've just begun to research the wonder of horticulture, which will ensure a healthier and happier world for everyone. Thank you.

## Kenneth Olson from American Dairy Science Association

Megan: Thank you. We're running a bit ahead of schedule, so I would like to ask if Kenneth Olson is here? You ready to go? Wonderful.

Ken: Thank you. Good morning. First I'd like to thank the organizers for providing this opportunity to provide input for all stakeholders relative to the direction of research funded through USDA NIFA. It's been an important function of USDA in the past and it continues to be for the future.

Ken: My name is Ken Olson, I'm a dairy scientist; I hold a PhD in dairy cattle breeding, or population of genetics in the University of Wisconsin at Madison. I've been an extension specialist and a full professor in the Animal Science Department at the University of Kentucky, the National Dairy and Animal Health Specialist for the American Farm Bureau Federation, member of the National Animal Health Emergency Management [inaudible 01:13:29] committee for APHIS, outreach coordinator for the Johne's Disease Integrated Program, or JDIP, a NIFA CAP program, currently work as the outreach coordinator for the Mycobacterial Diseases of Animals, Multi State Initiative, another NIFA program, I'm outreach coordinator for the American Dairy Science Association, and science policy coordinator for [inaudible 01:13:56], working with the science policy committee.

Ken: Now I raise these not because of what I've done, but to demonstrate the fact that I've worked with USDA NIFA in a variety of roles, a variety of ways, over many years; Worked both as a researcher, seek competitive grants, and also working with producers as far as identifying priorities. So I think it's perhaps a somewhat unique perspective that's brought to the table.

Ken: Now one thing that has been mentioned previously is the proposed reorganization of NIFA. We recognize that this is something that you don't necessarily control, but it is a concern for [inaudible 01:14:44] and for the folks that I work with. We recognize that many communities, including the one where I live, have indicated an interest in hosting NIFA, but we feel it's really important for the future, for addressing the issues that you're talking about today, that NIFA be located in the Washington, D.C. area. Groups, such as those that I work with, do find this important. We work with other agencies throughout USDA; We work with other [inaudible 01:15:20] organizations, we work with Congress, and being able to visit them in a single visit is much more effective, much more efficient; If NIFA is moved from the capital region, it's likely that there will be less input into the agency.

Ken: We're also very concerned about the loss of staff. It is a real concern, losing the expertise that exists there. I can speak to this personal experience, I was with

the American Farm Bureau Federation at their headquarters in Park Ridge. When it was consolidated into the Washington, D.C. area, half of their staff that worked in the area was lost, and we see that as a major issue that we really want to raise up and have considered as it moves forward. Results of the loss of staff are things that cannot be filled immediately and so it would have a significant negative impact on the ability to answer the questions that are being asked today. So, it also has potential large negative impacts on funding for research in both the short and intermediate term.

Ken: Now [inaudible 01:16:31] science policy [inaudible 01:16:33], serves as a voice for animal agriculture that reaches from the test tube to the table. We embrace all of animal agriculture. Now while most sections of production agriculture are currently facing financial challenging times, research is critical for the future, while being both producers and consumers. We support a research portfolio that's balanced in funding for animal and plant work, as well as between intramural and extramural research. ERS studies confirm that the plant and animal sectors are basically equal as far as income generated, but if we look at the research funding that's directed in different directions, or to the two sectors, that is not the case. Now we've worked with that in the past, progress has been made, but it's something that we certainly continue to push the need to address. I would point you to a paper funding equity for animal science research, 2014 Report to the National Academies of Science, by Russell Cross and coworkers at Texas A&M, as well as various ERS studies for detail.

Ken: Now [inaudible 01:17:49] works with others in an effort to obtain additional funding for ag research. We recognize it's critical, it's been raised before. But we do need to raise the level of funding for agricultural research. USDA, I recognize does not set the budget, but it is important that USDA be a leader in pushing for increased funding, rather than accepting decreased funding for it. So we urge that to be a part of the program as well. Now, NIFA and ARS working with research components and other agencies have a long history of effectively seeking and using stakeholder input. This has been done through targeted stakeholder sessions, I think they've been very affective, I've had the pleasure of participating in a number of those, and we certainly urge that that be done. Sessions, such as this, are important for identifying broad areas, but we need to have that additional detail that goes into really identifying what the critical areas are.

Ken: It's important that we bring together multiple disciplines to address the issues, and one area that may need greater attention in the future is use of big data and precision agriculture; I think that's something that goes across the various sectors, but something that we recognize is needed.

Ken: The process of working through national program areas and ensuring collaboration between the research arms of USDA serves well in identifying the knowledge gaps and research needed to fill those gaps. So encourage that that sort of activity be continued for the future.

Ken: [inaudible 01:19:40] has worked to identify a range of areas that are needed; focus areas that fit into the broad spectrum of things. And three of those that come to mind are food security, basically ensuring an adequate supply of safe and healthy food for growing world population. Second is one health; looking at all aspects of the intersection between animal and human health. And the final is stewardship, or caring for the environment and the wellbeing of animals. We would again note that big data will be an important component across all these areas, but the bottom line is that our research efforts must have an overall objective of providing a safe, secure, affordable food supply for all in a responsible manner. An integrative, evidence based systems approach, that's based on science, will be an important component of all these. We look forward to continuing to work with you, to identify the needs, and work in the specific areas of that, [inaudible 01:20:48] a strong advocate for that, and communicating with the public, we encourage opportunities to work together to do that, so thank you.

## Linda Kinkel from American Phytopathological Society

Megan: Thank you. We'll do one more speaker before break. Linda Kinkel? From the University of Minnesota.

Linda: So, I have some slides... Excellent.

Linda: I'm Linda Kinkel, I'm a professor in the Department of Plant Pathology at the University of Minnesota. And today I'm here representing the American Phytopathological Society. We're a society of over 4,500 members globally, and our research focuses on stresses, in particular, pathogens, abiotic stresses, and the roles of microbes in plant health. And our goal is to not only develop foundational knowledge in this space, but to translate that information to enhance productivity and sustainability of agroecosystems.

Linda: In response to the NIFA listening session opportunity, we surveyed our national and international membership and we got over 300 responses from U.S. members and I'm summarizing those for you today.

Linda: So the first question: What's the greatest challenge? And our membership who responded to our survey really we're responding to two distinct polls that our pulling our research at this point. One is the tremendous challenge to feed the growing world population. As we hurdle towards nine to eleven billion people over the next 50 to 100 years, how do we feed these people when we can't make land? And at the same time, we recognize the limits of our environmental resources to support agriculture, and especially the potential negative - not potential - and real negative impacts of agriculture on the environment.

Linda: So in response to these two polls pushing our research, collectively, the greatest challenge among our members was really articulated as our challenge to increase the productivity and resilience as a distinct attribute of our systems,

while simultaneously working aggressively to reduce the negative environmental impacts of agriculture.

Linda: Within this greatest challenge, our membership responses really coagulate into four distinct top priorities for NIFA investments.

Linda: One top priority is integrated management of agriculture biomes and plant genetics, to increase productivity and resilience of agroecosystems. NIFA's done an outstanding job in developing some explicit lines of support for microbiome research; This is a huge space of investment, both in the Federal Government, but also in private industry; We think those substantial investments need to continue because the gaps in our foundational knowledge are significant.

Linda: Similarly, NIFA funding has helped advance novel approaches to advancing plant genetics including use of crisper technologies; We think these foundational investments need to continue but we don't wait until we know everything before we start putting these pieces together on the ground. So we are also integration of managing approaches of microbiomes and plant genetics across environments, to support agroecosystem productivity.

Linda: A second priority within our community is enhance spaces for predicting emergent and re-emergent plant pathogens. Global commodity movement, changes in the environment, and changes in management practices have lead to significant threats, from emergent or re-emergent pathogens. You can think of citrus screening, soybean rust, stem rust 99, [inaudible 01:24:55] in California, many of our highly valuable crops, but also natural habitats, are threatened by emergent and re-emergent pathogens. We believe that significant investments are needed in the basic science to understand the ecology and epidemiology of emergent pathogens, but also the development of rapid diagnostics to let us respond more quickly to emergent pathogens across the landscape, especially in crop and production systems are needed.

Linda: Another priority for our society is increased resources for forest health. Forests are being devastated by increasing temperatures and reduced rainfall in many areas. We see this in diseases and insect outbreaks and many of these then translate to devastating forest fires. At the same time that we see these major impacts on forest health, we've seen reductions in the number of forest pathology graduate programs nationally, and reduced national and state investments in forest health. We urge new investments in forest health and forest research across the country.

Linda: And finally our fourth priority, for research extension and education, is in making sure that we continue and increase investments in the national plant disease diagnostic network. It's the national network of diagnostic labs that's really the first line of defense when we think of emergent pathogens but also when we think about where are the major disease challenges in the growing season; The sooner we have good national information, the better we are at responding with management; Early management reduces impacts. So National

Plant Disease Diagnostic Network second priority in this space is workforce training. Academic training often doesn't give students the on-the-ground infield experiences that students and industry seeks. We urge USDA to invest in workforce training especially in the lines of offering internship programs for students from undergrad to graduate and post doctoral research opportunities.

Linda: And finally, what about the breakthroughs; Where are the breakthroughs that will really be game changers in our field? One thing that's critical for us, we believe, is infield, real time, on the ground diagnostics; What's wrong with this plant? What's wrong with this field? Again, rapid detection means we can make management decisions sooner. Early management decisions can reduce impacts on the environment. So we need advances in these technologies sooner rather than later. And finally databases; This has been mentioned by a few others; We need support for database generation, database accessibility; Databases are critical to integrating and synthesizing the large volumes of agricultural microbiome and crop productivity and soil health data on a national and international scale; We're lacking in databases that can drive us forward. We need support for analysis of this data; This includes advances in our analytic capacity but also training for students, faculty post-docs to become adept at analyzing these large-scale data sets, and finally in translating these data to solutions.

Linda: Collectively, we think these priorities and these technology breakthroughs will be critical to achieving the grand challenge that we pose. And finally I want to go off my slides briefly and echo Ken's comments; In our society there's enormous concern about the move of NIFA staff and headquarters out of the D.C. area. Our society is many societies regularly travel to Washington to meet with NIFA staff as well as NSF, EPA, congressional representatives; We're deeply concerned that the move of the NIFA headquarters away from will reduce access, opportunities for input, NIFA's impact on policy making and policy decisions in the D.C. area, and will also result in the loss of extraordinarily valuable staff which will compromise the agency.

Linda: At the end of the day, we really appreciate the opportunity to speak to you, and we hope that our comments are helpful. Thank you.

## Kent Olson from American Phytopathological Society

Megan: Alright, because this is being broadcast, we are gonna do one more speaker before the break. If Kent Olson is here? Thank you.

Kent: Got some slides there? Thank you. I'm Kent Olson, I'm an associate dean for the extension center for community vitality here at Minnesota. I grew up on a farm in Iowa; I went through the Iowa state system, worked in farm management for years, a professor both in California and here in Minnesota, but over that time growing up I started to realize how important the community is, the rural community is as part of that production system, so I'm pleased to be part of

that, and working on the community side, so I'm kinda speaking for the communities here at this session today.

Kent: We are very thankful for the funding that NIFA puts into communities that USDA puts in both in D.C. and out in the states, how it helps out [inaudible 01:30:43]. And what I want to talk about is some of the things we see, from our viewpoint.

Kent: The greatest challenge. A lot of change going on in these rural communities, so the greatest challenge is just kind of understanding what those trends are, where that might be pointing out and how to adapt. The demographics as you know and aging population probably, but we also have people not only just moving out to rural communities, we have people moving in. Who are they, what are they? One very beneficial grant we have from NIFA going on right now in our center is looking at newcomers. What's happening, who are they, why are moving? How are they integrating themselves into those communities, how can we work with them? How can they participate... But there are some cultural challenges, shall we say, so we're also looking at as part of this grant or coming out of that grant that's made possible by NIFA is how can they adjust, how can they incorporate, help out in the new agricultures.

Kent: The greatest part of this greatest challenge is also just the economics. What's going on, what's happening? How can they adjust to all the greater economy but yet still have a viable economy locally. As you know, probably, there's a lot of farmers, even large farms, where the main farmer or one of the farm family has off-farm job. This is very critical to the quality of life for that farm family. So how can we help with that community in order to keep that job or those jobs there locally, to do that? To keep that second job there and the diverse economy within those rural communities also helps sustain that community. So there's not just the boom and bust with agriculture, there are other industries there too.

Kent: This is some data from 2014, looking at the grid, the hashmarks, says in this region of Minnesota, the hashmarks indicate that that manufacturing industry is within the top three for employment. The colored, the gold, whatever we wanna call that color, that it's in the top three in output sales. Manufacturing, both in sales and employment important. Now what surprised us was the importance of services within each region; Health, government, any kind of service entity, the hotels, if you think of Minnesota's tourism you can understand why a part of that's there, both in output and input. But agriculture on the western side of Minnesota is important or in the top three; Still important in other areas, but not in the top three. And if we look at more recent data, yet unpublished, we're grinding through some of the data from 2017, the importance of manufacturing increase is the employment in the top three for agriculture is decreasing some, probably both due to manufacturing and recovering from the recession, more so than agriculture, and agriculture are having some tough times right now with low prices. So the Ying and the Yang of the economy and fluctuation. But still recognizing that there's more in those

communities than just agriculture. And it's important for the sustainability, the diversity of those local economies.

Kent: Most needed breakthroughs. Just trying to identify ways the community can adapt. How can we recognize these new residents? Not just immigrants from other countries, but immigrants from, in our case, Minneapolis, St. Paul; Refugees from Minneapolis, St. Paul, the urban life. Some of them come with their own job. We call them the 1099s, IRS form. They have retirement income, they have other jobs, consultants, telecommunications, how to get them integrated and become part of the community, and how to help the long-term residents adjust to these new residents and that they're not quite the same as they're used to.

Kent: Another part, transitioning to rural businesses, there's something like over 60% of mainstream businesses are owned and operated by people very close or past retirement age. How can that community, as a community, help them transition that business to a new generation? To keep that hardware store, to keep that restaurant, in that area versus the community just having their hands off, how can we help them along? And NIFA people are doing that, helping us out here as well as giving this grant to look at how to do that. And just that basic stable funding source that helps us keep people around.

Kent: Another breakthrough is just helping these communities know and grow their assets instead of just having the woe is me, life is going bad out here in rural area, well what do we have? The people are interested in, how can we use these parks? How can we use these rural areas to attract people to come and live and increase that.

Kent: And the top priority we would have is just looking at that improving quality of life, how can we help with the economy? And part of this is in the midst of all the needs for agriculture, don't forget communities as you go through your ration process as we talk to our Congress people. Looking at the economy, housing, broadband, health, how can we improve those to keep that local economy thriving, growing so that that community can be sustainable in the future, and remain part of that agricultural production system? So it's not just tractors and fertilizer and genetics, there's all kinds of other things going on that need to part of that system.

Kent: I had that last part down there, provide hope, decrease despair; The lack of jobs, the lack of view, the lack of hope, gets people into what they call diseases of despair, call it addiction, the opioids. If we can help understand, help these communities adjust, we can pull people out of that disease and give them some hope for the future. And NIFA is certainly a big part of that process.

Kent: In summary, what our mission is and what I think we can look at is, how can we help communities choose and create their desired futures? We do this both in community economics, community development, leadership training, civic

engagement training, tourism, dealing with all of that, how can we help them decide what they want to do and create for their own future?

Kent: So thank you.

Megan: Thank you. So next, we're gonna take a break, we're gonna break till 10:30, and I invite anyone who hasn't signed in to do so, especially if you would like to add your name to the agenda. We'll have plenty of time to hear from anyone that's in the room, so it'd be great to know a little bit ahead of time, but, you know, we can add speakers as we go. We'd also like to take a photo of the group that's here today, so please come on up to the front in a couple minutes and we will do a group photo, and enjoy some of the refreshments and we'll reconvene at 10:30. Mm-hmm (affirmative). Thank you.

## Ryan McEnaney from Bailey Nurseries

Megan: Alright, thanks everyone, we're gonna get started on the second half of the morning program for NIFA Listens: Investing in Science to Transform Lives. First up, we'll have Ryan McEnaney from Bailey Nurseries.

Megan: He has a presentation.

Ryan: Good morning. Thanks for having me, we really appreciate the opportunity to be here to speak. My name is Ryan McEnaney and I am here this morning on behalf of a couple of organizations, Bailey Nurseries, which is a company of which I am a fifth-generation owner, as well as the National Initiative for Consumer Horticulture.

Ryan: So just some very brief background, the National Initiative for Consumer Horticulture, as Mary alluded to earlier, is sort of a conglomeration of a bunch of different silos of the horticulture industry, from educators to researchers, public gardens, breeders and growers like we are at Bailey Nurseries, to master gardeners and sort of everyone in between. And the goal is to have a unified voice so that we can educate consumers and work on other different levels government and public policy; On the benefits of gardening, getting more people invested and excited about and participating in what is gardening, as well as increase the value and funding for what gardening is on a bunch of different spectrums.

Ryan: As of 2017, 70% of U.S. households participated in some sort of gardening, whether that's actually digging in the dirt outside or working with vegetables. And the goal of the National Initiative for Consumer Horticulture is to get back to 90% by 2025.

Ryan: Just some very brief background on Bailey and who we are, we are a wholesale grower of trees and shrubs, as I mentioned we are a fifth-generation of family owned business. That's me and my mom. She is the president of the company,

Terri McEnaney. Many of you may know us from the university. We have a long-standing partnership with the University of Minnesota from our last 113 years of business.

Ryan: For the general consumer, they probably know not us, but our brands. In addition to being a wholesale grower, we own three of the largest plant brands in the world, one of which is Endless Summer. So, if you see a blue pot in a garden center, that is from us. We introduced that plant in 2004 and it still remains the best-selling collection of hydrangeas in the world. We just surpassed 30,000,000 sold last year. I'm here representing the bottom part of the funnel and how we communicate with the end consumer and how all the research then affects what we do as we work with that consumer.

Ryan: Very briefly, just some data on what the benefits of consumer horticulture is. This is from the National Initiative for Consumer Horticulture. They've done research already through their multiple different venues. All this data is available on [consumerhort.org](http://consumerhort.org), but very briefly, consumer horticulture employees 2,000,000 people a year. It has almost \$200,000,000,000 of economic value. It's a really, really big and impactful organization.

Ryan: Another thing that's really important to realize with this is the opportunity for revenue impact for municipalities and nonprofits. One example of that NICH has put together is the revenue generation, for exactly, in Philadelphia. Their parks in one year generated \$23,000,000 in city revenue. One of the other things that this organization really works to do is educating the public on what the impact of plants and trees do for their communities, that those same Philadelphia parks reduced the heating and cooling by eight to 12% with just one 25 foot tree. These are just some small examples of all the work that this organization is doing to showcase the impact of what consumer horticulture is.

Ryan: There's two very brief things that I'm going to talk to you about today and how funding can help this organization and help our industry as a whole. One is through research partnerships, especially for a company like ours where we are, again, on that bottom part of that funnel. We don't do a lot of the research ourselves. We rely on partnerships.

Ryan: The America Public Gardens Association is one of the major parts of the National Initiative for Consumer Horticulture. Casey Sclar, who's the president is on the board of the organization and they are one of the premier research partners for us. They do everything from plant protection to sustainability and then, again, I'll talk about in a moment with education.

Ryan: Some of the other organizations that we work with. American Hort, which is our national horticultural association has a wing called the Horticulture Research Institute that, again, works across all disciplines. Organizations like the U.S. National Arboretum and the Minnesota Arboretum as well are great partners for those of us in the growing and breeding side of the business.

- Ryan: Then, one other different piece of research that I think is interesting. There's an organization called the Home Garden Panel and they're not doing the research like many of you are. They're working on consumer research and how a consumer engages with our product. They are really good at collecting data to help us communicate with the end consumer or with younger people growing up who are looking to potentially get into our industry and help us to communicate with them.
- Ryan: There's a list here of some specific things that our partnership organizations are working on, but there's one specific thing that I want to talk about that we have already done that's just a great example of what this funding can do and that is with Dutch Elm Disease. The University of Minnesota has been a leader in that. Mark Stennes was a great partner of Bailey nurseries as well and is working with what is now called the Saint Croix Elm.
- Ryan: Again, we have this long-standing history with the University of Minnesota and so when this plant was brought in, research was done because it was showing resistance to Dutch Elm. There was a lot of time spent at the university to determine that it was truly resistant and then that plant was then given to Bailey nurseries, which we then introduced for distribution all around the United States so that we can have a really strong American Elm back in our landscapes.
- Ryan: That, along with other breeding efforts, we have a breeding company. I don't know if you know Doctor Michael Dirr from the University of Georgia. We bought his breeding company three years ago so we do a lot of in-house breeding work. We rely on partners, especially with the USDA to make sure that we can introduce the best new plants that also have that pathogen resistance.
- Ryan: The final piece that I want to talk to you about today is the consumer education and consumer marketing and how important that is so that we can not only engage the homeowner with everything that we do but also educate and get people excited about coming into this industry. The American Public Gardens Association represents all the public gardens in the United States. One thing that's really interesting and exciting to me is that they work with over 2,000,000 people on really specific, targeted education programs per year. That's everyone from elementary-aged kids all the way through senior citizens.
- Ryan: It's a really important piece to have funding to help support those programs and, again, that's just through the American Public Gardens Association. There's other Master Gardener Extension programs and so many others that have a really dramatic effect. Along with that, there's other consumer direct to marketing, getting them just to get their hands dirty and dig in the dirt. It's so important that they do that in an informed manner.
- Ryan: That is where the National Initiative for Consumer Horticulture comes into play where they can pull all parts of our industry together so we can have that unified voice to get people excited because a more educated public leads to a

more engaged public, which leads to more sustainable practices, a stronger industry, more jobs, and getting more people excited. That's the last thing that I want to leave you with, with the importance of marketing what our industry does is being able to get people excited about working because we all talk about how labor is so tight.

Ryan: These STEM programs and finding other ways to show the diversity of what our industry offers from research all the way through something like my role, which we sort of created. I am the spokesperson for three consumer plant brands and I get to travel the country and talk about gardening with people. That's not something that people really know about. Being able to market this wide-diversity of what our industry does is incredibly important and we need support in being able to do that. Thank you so much.

## Neil Anderson from University of Minnesota

Megan: Thank you, Ryan. Next, we have Neil Anderson from the University of Minnesota.

Neil: Good morning. My name is Neil Anderson. I grew up on a dairy farm in the state of Vermont and became involved in horticulture and plant breeding when I was five years old. I'm here to talk today about the importance of plant breeding. I think this emphasized Ryan's testimony that he just gave about the importance of products in plant breeding.

Neil: Currently, I'm a professor in the Department of Horticultural Science at the University of Minnesota on the Saint Paul campus. I specialize in floriculture, specifically flowering breeding and genetics. Our department has eight plant breeders working on a diversity of horticultural crops from flowers, trees and shrubs, turf grass, ornamental grasses, tomatoes, potatoes, grapes, and wine to apples.

Neil: Likewise, our sister department of Agronomy and Plant Genetics at the university hosts 10 public sector breeding programs, which means that as many as 18 public-sector breeding programs are here at the University of Minnesota. This is an important contribution to the future of agriculture throughout the country.

Neil: According to a recent survey by the Minnesota Nursery and Landscape Association, horticulture is a significant contributor to the Minnesota economy with an estimated value of \$3.2 billion at the retail level. The Minnesota horticultural industry is supported by various organizations such as the Minnesota Nursery and Landscape Association, the Apple Growers of Minnesota, the Midwest Fruit and Vegetable Growers, the Minnesota Turf and Grounds Foundation, the Minnesota State Horticultural Society, and many, many others. These organizations partner with plant breeders and physiologists

to create, test, produce, and market products that are superior for Minnesota growers and growers and consumers countrywide and worldwide.

Neil: I am the PI of a current USDA NIFA ELI grant on innovative hands of undergraduate entrepreneurs in urban agriculture. NIFA is really a very important sponsor of increasing our engagement with minority students into modern-day agriculture, particularly in urban settings. The Twin Cities here of Minnesota have a very large urban population and urban farming is a new field that we are venturing into. We need to have this type of funding continued by NIFA. Several faculty in my department also have specialty research initiatives or SCRI grants. I applaud these NIFA granting efforts, but much more is needed.

Neil: Specializing in a field where the majority of crops are grown as ornamentals for their intrinsic beauty and horticultural therapeutic benefits, federal and other funding sources are more difficult to obtain since the majority of floricultural crops are non-edible crops. My program has integrated production education with ornamental, edible crops using hydroponic or aquaponic production methods suitable in urban agriculture production settings. Most of the plant breeding programs in my department, including my own, work with perennial crops, which provides numerous benefits to society. Several programs are also involved in the Forever Green Initiative as was testified about earlier.

Neil: NIFA grants provide valuable resources for my department and our programs to enhance the mission of educating students, particularly minorities, and conducting research in the promotion of urban agriculture and novel production methodologies. However, much more needs to be done. We look to NIFA to increase their support of those specialty crops of horticulture.

Neil: It is my opinion that the greatest challenge facing us in our century is long-term, sustainable, low-carbon input, urban-production of annual, biannual, and perennial herbaceous and woody crops in controlled environments and the field. Controlled environments include greenhouses, warehouses, high tunnels, and low tunnels. As a plant breeder, my program and crops are continuously faced with the annual climate changes that impact important factors such as winter survival here in Minnesota, cold-hardiness along with the corollary acclimation and deacclimation rates, as well as heat and drought stress tolerance both outside and in controlled environments.

Neil: We have found that plants that are reliably hardy in USDA zones 3, 4 are sometimes killed outright in warmer, open winters that lack snow. It's important to work with plant breeders and conduct research on creating crops that can be resilient to the changing climatic conditions. The question remains as to how we can achieve the changes needed for modern-day agriculture. The answer lies with continued funding of plant breeding and genetics in order to make genetic [inaudible 01:54:40].

Neil: In my discipline of horticultural science, specifically ornamental plant breeding, few if any funding opportunities are available to transform new or existing

crops. This is particularly problematic as new methods of producing plants particularly for urban farms such as rooftop gardens, hydroponics, and aquaponics do not have crops to use that are bred and selected and adapted to these production environments.

Neil: Already in our research with aquaponic production of fish and plants in greenhouses and warehouses in Minnesota and the Midwest, we have discovered that using crops adapted for field production into aquaponics is fraught with difficulties. We have found that day-neutral strawberry cultivars bred for field and high-tunnel production were susceptible to spider mites in both greenhouses and warehouses, which devastated the entire crop, breeding yields significantly lower than in the fields. Plant breeders can solve this and many other problems.

Neil: On a separate front, having plant breeders actively select against invasive potential in crops during the breeding and domestication process is another important need that can be realized to continue the continued evolution of important crops that are not invasive. I propose that NIFA devote future funding opportunities for plant breeding programs devoted to specialty crops within horticulture and this can be done in coordination with many of the national organizations that exist in the promotion of plant breeding such as the National Association of Plant Breeding and the multi-state research project SCC80: Sustaining the Future of Plant Breeding.

Neil: While I do not believe it is a wise idea for Congress to move NIFA out of the District of Columbia, were this proposal to be realized, I think the Twin Cities area of Saint Paul and Minneapolis would be a perfect place to be the new home for USDA NIFA given our large urban and suburban populations of diverse cultures and being the Midwestern hub for science, innovation, technology, and education. If this move occurs, I strongly support the potential relocation of NIFA offices to Minnesota in the Twin Cities, in particular, the Saint Paul campus of the University of Minnesota where our agriculture research is centered. It would be the perfect location for NIFA.

Neil: I applaud the efforts of NIFA in hosting these country-wide listening sessions and support enhanced NIFA funding to supply long-term production of ornamental and food crops. Thank you.

## Dale Gallenberg from University of Wisconsin

Megan: Thank you. Next, we have Dale Gallenberg from the University of Wisconsin River Falls.

Dale: Hi. Good morning everyone. My name Dale Gallenberg. I'm the dean in the College of Agriculture, Food, and Environmental Sciences at the University of Wisconsin River Falls. I'm here today representing UW River Falls but also speaking on behalf of other non-land-grant universities and campuses in the

University of Wisconsin system including UW Platteville, UW Stevens Point, and UW Stout.

Dale: We appreciate NIFA's efforts to obtain input from stakeholders so we can all advance our shared mission of teaching, research, and extension. Today, I'll try to address some of the challenges the agriculture industry is facing and what our top priorities are for addressing those challenges.

Dale: In Wisconsin, one out of every 12 jobs is related to agriculture and the industry annually contributes nearly \$90,000,000,000 to our economy. One of the keys to supporting through agriculture industry's workforce and in discovering new innovations to further grow this major industry is the university system. While Wisconsin is home to UW Madison, one of the nation's premier R1 research and land-grant universities, the non-land-grant universities are also necessary to fully realize NIFA's mission of supporting research, education, and extension in food and agriculture in not just Wisconsin, but across the U.S.

Dale: As an example, one sector of the agriculture industry that we specifically support at UW River Falls is the dairy industry. UW River Falls Dairy Science Program is one of the largest undergraduate dairy science programs in the country with approximately 140 students. Teaching is our principal mission and with two laboratory farms, one of which house our dairy learning center, we play a critical role in providing hands-on experiences to students to better prepare them for a variety of roles and careers in the dairy industry.

Dale: One of the greatest challenges currently facing the dairy industry in Wisconsin is oversupply for current available outlets and as a result, falling prices of milk. The new trade deal with Canada will help provide increased opportunities for Wisconsin dairy producers in the Canadian milk market, but there is still a long-term and complex problem that needs to be addressed and solved.

Dale: In June of 2017, the UW System, Wisconsin Department of Agriculture, Trade, and Consumer Protection, and the dairy industry stakeholders engaged with one another in a dairy summit to identify the challenges and opportunities facing the industry. Following this summit, the UW System, DATCP and the dairy industry formed a Wisconsin Dairy Taskforce 2.0 that is in the process of developing concrete recommendations in areas like workforce development, research and innovation, and pricing and market volatility. UW System has been and will continue to be a key player in these discussions moving forward.

Dale: As one of the non-land-grant universities in the UW System, we are part of that group being called upon to help the state's dairy industry and, indeed, the broad agriculture industry of Wisconsin as a whole maintain a skilled workforce as well as discover new innovations to advance the industry. The funding NIFA provides to non-land-grant universities to help serve the industries in Wisconsin and other states is critical. However, to date, no funding appropriation for NIFA's non-land-grant colleges of agriculture or NLGCAs capacity-building grant program has been proposed as a line item in the president's budget. Rather,

appropriations have come through annual spending bills enacted by the U.S. Congress.

Dale: The federal government has for many years funded capacity-building grants to the 1862, 1890, and 1994 land-grant institutions recognizing their important contributions to education, research, and extension in agriculture. However, non-land-grant institutions such as ours are enrolling an ever-increasing share of undergraduate students in agriculture, food systems, and renewable resources. In part, this helps fill the pipeline of students to graduate schools and industry that furthers the research mission addressed in many of the previous presentations today.

Dale: Additionally, though, the non-land-grants are making significant direct contributions to basic and applied research and to extension and outreach. It was only recently that the 2008 Farm Bill and subsequent farm bills authorized a capacity-building grant program for the non-land-grants. These capacity-building grants allow our universities to further provide necessary opportunities for our students to gain hands-on learning experiences and their ability to conduct research.

Dale: For example, a capacity-building grant awarded to UW Platteville gave students the ability to conduct applied research on grazing-based, dairy production systems. At UW River Falls a capacity-building grant focused in part on development of the simulation model for students to use in studying capital investment decisions on Wisconsin dairy farms. These grants and others at UW River Falls, UW Platteville, and other non-land-grant institutions around the U.S. represent targeted investments resulting in significant impact for NIFA in its mission of teaching, research, and extension. As capacity grants, they also allow the non-land-grant colleges of agriculture to be more competitive in other grant-funding programs sponsored by USDA NIFA and other federal agencies.

Dale: We respectfully ask NIFA to ensure that support of programs and opportunities in agriculture and renewable resources at non-land-grant universities is a national priority and receives a stable funding source through a line item appropriation. On behalf of the University of Wisconsin River Falls, UW System, and the non-land-grant, agriculture institutions and community nationwide, thank you for this opportunity to comment. We look forward to working with you to enhance NIFA's success. Thank you.

## Greg Cuomo from University of Minnesota

Megan: Okay. We have two more names on our confirmed list, but I know they may be arriving late. Is Erin Meyer here? Okay. How about Greg Cuomo? Wonderful. Thank you. From the University of Minnesota.

Greg: Sorry about that. I appreciate the opportunity to provide NIFA with input on research priorities in food, agricultural and natural resources. My name is Greg

Cuomo and I serve as the associate dean for research and graduate programs in the College of Food, Agricultural and Natural Resource Sciences at the University of Minnesota and as Deputy Director of the Minnesota Agricultural Experiment Station. Today, I'll be sharing perspectives on both the current efforts and future focus of the University of Minnesota and the nationwide network of state and agricultural experiment stations.

Greg: As you likely understand, the agricultural experiment stations are the research arm of the land-grant universities. As part of the land-grant system, the University of Minnesota contributes to the comprehensive network of institutions whose mission is to serve society, provide access to high-quality education, train tomorrow's leaders, and do research to address the grand challenges of providing safe and abundant food for all and enhancing our environment. The land-grant system is strongly linked in our commitment to these principles.

Greg: I share this background as context for my reflections and the request that I'll make. Today, many articulated key needs and the importance of their work to society and I want to thank them for their efforts. I'm going to step back and talk more generally about the work and the need for support for the larger mission. First, let me turn to my role at the University of Minnesota. The College of Food, Agricultural and Natural Resource Sciences or CFANS lives out the land-grant legacy through its mission: inspiring minds, nourishing people, and enhancing the natural environment. CFANS is driven by putting students first and educating the leaders of tomorrow by creating science-based solutions, by growing our economy, and by extending our impact and reach globally.

Greg: The importance of the land-grant mission is within the title of our college, the College of Food, Agriculture and Natural Resource Sciences. We often ask audiences, "What's the most important word in that title?" Then, "Food, agriculture, natural resources, sciences?" Depending on where we are, we get different answers. The most important word in our college's name is 'and'. We must produce food to feed a growing world population and enhance our environment. These are not choices. They are imperatives.

Greg: We are indeed tackling society's grand challenges. This is made possible through our important relationships with NIFA. As we continue to prioritize our research focus, we envision a world that includes lakes free of invasive species, disease resistant crops, products that protect and promote the health of our friends and family, and we do this by turning to science to find solutions that drive a sustainable future.

Greg: Our focus at the University of Minnesota is around a number of key research platforms including big data and insight, climate adaptation, microbiomes and their relationship ranging from soil health to human health, novel crop development, water resource issues, and the connections between animal health, human health, and nutrition. That said, let me briefly highlight a few efforts, big data and insight, novel crop development and the research

platforms that use emerging technologies to enable interdisciplinary approaches to addressing key issues.

Greg: We think it's critically important to further our research in the data and insight space. Our primary effort, the genetics by environment by management by socio-economic or G.E.M.S. platform turns big data across multiple information and input streams into actionable information. This approach to data enables a better decision-making tools, improving precision management systems to optimize productivity resulting in more food with less input.

Greg: Additionally, as you already heard today, we are focusing our work on novel crop development. We are researching new ways of developing crops for agricultural production that strengthen economies while protecting water and other natural resources. For example, kernza and field pennycress are true value-added crops that protect the soil and are now moving towards commercialization.

Greg: Lastly, at the University of Minnesota, we connect disciplines like plant breeding, big data and computational biology to address food production, human health and nutritional needs. This comprehensive and integrated approach highlights how the University of Minnesota and land-grant universities have adapted to addressing evolving research needs.

Greg: With that, let me turn to a more national focus. First, and I know you've already heard this, we firmly believe that relocating NIFA away from the capital region will have profoundly negative effects on NIFA and land-grant university partnerships. While it may be easy to schedule meetings over the web, relationships are not so simple, particularly as partnering with agencies like the National Science Foundation and the National Institute for Health drive the interdisciplinary approaches needed to address the challenges that face society today and into the future.

Greg: Now, I am going to return to the work of the land-grant universities. We plainly need to produce more with less. We need to reduce inputs. That's water, fertilizer, pesticides, fuels, and energy across all production sectors. This must be done in a sustainable way. In this room, we all understand that. To do more with less will require full participation in NIFA's land-grant partners, research, educators, and extension specialists. We support NIFA in providing innovation, innovative opportunities that seek an integrated approach to sustainable and resilient food systems.

Greg: What are our top priorities? Strong support of public agricultural research and development enterprise. The support that's needed breaks down into three priority areas: capacity funding, the Agricultural Food and Research initiatives or AFRI, and infrastructure. Of these three, infrastructure poses the largest challenge. It offers many opportunities for innovative state and federal partnerships.

Greg: Capacity funds are critical because of the flexibility they provide. They represent the partnership with the federal government that provides core equity investments, enabling land-grant institutions to be responsive to both short-term challenges when they arise and to take a long-term perspective to prepare for an unknowable future. It is a land-grant system that looks to the future, takes the risks, and does the research to prepare for threats to production, human nutritional needs, and the environment. The land-grant system uniquely fills that role.

Greg: ARRI, NIFA's competitive grant initiative, funded in FY18 at \$400,000,000 is authorized at \$700,000,000. We appreciate that NIFA does not have control over appropriations. Conversely, we are confident that NIFA is supportive of AFRI funded at its fully authorized level and we recommend that NIFA consistently strive to secure the authorized funding during internal budget negotiations while strategically maintaining capacity funds.

Greg: Let me close by saying we recognize that NIFA is a critical and key partner to realizing our land-grant mission. We value that partnership. Working together, the land-grant system and NIFA are well-positioned to meet food, nutritional, and environmental imperatives facing society today and into the future. We very much appreciate the time and opportunity today to outline our priorities to reach that full potential of the land-grant mission and thank you.

## Bev Durgan from University of Minnesota/Extension Committee on Policy

Megan: Thank you. Okay. Next up, we'll have Bev Durgan from the University of Minnesota.

Bev: Good morning. It's a pleasure for me to be here today. My name is Bev Durgan. I'm dean of University of Minnesota Extension and I'm here today representing University of Minnesota but also ECOP, which is the Extension Committee on Policy, which is the national organization that represents Extension on the Board of Agricultural Assembly within APLU. So, a lot of acronyms but, again, ECOP sets the priorities for Extension across the nation when we look at partnering with Extension with the rest of the land-grant mission.

Bev: I want to thank NIFA for being here today and for coming to University of Minnesota and Minnesota to talk about the priorities that NIFA will have going into the next year and really into the next Farm Bill session that all of us, I think, are very interested in and where that process is going.

Bev: Extension is a major and a significant partner with NIFA. NIFA provides funding for Extension programs throughout the U.S. and Extension is one of the ways that we connect research and NIFA's mission to the stakeholders throughout the nation. Extension brings science-based information to citizens across the state and throughout the Midwest and the nation.

Bev: One of the things I'd like to talk about today and several other people did is about capacity funds. Capacity funds are very important to Extension here in Minnesota, but also in the nation. In fact, capacity funds provide about 15% of our funding here at University of Minnesota and this funding is used to help support the salaries and the programs of our Extension faculty and our educators throughout the state. If it wasn't for capacity funds, we would not be able to have the faculty that we have to really apply for some of the NIFA competitive funds.

Bev: As Doctor Kent Olsen just mentioned earlier today, one of those large AFRI grants was to be working with communities for communities to make sure that they are a welcoming place for newcomers, whether they're newcomers from the urban area or are new immigrants. We also recently received a large AFRI grant to work with rural grocery stores.

Bev: As Kent mentioned, but many other mentioned is that communities are very important to agriculture and our farmers, and that when communities lose their rural grocery stores, not only do they lose a sense of community, but they also lose an important market for our local growers. We have a grant where we're looking with rural grocery stores, helping them connect with local farmers, and helping them then to open up new markets and new opportunities to local agriculture.

Bev: Some of the questions that were asked today about what are some of the needed breakthrough science and technologies that you would like to see NIFA invest in. One of those is multidisciplinary research and extension. As we heard throughout today is that some of the big issues facing agriculture in our communities cannot be solved just by one discipline. So working across those disciplines and making sure that we have these large multidisciplinary teams to tackle some of these big problems.

Bev: Also was mentioned today is that we really need to keep the funding we have and increase the funding at land grant universities to support the mission of extension, research, and education. This is especially true when we look at where our workforce is going to be in the future for agriculture, but also in rural communities. We are an extension not only in Minnesota but also throughout the US, have a substantial investment in 4-H, and for those of you that are not familiar with 4-H, you may not know that 4-H is the largest youth serving organization in the nation, and in Minnesota, we have over 65,000 youth involved in our 4-H programs, which is an important way that we look at our workforce, but also our workforce in agriculture in some of our STEM disciplines.

Bev: If I talk about some of the priorities of extension here in Minnesota, but also nationwide, I'd like to list a few of what our priorities are and what we'll be focusing on in the next year. They include nutrition, health and wellness, 4-H and our positive youth development, water quality, food production and food security, community and economic development. Again, I would like to stress

that agriculture, agriculture production, and natural resources are important part of what extension focuses on not only here in Minnesota, but throughout the nation. We also have to make sure that we are also looking at those communities where those farmers are living, the families that those farmers are part of, and that whole part of having good functioning communities, rural communities, so that we can continue to support our agricultural production and natural resources.

Bev: With that, I would like to again thank NIFA for being here today, and also on behalf of ECOP, I'd like to again, echo some of the other comments that we've heard today about NIFA moving out of the Washington, DC area. ECOP feels that this would be a mistake. It again, will prevent some of the good interactions that we have with other agencies and that we, again, strongly I ask NIFA to reconsider and USDA to reconsider moving NIFA from Washington, DC. With that, thank you very much.

## Greg Schweser from University of Minnesota Extension

Megan: Thank you. Next up, we have Greg Schweser. Thank you.

Greg S.: Hello. I'm Greg Schweser. I work with extension at the University of Minnesota in a unique program called the Regional Sustainable Development Partnerships. The Regional Sustainable Development Partnerships work within our five regions in Greater Minnesota and we are the ear to the ground of the people, of the farmers, and the community members out there. What our unique niche and our role is as we take those innovative ideas and concepts that people are working on in agriculture and we bring them to the university and help solve those problems with in-reach by connecting university expertise and resources to issues that were identified and brought to us from the community members.

Greg S.: I just want to speak very briefly today about some of the things that are coming up that I hear from having my thumb on the ground in the communities out there, and in particular in the area of local and regional food systems. So local and regional food systems have been growing steadily over the past 10, 15 years now. It's no longer a niche thing. It's something that happens everywhere all over the place. But that has presented itself some unique challenges as well. And some of the things that people are looking to, to address these challenges are, I've got about three of them here I want to talk about.

Greg S.: One of them is, it's time to start graduating above the level of CSA and farmer's markets in Minnesota and in many communities in the upper Midwest. We still are in this pattern where farmers are bringing their stuff to CSA and farmer's markets to make those direct market sales. Well, a lot of those have started to become saturated and farmers are now very skilled at growing a lot of things, and we need to start figuring out how to create new markets for these crops.

Greg S.: So one of the ways that we are addressing that and working on that in Minnesota is by trying to use the existing infrastructure that we have, rather than create a new infrastructure. We're trying to figure out how to use those grocery stores, those warehouses, those roads, those green elevators, all those things that we already have, how to incorporate those local food systems into those existing infrastructure to serve our rural communities, our farmers, and our urban dwellers too.

Greg S.: Another thing that we've been working on a lot is year-round production and year-round crop storage. So a lot of farmers are really struggling whether you're a local food farmer with a five, 10 acres or whether you're a large commodity crop farmer, everybody's sort of struggling right now. And one of the things that we can do to create a more viable farming system is by looking at ways that we can grow crops year-round with energy efficient infrastructure through greenhouses, high tunnels, hoophouses in high tunnels, passive solar greenhouses, any number of things, there's a lot of things out there, but a lot of these are in their infant stage, so there's nothing that's very large scale right now that's an energy efficient solution, but there are a lot of things out there that people are trying to figure out.

Greg S.: Another one is crop storage. So in Minnesota for example, we have a unique environment where with our cold winters and our ability to grow a lot of diverse crops like squash and carrots, we have the ability to be a unique center for carrot production for example. There are other things, but we don't have these large crop storage systems where we could have thousands and thousands of acres of carrots for example. There are people interested in those types of things and figuring out how we can create a more vibrant, diverse, agricultural economy, a horticultural agricultural economy beyond that small, small scale level. That takes a large understanding of the economics of the scale, both on the farm scale side. How do you scale up and what kinds of equipment, machinery do you need but not be too big? What's the right size equipment and a scale? And so on the scale side, on the economic side. So how do we make this work from a more macro level?

Greg S.: Another large issue that is facing almost all of our farmers is climate change and we need to look at climate resilience and climate adaptation. And so when I think of resiliency, I think both on the national scale and the local scale. In the southwest when we have year multi-year round droughts, that impacts our food access in the Midwest. Then a year later when you have one year of flood that dramatically impacts our food access in the Midwest with crop increases and price increases, so being able to offset some of that and create at the same time more vibrant, diverse farm economies is something that's important.

Greg S.: Adaptation in Minnesota, especially in the southeast region, we have instances where they're consistent hard storms, large storm events, and flooding events that are yearly and consistently starting to drown out our farmers. We also have bizarre instances where the snow melts in December and then freezes and then we have crop fields that are covered in ice and any cover crops that were put

into those fields no longer will grow. And so that's sort of changing weirdness that needs to be addressed if we're going to continue to have a viable, functional, diverse agricultural system.

Greg S.: Finally, one more thing I want to say, this isn't exactly about a production or food, but healthcare. Our farmers need access to affordable health care and they need it in order to continue to be able to farm. Without it, it leaves everybody viable to losing farm to debt into crisis. So with that, I'll step aside and you'll be the next. Thank you very much.

## David Marks from University of Minnesota

Megan: Thank you. Next up, we have David Marks from the University of Minnesota.

David: How does this ... Let me get back here. Wasting all my WiFi here.

Megan: So it's just the right and the left. Uh-oh, we're losing our battery. I think we might be losing our battery on this one.

David: I'm a magnet for this kind of thing. Happens all the time.

Megan: It should be right arrow, forward, left arrow.

David: So take me back.

Megan: If nothing else, aim towards the back of the room and then it'll work better.

David: One more.

Megan: Here's a battery.

David: Can I just say next slide too if I need to?

Megan: Yeah. Yeah. I can advance it for you.

David: Okay. Thank you. Sorry for the delay there.

David: I'm going to do something on a little bit different and one of the thing I want to do is give you a story that I think will be considered a success story for NIFA. I'm David Marks, a professor in plant biology and I'm a basic research scientist, spent most of my career working on the model plant Arabidopsis all by myself in the lab with a few post docs and students and such. My research of the last few years has taken different course and I want to tell you about that. As I said, I'm hoping it will be considered a success story as the research I'm going to talk about has been funded by NIFA largely through that joint USDA-DOE program.

David: Okay. And so we've already seen this other story here from Mitch Hunter a little bit ago, and this the business of sustainability of our current farming systems is threatened by the fact that during much of the year, this soil is left barren, richer vaults, nutrient leaching and hustle, soil erosion. I would also just venture to say that this also represents an opportunity in that this land that is not currently in production. If it was in production, could help feed that growing population.

David: Okay. And we've seen this light here too, just the emphasizing that this nutrient runoff has severe ecological problems causing dead zones in the Gulf of Mexico, more close to home, algal blooms that our lakes and streams. And also a very important right here in Minnesota, it's also a big problem that the well water in many of the rural communities is being contaminated with nitrates and that each of those red dots represents a well that's over the acceptable limit.

David: So what can we do about this? This is something that has concerned Don Weiss who put together the Forever Green Initiative that we have already heard about, to try to address this problem. And one of the things that Don has done is he's identified a potential cover crop that will help the situation and that is pennycress. What pennycress can do, it can grow as a cover during the barren period and take up the excess nitrogen as shown here, just as well as a crop such as though winter rye, which is a traditional cover crop. The advantage of pennycress is that it's going to give us an economic return on a harvestable oilseed.

David: So where does pennycress come from? Well, Don drove up and down around the country looking for pennycress in ditches here and there. And this is just a sample location. But the cool thing about pennycress is that right out of the ditch, it can produce a couple of thousand pounds per acre of an oilseed that as it is a wild, can't be used as an edible food. But it can be used for biofuels. And so pennycress has some really nice attributes already, just as a wild weed. It can be harvested with conventional equipment.

David: So how do we envision pennycress to be put into the field, something like this where it's going to be growing and planted in standing corn or shortly thereafter harvest, allowed over winter to provide the ecological benefits, ecosystem services to take up that nitrogen, get it off the field with harvest for oilseed in time to put out beans. So the idea is to make this whole new cropping system without disrupting the current farming system.

David: So pennycress right out of the ditches, though a weed, has a lot of weedy characters. The plant should mature a little bit early, so we can get it into that interval. The seed pods shatter like a weed. The seeds are not edible and so on. And what my research has been is to address those problems. And very quickly, we've been able to, in just a few years find the crucial domestication traits that will allow pennycress to take its place as a potential major crop species. One to fit into the interval, we have identified lines that flower early and mature early that will allow that farmer to get the beans on the field timely.

David: Okay. We also have shatter. That's an issue. We've been able to identify lines that show reduced shatter. Just show it here. We've been able to find a plant that no longer have that look assimilate. Pennycress is known as stinkweed, and here we have a variety that no longer has that. We've also been able to create a variety that no longer has the toxic oil. We've been able to create a variety that has a canola like oil. And all this has been done largely because we've been able to quickly do this because of research that we've done on the model plant, Arabidopsis. What I would maintain, and that is that Arabidopsis has provided a road map for how to proceed with pennycress. Because all those traits I just talked about, we already know everything about those from research on Arabidopsis.

David: And so for just for instance, here, just a comparison of Arabidopsis and pennycress are very closely related. With the all the years and years of work on Arabidopsis to describe flowering in Arabidopsis. Knowing the genes based on pennycress, we now know everything about flowering pennycress. And so my feeling is simply that more basic research would greatly benefit all plant biology, especially breeding.

David: This is a bigger team put together by Don Weiss, that's not just me. [inaudible 02:33:59] industrial partners all working together to do this. And I will again argue that basics clients is the key to what has drove this research in that we know that the causative mutations that are for all those different traits. I would argue that basic research should be a required part of many aspects of NIFA funded research including the flagship cap program. With that, I'm done.

## Julie Weisenhorn from University of Minnesota

Megan: Great. Thank you. Next up we have Julie Weisenhorn.

Julie: Thank you NIFA for being here, for the listening sessions. This is my first listening sessions, so I'm pretty excited to be here and I am an extension educator in horticulture with the University of Minnesota. I'm also past chair of the Environmental Committee for the National Institute of Consumer Horticulture, which my colleague Ryan spoke so eloquently about.

Julie: I wanted to give a little bit of information about niche and that its main goal is to increase gardening in the United States so that 95% of citizens are gardening by the year 2025. Ryan mentioned that 70% of people have been listed as doing some kind of gardening and that's a great number, but we want to get it up to another 25%, to 95%. That's a big goal and not very far off. We are eager to partner and continue to partner with NIFA, as well as our partners in nonprofits and academics, universities extension, et cetera.

Julie: So I didn't come into horticulture as a kid. I didn't care for gardening when I was a child. My first crop that I harvested was a rotten potato, which really put an indelible memory in my head. I got into it because I became a first time home

owner and bought a house in south Minneapolis with my husband back in 1989. I knew nothing about yard work. My dad and mom had often done the yard work at our house. My brother mowed the lawn. I really didn't have to do anything.

Julie: But one of the things that I did do as a child and growing up was I enjoyed the landscape we had in her house in Rochester. Rochester, Minnesota is located south of the Twin Cities, and the house that we lived in was built by my grandfather and had a fantastic landscape, which I now appreciate much more than I did back then.

Julie: One of the things that I was allowed to do in that landscape is pick whatever I wanted, play whatever. I climbed trees, dig in the dirt, do whatever I wanted to do. I didn't really see it as gardening or landscaping or horticulture or anything, but it instilled in me a memory growing up and I think that that openness that my parents gave us was really important in setting the stage for future science and inquisitive minds and curiosity.

Julie: When we bought our first house, I'd had some small successes with house plants. I was pretty good at it. I could grow ficus tree and I could grow hoyo plant. It was that little tiny bit of success that made me pretty confident that I would be able to grow something in my backyard. And we had a small urban backyard, it was right on a very busy street, had an alley in the back, and so not prime real estate or horticulture location. But I had some success and I think that's part of our role at NIFA as well as extension and in horticulture and niche and all of these different groups in our consortium, is to help people have success.

Julie: The problem is there's a population out there that we don't reach in extension, and I'll speak personally about that. There's a group of people, there's a population, some audiences that know nothing about extension. I am an example. I didn't know anything about extension growing up. I think that, that's the biggest challenge for NIFA and for those of us involved is to reach those populations and audiences.

Julie: There are people like I was, a first time homeowner. I bought a house, I've got a mortgage, I've got a yard and a landscape, and I don't know anything about caring for it. How can we reach those people? How can we reach the people who have now immigrated into Minnesota, but are not familiar with our growing capabilities and our culture, and the fact that you can't grow things year round here? How do we reach these people?

Julie: So I think that's the biggest challenge. What I'd like to see is that we have a priority within NIFA to generate and create technology that's innovative, that helps all of us that anybody can use to reach those audiences. So the nonprofits, public gardens, consortium's like niche, extension, universities, industry, our partners, that we would have that technology at our fingertips so that we could reach those people. I don't know what it is, I'm not here to give an answer to

that, but I'd like to see dedication from NIFA in the form of funding and support of entities like niche and extension and the nonprofits and the industry to support some kind of technology that helps us to reach those audiences about horticulture.

Julie: With that thank you again for being here. Glad you came on a nice day and it wasn't snowing, and I look forward to working more with you in the future. Thank you.

## Closing Remarks

Megan: All right. Is Nancy Ellis here? I might have the last name right. Anyone else in the room like to provide comment before we wrap up today? All right then. I'd like to introduce Dr. Randi Johnson. She is going to provide a wrap up, a synthesis of what we heard and in addition we will be posting the video, the transcripts, and eventually a report of what we heard in 2018 on the NIFA Listens website. So you should be able to find that pretty easily with a quick Google search or going to [www.nifa.usda.gov/nifalistsens](http://www.nifa.usda.gov/nifalistsens).

Randi: Well first off, I want to thank you all for being here. We took time out of your day, sometimes more than one day for coming here. I know it was a stretch for some of you. It's important we hear what you have to say. We're in Washington, DC for awhile, and I know you want us here if we're not there from what I heard. Okay. See I did summarize some things.

Randi: But you all are important for getting us information that comes from the ground up. I mean, we're out there, but you are all out there much more. We appreciate what you've said to us and I'm going to summarize my nine pages of notes, which I've had no time to go over and summarize other than going oops. And just for the record, volunteering to summarize the end of the day or morning is not the wisest thing to do. But once again, thanks for being here.

Randi: My notes. I heard a lot about a systems approach. To me, as I've listened to today's stuff, the definition of sustainable agriculture just came through to me. I mean, it's about production and profitability, it's about maintaining a healthy environment, and it's about people. What I heard all day long or all morning long, we're not past lunch yet, is the importance of all three of those aspects. And so we have to take a systems approach and look at the big picture as well as looking at other things.

Randi: Communities came up over and over again. I heard one, health. I heard the need to develop markets because we have things that we don't have the markets for and we're developing new things so that we can keep a healthy pasture or field or forest where we're going to have to have markets for these new crops we're developing. And the need for extension and nonprofits as we deal with these communities as well. That's something we're gonna have to take back and better incorporate into our RFAs.

Randi: Breeding came up quite often. Being a quantitative geneticist, something I could get into. The need for new crops, be them to keep those cover crops out there, your land covered for a new situation. For example, if you are breeding indoors, you're doing high houses, we need something different. If we're doing organic agriculture, we need things designed for that. And in order to get there, I heard multiple things we need to do. We have the high tech techniques, which we need to further develop so we can make progress there. But at the same time, we need the techniques that are appropriate for organic agriculture. So when it comes to breeding, there's plenty to do.

Randi: Big Data came up time and time again. It's out there. How do we assemble it? How do we use it? How do we answer the questions? Being the Director of the Climate Change Division, it was good to hear climate change come up over and over again. How do we adapt? How do we put farming systems out there which can actually improve the environmental footprint of what we do, capture the carbon? These sorts of things. And along those lines, sustainable crops and the new crops that are going to enable us to increase the production we need for the growing population. Not only do we have to have a better environmental footprint, we've got to go from being negative to positive. The challenge is just getting neutral so we have a long way to go there.

Randi: Like I said, I've just scribbled all this stuff down, and I'm sure I'm going to miss some of what you all said, but I do have nine pages of notes. We've recorded you and somebody's going to transcribe this. So trust me, I'm sure I forgot plenty. Healthy communities, healthy environment, diversity.

Randi: Diversity from the point of understanding our communities, they're becoming more diverse. How can we support that community so that those communities thrive, especially the rural communities, and at the same time, the diversity in our workforce? I mean, that's a challenge we've all had over the years. How do we increase that diversity.

Randi: A number people mentioned under funding. I'm not surprised. I've done it more than once in my career. We heard about horticulture, we heard about animals, we heard about organic agriculture. So that came through and then I've heard a lot about partnerships.

Randi: In my five minutes of looking at 10 pages of notes, this is what I've heard. Be assured we're listening even closer. I know there's a transcript of this, you all be able to see it. Like I said, I appreciate you being here, and we will take your comments. We actually listened to them last year. Be aware that if we use them in an RFA, we can't tell you what we did with it. Okay? That would be illegal, but we heard you last year, we're hearing you this year.

Randi: So any other questions or comments before we close up here? Not that I can see anybody with a light in my eyes. Okay. On that note, thanks for coming. Stay in touch with us. You can find us online. You can contact me, Louie, Megan, or any of the other people we have there. You know most of our NPLs, they're on

the webpage as well. Thanks so much and we'll see you when you come visit us wherever we're going to be.