HEARING TO HIGHLIGHT RESEARCH INNOVATIONS ACHIEVED BY OUR NATION'S AGRICULTURAL COLLEGES AND UNIVERSITIES

HEARING

BEFORE THE

SUBCOMMITTEE ON
BIOTECHNOLOGY, HORTICULTURE, AND RESEARCH

OF THE

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HEARING TO HIGHLIGHT RESEARCH INNOVATIONS ACHIEVED BY OUR NATION'S AGRICULTURAL COLLEGES AND UNIVERSITIES

TUESDAY, SEPTEMBER 29, 2015

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON BIOTECHNOLOGY, HORTICULTURE, AND RESEARCH,
COMMITTEE ON AGRICULTURE,
Washington, D.C.

The Subcommittee met, pursuant to call, at 10:06 a.m., in Room 1300 of the Longworth House Office Building, Hon. Rodney Davis [Chairman of the Subcommittee] presiding.

Members present: Representatives Davis, Thompson, Scott, Gibson, Denham, Yoho, Moolenaar, Newhouse, Conaway (*ex officio*), DelBene, McGovern, Kuster, Graham, and Peterson (*ex officio*).

Staff present: Haley Graves, Jessica Carter, John Goldberg, Mary Nowak, Mollie Wilken, Stephanie Addison, Faisal Siddiqui, John Konya, Anne Simmons, Keith Jones, Liz Friedlander, Nicole Scott, and Carly Reedholm.

OPENING STATEMENT OF HON. RODNEY DAVIS, A REPRESENTATIVE IN CONGRESS FROM ILLINOIS

The CHAIRMAN. This hearing of the Subcommittee on Biotechnology, Horticulture, and Research to highlight research innovations achieved by our nation's agricultural colleges and universities, will come to order.

I would like to first welcome everybody. I will offer my opening statement here momentarily too. I apologize for being somewhat late. One of those few occasions here where the elevators weren't working too well in the Longworth Building, and in order to try and save one of my—well, some of us. Actually, I was trying to save, Mr. Chairman, one of your fellow Texas colleagues who was stuck with a little bit of the elevator door open. Note to self, don't stick your finger in there. I almost lost it. But Kevin Brady is doing fine, so he is okay. So my apologies and my excuse because the Chairman, Mr. Conaway, always like to start hearings on time and I don't want him to take away my gavel. So thank you again for coming, and I would like to begin with my opening statement.

Good morning. Again, I would like to welcome everybody here. This is the third in a series of hearings highlighting ag research, extension, and education programs for this Subcommittee. On April 14, we had the honor of hosting Deputy Secretary of Agriculture

Harden, along with 17 bright and gifted young people involved in the 4–H Program. These young men and women spoke to us about the need and opportunity to build a coalition of urban and rural youth to enhance agricultural knowledge across our nation. Then on July 15, the full Agriculture Committee held a historic hearing involving the presidents of all 19 1890 land-grant universities in order to commemorate the 125th anniversary of the enactment of the Second Morrill Act. This Act, like its predecessor in 1862, contributed to our nation's capacity to conduct research in support of agricultural production through the creation of land-grant universities.

Since that time, we have added to our capacity by providing land-grant status to designated tribal colleges in 1994, and quasi-land-grant status to cooperative forestry colleges under the McIntire-Stennis Act, our nation's veterinary colleges under the Animal Health and Disease Capacity and Infrastructure Program, and most recently Hispanic-serving agricultural colleges and universities in 2008.

We have likewise recognized the investment in agricultural research capacity in numerous unaffiliated colleges and universities, and have authorized funding to further augment capacity and infrastructure at these designated non-land-grant colleges of ag. Together, this system of agricultural colleges and universities provides our nation's farmers and ranchers with tremendous advances in technology, as well as helping to solve problems ranging from food safety to resource conservation, from nutrition to water quality, and from diseases of livestock and crops to renewable energy production.

Two weeks ago, the Agriculture Committee heard from the various mission areas and agencies of the USDA. Among the testimony we heard was commentary from the Research, Education, and Economics mission area, highlighting the return on investment from ag research. For example, the Agricultural Research Service introduced 348 new plant varieties last year, and filed 110 patent applications. Some of the work done by ARS has resulted in the insecticide DEET, the most common active ingredient in insect repellents, flaked mashed potatoes, sliced apples that stay fresh longer, and frozen foods. Now, the flaked mashed potatoes don't come close to the real thing, but they are good in a hurry. A conclusion drawn by many stakeholders is that we must prioritize food and agricultural research within our national policy discussions. I am convinced by what I have seen, that the public support for ag research does, in fact, have a very high rate of return. In fact, the International Food Policy Research Institute, having studied the impact of ag research and extension published since 1953, has concluded that this investment has provided an annual rate of return of 48 percent. I would like my 401(k) to do that. How about each of you? And to echo comments made by Pope Francis during his address to Congress just last week, "I am confident that America's outstanding academic and research institutions can make a vital contribution in the years ahead."

We recognize that as we approach our discussions in developing the next farm bill, there are numerous policy changes confronting our nation's research sector. Today, we will begin those discussions.

In doing so, we have assembled a great panel of preeminent researchers representing some of our most illustrious agricultural colleges and universities, and have asked that they focus on the successes that have resulted from this Federal investment.

I am particularly honored that the Dean of the University of Illinois College of Agriculture, and my friend, Dr. Bob Hauser, has joined us today and is participating in the hearing. Dr. Hauser has served on the faculty in the College of Agriculture at the U of I for more than 3 decades, and understands the importance of the agricultural research conducted at America's land-grant universities. I look forward to hearing from him and the other distinguished members of our panel about some of the great success stories from our agricultural institutions across the country. And, Dr. Hauser, I have to give you credit, you came just at the right time to the event I was at Saturday at the U of I, just in time to not have to hear me speak. That was very good. Yes, exactly.

[The prepared statement of Mr. Davis follows:]

PREPARED STATEMENT OF HON. RODNEY DAVIS, A REPRESENTATIVE IN CONGRESS FROM ILLINOIS

Good morning. I would like to welcome everyone here today to the third in a series of hearings highlighting agricultural research, extension, and education programs.

On April 14th, this Subcommittee had the honor of hosting Deputy Secretary of Agriculture Hardin along with 17 bright and gifted young people involved in the 4–H program. These young men and woman spoke to us about the need and opportunity to build a coalition of urban and rural youth to enhance agricultural knowledge across our nation.

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cluded that this investment has provided an average annual rate of return of 48%. And to echo comments made by Pope Francis during his address to Congress just last week, I am "confident that America's outstanding academic and research institutions can made a vital contribution in the years ahead."

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Before I introduce the rest of the panel, I would first like to recognize the distinguished Ranking Member of the Subcommittee, Ms. DelBene for her opening statement as well as to introduce her honored guest.

The CHAIRMAN. And before I introduce the rest of the panel, I would first like to recognize the distinguished Ranking Member of the Subcommittee, Ms. DelBene, for her opening statement, as well as to introduce her honored guest.

OPENING STATEMENT OF HON. SUZAN K. DELBENE, A REPRESENTATIVE IN CONGRESS FROM WASHINGTON

Ms. DELBENE. Thank you, Mr. Chairman, and thank you for calling today's hearing on a topic that we are both passionate about. And thanks to all of our witnesses for being here today. I am especially excited to have Dr. Jim Moyer from Washington State University here to share his perspective on this issue, and explain some of the great research being done at Washington State University. Dr. Moyer is the Associate Dean of Research for the College of Agricultural, Human, and Natural Research Sciences at Washington State University, and while the main campus is located Pullman on the eastern side of Washington State, and closer to Congressman Newhouse's region, they also have an extension in Mt. Vernon in my district, and an extension where they are doing fantastic work, particularly in agriculture. So Dr. Moyer has been doing research in the field for over 30 years. Sorry to date you there. I am very proud to have him here. And we look forward to your testimony.

Research provides the foundation for innovation, particularly in agriculture. Not only that, but it is important that researchers have the certainty to see a project through to the end. Starting and stopping research because funding runs out is highly detrimental. As a former businesswoman, I understand that when the Federal Government invests in research, it saves us money in the long run. And it might not always be clear to everyone why basic research is important or what it will teach us, but that work has been very critical. There is even an award called the Golden Goose Award which celebrates obscure science to show how basic research, even research that may sound odd, can lead to major breakthroughs and significant impacts on society.

Last year, as hopefully everyone in this room knows, we passed a 5 year farm bill. A very important part of that 2014 Farm Bill, for my district and for many others, was that it included unprece-

dented funding levels for research on specialty crops, some of which is being done at Washington State University's Mt. Vernon campus. Programs like the Specialty Crop Research Initiative, SCRI, gives us a great return on our investment. And we are fortunate to have fantastic universities across the country doing all kinds of valuable research. The Agriculture Committee recently held a hearing to mark the 125th anniversary of the enactment of the Second Morrill Act of 1890, which authorized additional direct appropriations for the land-grant colleges of agriculture that had been established under the First Morrill Act of 1862. Not investing in research harms our economic competitiveness, and hinders the important work that has been started in many areas.

I am pleased we are holding this hearing to learn about the innovative work being done throughout the research, extension, and education communities, and to learn about the challenges that you are facing.

So thank you again, Mr. Chairman, for holding this hearing. And I yield back.

The CHAIRMAN. Thank you, Ranking Member DelBene.

The chair would request that other Members submit their opening statements for the record so the witnesses may begin their testimony, and to ensure there is ample time for questions. The chair would like to remind Members that they will be recognized for questioning in order of seniority for Members who were present at the start of the hearing. After that, Members will be recognized in the order of their arrival. I do appreciate the Members' understanding.

Witnesses are reminded to limit their oral presentations to 5 minutes. All written statements will be submitted for the record.

Again, I would like to welcome all of our witnesses to the table. Dr. Hauser, Dr. Moyer, and now I would like to also welcome Dr. Mindy Brashears, the Director of the International Center for Food Industry Excellence, at Texas Tech University in Lubbock, Texas. It is okay, it is not the University of Illinois, and Mike is not here to hear that. Dr. Michael Heithaus, the Associate Dean of the College of Arts and Sciences at Florida International University in North Miami, Florida. And thank you for spending a few minutes with your Congressman, Carlos Curbelo, as he came by earlier today too. Dr. Michael P. Lacy, Professor and Department Head, the Department of Poultry Science at the University of Georgia in Athens, Georgia. And Dr. Douglas D. Buhler, Senior Associate Dean for Research in the College of Agriculture and Natural Resources at Michigan State University in East Lansing, Michigan. And I ask that you and my colleague, Mr. Moolenaar, take it easy on the University of Illinois this year in football.

Dr. Hauser, speaking of the University of Illinois, please begin when you are ready.

STATEMENT OF ROBERT J. HAUSER, PH.D., DEAN, COLLEGE OF AGRICULTURAL, CONSUMER AND ENVIRONMENTAL SCIENCE, UNIVERSITY OF ILLINOIS, URBANA, IL

Dr. HAUSER. Mr. Chairman, and distinguished Members of the Subcommittee on Biotechnology, Horticulture, and Research, as mentioned, I am Bob Hauser, Dean of the College of Agricultural,

Consumer and Environmental Sciences. At Illinois, the Experiment Station and the Illinois Extension is also under the Dean's supervision.

Thank you for the opportunity to testify on the subject of agricultural research and innovation. I will focus my remarks on agricultural research issues related to major crops and renewable energy crops, and the role of USDA–NIFA funding.

While my written testimony expands on points made during the next 4 or 5 minutes, I would like to emphasize three take-home messages. First, Federal-state partnership for agricultural research between USDA and state agricultural experiment stations has been a huge success, and we need to ensure that same success, going forward, by ensuring appropriate capacity. Second, agricultural research and development benefits greatly from partnership between public and private institutions. And finally, the need for agricultural research, especially among major crops, is absolutely critical for consumers at home and worldwide.

For context, our college research derives support from many sources, with annual research expenditures at about $45 million. Our competitive research support from USDA is roughly equal to our USDA formula funds, and we are funded at higher levels from other Federal agencies and from private companies. We have also been awarded significant grants from the USAID.

Now, I cited several, several, examples in my written testimony of successful crop research assisted by USDA–NIFA involving nitrogen uptake, flowering response, photosynthesis, planting density, and on and on, and these successes often involve other efforts and partnerships at the University of Illinois involving, for example, our Plant Breeding Center and the Energy Biosciences Institutes, and others, but an important point is that USDA projects are instrumental in a positive proof of concept, and then leveraged into much, much more. Another thing to keep in mind is that we translate science for use in practice, whether it is technology or whether it is information. I just mentioned some technology examples, but a couple of other information examples include USDA assistance in helping us develop FarmDoc, a leading platform for farm and risk management research and decision tools, and USDA has also helped us put the timely information in the hands of producers during the implementation of the most recent farm bill. Again, as illustrated by most of these examples, we like to leverage resources through these partnerships. Just yesterday, for example, a major chemical and agricultural technology company launched an innovation center on our campus that looks to partner with us in many ways, including improved cropping systems. But we do have some challenges. Those challenges are often related to declining state support for agricultural research and extension. As higher education relies more on tuition, we cannot justify subsidizing agricultural research activity with student dollars. With respect to crop science, attracting a sufficient, number of top students is an issue, even though the jobs are plentiful for those students. A research productivity in this area measured in a competitive grant funding has been excellent, but crop research, like all research in academia, is driven by grant opportunities. But funding for the locally applied research, that locally applied research in this area, has diminished.

Illinois has lost substantial capacity for crops research, and one example is the recent budget cut devoted to crops in four field research centers. But despite these challenges, were all exceptional opportunities for Illinois and our sister institutions.

Secretary Vilsack addressed us on campus about international food security a couple of weeks ago, and he emphasized the need to invest more in agricultural research and education because all are beneficiaries of agriculture, he argued, and consequently, land-grant universities must have capacity to conduct agricultural research and education in the next levels of competency.

I want to wrap things up here with four policy implications. First, agriculture, especially major crop agriculture, has global implications. Invest to meet those global challenges, but understand the importance of science applied locally. Two, emphasize partnerships appropriately. Be willing to apply Federal resources as a public good where the gaps exist. Three, emphasize competitiveness, but be smart about capacity, and work with the states to ensure the health of land-grant institutions. And finally, and this is very important, universities invest in scientific research in response to grantors. If resources are not apparent in agriculture, universities will invest in other areas.

So with that, I wish to thank the Committee again for the opportunity to share our perspective, and we very much appreciate your support of agricultural research, education, and outreach.

[The prepared statement of Dr. Hauser follows:]

PREPARED STATEMENT OF ROBERT J. HAUSER, PH.D., DEAN, COLLEGE OF AGRICULTURAL, CONSUMER AND ENVIRONMENTAL SCIENCE, UNIVERSITY OF ILLINOIS, URBANA, IL

Mr. Chairman and Distinguished Members of the Subcommittee on Biotechnology, Horticulture, and Research: My name is Robert J. Hauser, and my testimony is on behalf of the University of Illinois. I currently serve as Dean of the College of Agricultural, Consumer and Environmental Sciences, or ACES, and both the Illinois Agricultural Experiment Station and University of Illinois Extension are under the supervision of my college at Illinois.

I would like to thank Congressman Davis, Chairman, Congresswoman DelBene, Ranking Member, and the other Members of the Agriculture Subcommittee on Biotechnology, Horticulture, and Research, for the opportunity to testify on the important subject of agricultural research and innovation, and to discuss associated policy challenges, such as ways to leverage Federal resources, cooperation between various institutions, means of extension and outreach, and other issues of importance to the agricultural research community.

I have been asked to focus my comments primarily on agricultural research issues related to major field crops and renewable energy crops, and the associated role of USDA–NIFA funding. This is appropriate, because Illinois is in the heart of the Midwest and is typically the leading soybean producing state and the second leading corn producing state, the two most valuable crops in America.

And the University of Illinois is among the leading institutions in the nation for research and development of biomass feedstocks for renewable energy.

Following are some key messages that I hope you will take away from my comments.

1. The Federal-state partnership for agricultural research, between USDA and state agricultural experiment stations, has been a huge success story—and it must also be a success story, going forward.
2. The continuum of agricultural research and development has critical opportunities for partnership between public and private institutions, but there are important roles for each to play in their own domains—and there is still a particularly important role for research as a public good.

3. The need for agricultural research, especially among the major crops, is absolutely critical for the consumers of food, globally—that means everyone—regardless of the relatively small population of significant producers in America today.

Our portfolio of research derives its support from many sources. For context, annual research expenditures within the college approximate $45 million, excluding our permanent state-funded personnel cost. Of that, the Illinois Agricultural Experiment Station receives about $7.2 million in Federal capacity funds allocated by formula from USDA–NIFA, mainly from Hatch and Hatch Multi-State allocations, and matched with our state resources. Similarly, University of Illinois Extension receives roughly $12 million of Federal funding, primarily from Smith-Lever and the Expanded Food and Nutrition Education Program, EFNEP, to support our outreach mission.

Our competitive research grants from USDA roughly equal the formula research funds, and we have been even more successful in competition for funding from other Federal agencies, and from private companies. We also benefit from a very robust cooperative relationship with USDA's Agricultural Research Service. Several of their preeminent scientists have long-term assignments on our campus, particularly in the disciplines related to crop sciences. In recent years, we have also successfully competed for significant grants as part of the USAID Feed the Future initiative. Further, our scientists have engaged in major interdisciplinary programs that are situated outside of the typical wheelhouse of a land-grant agricultural college. It is here at these nodes of science that future breakthrough innovation is likely to happen. So the point is that we look for programs that will move our ideas forward into action and results, and USDA–NIFA programs are a necessary component of that mix.

Our goals related to our work in crops could be summarized in several ways, but perhaps to put it simply, we work to help insure food and energy security, profitable agriculture and food systems, rural and family prosperity, and resource stewardship.

Successes

We utilize support from our Federal partners in many ways to further our aims in crop sciences. Important projects are funded by USDA–NIFA, but it is important to keep in mind that they are very often part of larger, more significant programmatic initiatives, often involving other institutions and private firms.

Just to cite a few examples—

Our crop scientists have made significant contributions in molecular or genomic biology for corn and soybeans. In recent years, USDA–NIFA competitive grants have allowed our scientists to explore the mechanisms of nitrogen uptake and utilization in corn. Nitrogen is, of course, an essential plant nutrient and a source of environmental concern. Other AFRI funding supports genetic research in soybeans, such as flowering response to seasonal photoperiod changes, a critical factor to environmental adaptation of soybean plants.

With the help of our partners in the seed industry, we established the Illinois Plant Breeding Center a few years ago, which is now recognized as the leading academic plant breeding program in the country. This model research and education effort is focused on training the next generation of scientists who will be needed to drive innovation forward in plant biotechnology, in order to achieve the output gains we need to meet future food demand. USDA–NIFA has funded research and education focused on achieving high corn yield under high planting density. That fits perfectly within the scope of the Illinois Plant Breeding Center.

The University of Illinois has made major contributions to knowledge pertaining to energy crops, biomass production if you will. As a partner in the Energy Biosciences Institute with UC Berkeley, Lawrence Berkeley National Laboratory, and BP, we established the crop feedstock research program that has formed a scientific foundation for renewable crops. USDA–NIFA projects on the sorghum genome and economic analysis of tradeoffs for biomass production contributed to this effort, and the University of Illinois will continue to operate its unique Energy Farm as a renewable crops resource, even though the Energy Biosciences Institute is currently being phased out. As is often the case, USDA projects were instrumental in some of the foundational research that led a positive proof of concept, providing the incentive for other stakeholders to join in building and sustaining the research program.

I have already emphasized the importance of ARS on our campus, particularly for crop sciences, where scientists are fully integrated into our research activities and making enormous contributions. Our groundbreaking work on photosynthesis has been led in partnership with ARS, and some of those scientists have been instrumental in our successful modeling of future environmental effects of climate changes

on crop production, through our unique capabilities for free air concentration enrichment (SoyFACE) at field scale.

Besides the pursuit of science that is directly related to growth and culture of crops, our mission is to also translate science for use in practice, whether that is provided as technology or information. That occurs not only through Extension programs, but also through technology commercialization processes, or by means of innovative research and education approaches that assist management decision making among the broader audience of users. To illustrate, USDA's support and data have been instrumental in our development of FarmDoc, one of the nation's leading platforms for farm management research, risk management information, and decision tools. Moreover, the grant for the USDA Producer Education Tools Project, awarded to Illinois from the Farm Service Agency, allowed us to put timely information and decision tools in the hands of producers during implementation of the most recent farm bill.

Illinois also invests its formula or capacity funding in support of various programmatic initiatives. For example, we have invested Hatch resources to seed interdisciplinary research in the early stages, through our Future Interdisciplinary Research Explorations (FIRE) grants program, and we similarly fund the ACES Research Academy to give young scientists the necessary tools to success in a research environment.

We work diligently to develop resource leverage from partnerships. In any of our cooperative relationships, it is essential to understand the roles and commitments of potential partners in each segment of the agricultural research process, basic to applied, and which change over time.

Just yesterday, for example, a major chemical and agricultural technology company launched an innovation center on the Illinois campus that looks to partner with the university in several ways, including improved cropping systems.

Our main building on campus for crop sciences, Turner Hall, is undergoing significant renovations to provide better learning and working space, in cooperation with several major benefactors from the crop industry. In the same way, we are reaching out to our industry partners to modernize our research infrastructure to utilize crops, in projects like our Integrated Bioprocessing Research Laboratory, which is under construction, and our Feed Technology Complex.

Challenges

Crop sciences at Illinois includes multiple related disciplines: agronomy, agroecology, plant protection, plant breeding, biotechnology, and molecular genetics, bioinformatics, horticulture, sustainable landscapes, and specialty crops.

In some respects our challenges at this point in time may be more extreme than for some of our peers in the Midwest, largely attributable to declining state support for the public goods involved in agricultural research and extension. Illinois is a major agricultural state, but it also has major urban populations, with significant competing demands.

Specifically for crop sciences at Illinois, the trends we see are clear.

- Attracting top students to enroll in undergraduate crop science majors is a challenge, even though the job market for those students has been excellent.
- Our research productivity, measured in competitive grant funding, has been excellent for our crop scientists. Being on the leading edge of crop-related science is essential for long-term excellence, because other academic institutions and industry aggressively compete for the same talent.
- The portfolio of crops research is driven, to a significant extent, by grant opportunities. The sources of grant funding for locally applied research have diminished substantially over the past decade.
- Our crop scientists compete, not only for USDA or other Federal resources, but also for resources within the university that are derived from the state and elsewhere.
- Illinois has experienced substantial permanent losses of scientific capacity and other assets for crops research over the past several years. One example is the very recent announcement of base budget cuts that have prompted us to reduce resources devoted to crops in four of our field research and educations centers in Illinois
- As our higher education budget model continues to rely more heavily on student tuition, we lack the justification to further subsidize agricultural research activity with student tuition dollars.

Nonetheless, the opportunity for Illinois and our sister institutions remains exceptionally bright and critically important—to build upon the success that is feeding

the world today. Just a couple of weeks ago, Secretary Vilsack came to the University of Illinois to deliver an address on international food security issues. To paraphrase one of his points, he suggested that we must invest commensurately more in agricultural research and education, despite the fact that only a small part of our population is directly engaged in agriculture. Because all people are the beneficiaries of a robust and successful agricultural sector, allocation of resources must not be based solely on demographic patterns or variables. He also made it very clear that the land-grant universities must have capacity and infrastructure to conduct agricultural research and education at the next levels of competency. USDA–NIFA recently asked institutions like ours for information about their infrastructure assets, in order to better assess the capabilities and gaps for critical scientific progress going forward.

States like Illinois are under tremendous fiscal pressure. Our decision to reallocate resources for our field research, the loss of personnel to carry out agricultural research programs, and years of decreasing investment in faculty scientists reflect that pressure.

On the other hand, non-traditional partners may be waking to the needs and opportunities. An initiative called "FARM Illinois" is engaging the broader business and civic community, especially in metropolitan Chicago, with the agricultural interests across the state.

Policy Implications

In closing, I would like to leave you with some broad ideas to consider as you deliberate Federal policies for agricultural research, education, and outreach.

- Agriculture, especially major crop agriculture, has global implications—but by its nature requires local knowledge. So while investing to meet global challenges, understand the importance of science applied locally.
- Emphasize partnerships appropriately, and be willing to apply Federal resources as a public good, where the gaps exist.
- Emphasize competitiveness, but be smart about the necessary capacity—and work with states to insure the health of land-grant universities and related institutions.
- Universities invest in scientific research capacity in response to the demands and criteria of grantors. If sufficient opportunities for resources and scholarship are not apparent for faculty or other scientific talent in agriculture to succeed in the long-term, universities will invest in other disciplines competing for scarce resources, especially those where student demand is strong and tuition revenue is most apparent. Real cooperation is needed among Federal partners, states, and industry to promote student interest and research needs in agriculture.
- Finally, because our programmatic research initiatives rely on multiple partners and sources of support, it is often difficult to identify a unique contribution from a particular partner. The temptation for any partner is to desire accountability for their specific contribution, but requirements need to be flexible enough for compliance without significant administrative burden. It is in everyone's interest to seek administrative efficiency at all levels of the agricultural research and education process.

I would like to thank the Committee once again for this opportunity to share our perspective with you, and we appreciate your support of agricultural research, education, and outreach.

The CHAIRMAN. Thank you, Dr. Hauser.

Dr. Moyer.

STATEMENT OF JAMES W. MOYER, PH.D., ASSOCIATE DEAN FOR RESEARCH, COLLEGE OF AGRICULTURAL, HUMAN, AND NATURAL RESOURCE SCIENCES, WASHINGTON STATE UNIVERSITY; DIRECTOR, AGRICULTURAL RESEARCH CENTER, PULLMAN, WA

Dr. MOYER. Thank you, Mr. Chairman, Ranking Member DelBene, Congressman Newhouse, and other Members of the Subcommittee.

Washington agriculture is one of the most diverse in the United States, growing over 200 different crops, many of which are classified as specialty crops. Washington is number one nationally in the production of ten of those crops, including apples, cherries, hops, and pears, and second in production of eight others, including grapes, onions, and potatoes. Specialty crops represent more than ½ of Washington's agricultural economy, and play a significant role in the agricultural economy of many other states as well. And further, specialty crops provide the fruits and vegetables that are the foundation of a healthy diet for everyone.

Feeding an increasing global population in the face of 21st century challenges that include climate change, diminishing water supplies, and disease and pests, requires 21st century research responses. This morning, I would like to highlight WSU's unique contributions to the Specialty Crop Research Initiative, or SCRI, funded by the USDA, National Institute of Food and Agriculture, as part of that solution.

SCRI is designed to serve the needs of the broader national agriculture industry by requiring multi-institutional and stakeholder involvement. This is a thoughtful feature that brings together the expertise needed to address complex problems, and to assure relevance. Since 2008, WSU faculty have been lead investigators, or funded collaborators, on 38 SCRI program grants that brought over $36 million to WSU to support Washington's agriculture, and a similar amount was awarded to collaborating land-grant institutions. These grants funded research to improve production practices, develop systems approaches to crop management, study climate change, pest and disease management, precision agriculture and automation, and develop genomic and bioinformatics tools to aid plant breeding efforts.

This morning, I will highlight two projects that demonstrate the critical value of SCRI. First, is research on biodegradable plastic fabric for mulches. WSU, with collaborators, studied mulch fabrics that suppress weeds and saves water, and can also be used for high tunnels that prolong the growing season. This was only possible because of the research collaboration among five universities and farmers. In addition, the results allowed farmers from Washington, Tennessee, and Texas to access niche markets for strawberries, and to improve yields of other crops such as tomatoes. Further, researchers collected valuable information that was previously unavailable. They first collected information on the performance of biodegradable plastic fabrics used to construct the tunnels and mulch covers. They also collected information on the effects of biodegradation of microbial communities in soil, and identify fungi and bacteria responsible for degradation. This research led to a second project, now underway, focused on developing non-woven polymers that can be used to manufacture fabrics that have high utility as biodegradable mulch.

The second example I will share is actually two projects that seek to improve the accessibility and application of the vast amounts of genomic data available for specialty crops. The data is valuable because it can be used to identify genes responsible for specific traits, and then by plant breeders to integrate these traits into varieties. The first project is the Genomic Database for

Rosaceae, which is led by Dorrie Main. This is a publicly available database with whole genome sequences, and genetics and breeding data for apples, peaches, and strawberries, and partial sequences and data for other crops such as almonds and pears that can be used for breeding projects. In addition to SCRI funding, this research is supported by several other sources, including the National Science Foundation and the Washington Tree Fruit Commission.

In the other project known as RosBREED, scientists from WSU and Michigan State University are leading 35 scientists from 14 U.S. institutions to utilize information from 22 U.S. *Rosaceae* crop breeding programs. This initial project was so successful that a second phase was funded to develop and apply 21st century DNA tests and breeding methods to produce new varieties with improved horticultural quality and disease resistance.

I have provided additional testimony for the record, describing these examples and the importance of SCRI funding to Washington agriculture.

I thank you for this opportunity to offer the testimony today. Thank you.

[The prepared statement of Dr. Moyer follows:]

PREPARED STATEMENT OF JAMES W. MOYER, PH.D., ASSOCIATE DEAN FOR RESEARCH, COLLEGE OF AGRICULTURAL, HUMAN, AND NATURAL RESOURCE SCIENCES, WASHINGTON STATE UNIVERSITY; DIRECTOR, AGRICULTURAL RESEARCH CENTER, PULLMAN, WA

Introduction

My name is Jim Moyer and I serve as the Associate Dean of Research for the College of Agricultural, Human, and Natural Resource Sciences (CAHNRS) and as the Director of the Agricultural Research Center at Washington State University (WSU) in Pullman, Washington.

Washington State University is Washington's state university. Through our five campuses, four research centers and WSU extension, WSU is physically present in every county, delivering education, research, and core services that benefit Washingtonians in their communities every day. The University also has a presence abroad with a new online global campus and international research. As a premiere, tier one research university and the state's land-grant university, WSU's mission is to drive education and innovation into our communities to support and grow the state's economy.

WSU is led by Interim President Daniel J. Bernardo, Ph.D. (former Dean of the College of Agriculture, Human and Natural Resource Sciences) since July 2015 after the death of President Elson S. Floyd. President Bernardo is carrying on the legacy of Dr. Floyd to maintain WSU's land-grant mission of advancing, extending and applying knowledge through local and global engagement.

WSU Research

Washington State University's research enterprise is driven by a diverse portfolio of extramural support with funding from state and Federal sources as well as commodity groups and industry. Competitive Federal funding streams from a variety of agencies are the primary source of funding for the institution.

WSU faculty have a strong history of success in winning Federal competitive grants. For 3 of the last 4 years, the 5th Congressional District in Washington (which includes WSU) was in the top five U.S. Congressional districts for receipt of USDA–NIFA awards. WSU faculty also compete strongly for Federal awards from DOE, NSF, NIH, and DOI. These funds support a broad spectrum of programs that include biofuels and natural resource management, as well as the entire agriculture value chain to improve food safety and security, lead to healthier foods, and enhance production of specialty crops, including organic production.

These grant awards support investigations in plant metabolomics, genomics and bioinformatics, plant breeding and animal reproduction, and pest management, as well as studies that affect end-use quality, transportation and marketing. Investiga-

tions supported by the NSF have contributed to our understanding of lipid metabolism in plants, as well as secondary metabolites such as riboflavin that contribute to healthier foods.

Genomics and bioinformatics investigations have not only led to an increased understanding of plant and animal genomes, but also the development of knowledge-based decision tools for pest management and other production practices. Federal research partnerships also support studies to ensure high end-use quality for new plant varieties as well as transportation and marketing research.

Our formula for success includes four research and extension centers located across the state staffed with over 50 faculty engaged in research, extension and teaching. Faculty at these centers and on the Pullman campus maintain strong relationships with growers and other members of the agribusiness community. This has translated into significant support for research, including endowed chairs designed to meet industry needs, as well as matching dollars and other forms of leverage, such as an internal seed grant program that enhances the competitiveness of faculty for Federal research funding. Faculty in the College of Agricultural, Human, and Natural Resource Sciences generate over $80 million annually in extramural support.

WSU Specialty Crop Research Initiative-Funded Projects

Washington agriculture is one of the most diverse in the United States, growing over 200 different crops many of which are classified as "specialty crops." Washington is number one nationally in the production of ten of those crops, including apples, cherries, hops and pears, and second in production of eight others including grapes, onions and potatoes. Specialty crops represent more than half of Washington's agricultural economy and play a significant role in the agricultural economy of many other states as well. Further, specialty crops provide the fruits and vegetables that are the foundation of a healthy diet for everyone.

Feeding an increasing global population in the face of 21st century challenges that include climate change, diminishing water supplies, plus disease and pests, requires 21st century research responses.

This morning I would like to highlight WSU's unique contributions to the Specialty Crop Research Initiative (SCRI), funded by the USDA National Institute of Food and Agriculture, as part of the solution.

SCRI is designed to serve the needs of the broader, national agriculture industry by requiring multi-institutional and stakeholder involvement, a thoughtful feature that brings together the expertise needed to address complex problems and ensure relevance.

Since 2008, WSU faculty have been lead investigators or funded collaborators on 38 SCRI program grants that brought over $36 million to WSU to support Washington's agriculture. A similar amount was awarded to collaborating land-grant institutions. These grants funded research to improve production practices; develop systems approaches to crop management; study climate change, pest and disease management, precision agriculture and automation; and develop genomic and bioinformatics tools to aid plant breeding efforts.

I will highlight two projects that demonstrate the critical value of the SCRI. First is research on biodegradable plastic fabric for mulch. WSU developed mulch that suppresses weeds and saves water and can be used for high tunnels that prolong the growing season. This was only possible because of the research collaboration among five universities and farmers. In addition, the results allowed farmers from Washington, Tennessee and Texas to access niche markets for strawberries and to improve yields of other crops such as tomatoes. Further, researchers collected valuable information that was previously unavailable. They first collected information on the performance of biodegradable plastic fabrics used to construct the high tunnels and the mulch covers, a previous barrier to adoption. They also collected information on the effects of biodegradation on microbial communities in soil and the identity of fungi and bacteria responsible for degradation. This research led to a second project, now underway, focused on developing non-woven polymers that can be used to manufacture fabrics for biodegradable mulch.

The second example I'll share is actually two projects that seek to improve the accessibility and application of the vast amounts of genomic data available for several specialty crops. The data is valuable because it can be used to identify genes responsible for specific traits and then by plant breeders to integrated them into varieties. The first project is the Genomic Database for *Rosaceae,* which is led by Dr. Dorrie Main. This is a publicly available database with whole genome sequences of apples, peaches, and strawberries that can be used for breeding projects. In addition to SCRI funding, this research is supported by several other sources of funding, in-

cluding the National Science Foundation and the Washington Tree Fruit Commission.

In the other project, known as RosBREED, scientists from WSU and Michigan State University are leading 35 scientists from 14 U.S. institutions to utilize information from 22 U.S. *Rosaceae* crop breeding programs. This initial project was so successful that a second phase was funded to develop and apply 21st century DNA tests and breeding methods to produce new varieties with improved horticultural quality and disease resistance.

WSU Projects for Specialty Food Crops funded by USDA

The WSU portfolio of competitively funded research from USDA that supports specialty crop foods includes research in five areas.

1. Production practices and systems management includes the previously mentioned projects for biodegradable mulches as well as three projects in fruit trees to support development of systems approaches to crop management.
2. Pest and disease management studies identified factors to reduce losses from insect pests such as the brown marmorated stink bug (tree fruit), the spotted wing *Drosophila* fruit fly (all fruit including wine grapes) and spider mites (hops). In addition, multiple projects have investigated viruses that cause internal necrosis in potato tubers as well as the transmission by insects of viruses that cause damage to specialty crops.
3. Genomics and breeding includes projects on peas and cranberries in addition to the highlighted projects above.
4. Precision and automated agriculture includes projects on water management, selective mechanical weed control, blossom thinning, and automated fruit canopy management.
5. The Organic Research and Extension Initiative (OREI) funds a number of WSU projects that support specialty crop production.

The movement by the Federal Government toward supporting projects that are multi-disciplinary and multi-institutional has challenged institutions to provide more advanced administrative support for these projects. The preparation of these grants requires greater emphasis on integrating the granting processes, contract management and research administration cultures from the participating institutions. This is a critical phase of grant preparation as well as grant management. Traditional administrative support for single investigator, foundational grants is not necessarily directly scalable, due to the increased complexity and organization of the projects.

Further, we have found that specific support for grant development to coordinate budgets, subcontracts and the compliance issues of the participating institutions is essential. In addition, the level of competitiveness requires support in the writing of the grants as well. Once the award is received, there is a high level of administrative work requiring additional resources to support team communication and organization. These additional resources not only detract from direct costs formerly available to the researchers, but also require institutional investments in a time when land-grant institutions are facing cuts on the state and Federal side. This is in addition to higher-level oversight needed to manage multi-institutional programs. All of this results in the lead faculty member devoting significant time to administrative tasks and less to the actual research. To respond to these needs, we have created positions specifically to support grant development, and we are experimenting with creating a group to assist with project management, which requires additional resources for administrative processes.

WSU's Grand Challenges

In addition to the ongoing research efforts in the College of Agriculture, Human, and Natural Resource Sciences, the WSU research agenda has recently undergone a comprehensive review to address complex societal problems that require the expertise of research universities for real world solutions. The identification of these grand challenges was a collaborative, university-wide effort with faculty, staff and administrators working together to unite behind the challenge.

Our strong Federal, state and community partnerships are essential to the pursuit of these grand challenges. WSU's value to Washington State and Washington, D.C., has never been more evident than through the successes of our partnerships with our Congressional delegation in helping position and grow WSU's leadership in five areas:

- Sustaining Health: The Uncompromising Pursuit of Healthier People and Communities.

- Sustainable Resources for Society: Food, Energy and Water.
- Advancing Opportunity and Equity: The Land-Grant Mission in Today's World.
- Improving Quality of Life through Smart Systems.
- Fundamental Research in Support of National Security.

These Grand Challenges are integral to the CAHNRS research portfolio, with many research programs in each of the five challenges. We have:

- 77 research programs in sustaining health,
- 157 research programs in sustainable resources for society,
- 47 research programs in advancing opportunity and equity,
- 28 research programs in improving quality of life through smart systems, and
- 15 research programs in fundamental research in support of national security.

The goal of the Grand Challenges is to increase collaboration between WSU faculty members and students, across disciplines and with researchers and partners worldwide, to explore integrated solutions.

Thank you for this opportunity to provide background on the importance of the Specialty Crop Research Initiative and the importance of Federal research to land-grant institutions like Washington State University.

The CHAIRMAN. Thank you, Dr. Moyer.

Dr. Brashears.

STATEMENT OF MINDY M. BRASHEARS, PH.D., PROFESSOR OF FOOD SAFETY AND PUBLIC HEALTH, TEXAS TECH UNIVERSITY; DIRECTOR, INTERNATIONAL CENTER FOR FOOD INDUSTRY EXCELLENCE, LUBBOCK, TX

Dr. BRASHEARS. Thank you very much.

Mr. Chairman and Members of the Committee, thank you very much for allowing me to speak today about the importance of food safety research, and the need for future funding in this area. I am a Professor of Food Safety and Public Health at Texas Tech University, and I have spent my career studying this important topic.

August 13, 1997, was a very significant day in my life. Not only was it my first day on the job as an Assistant Professor at the University of Nebraska, it was also the day of the Hudson Foods ground beef 25 million pound recall due to *E. coli* O157:H7 contamination, which was, at the time, the largest recall in U.S. history.

Hudson Foods was located in Columbus, Nebraska, and I was hired with an extension role to work directly with the industry and to field media requests. I remember being interviewed on that first day, and I tried to be reassuring, but really wondering how can we ever solve this problem. On a day I expected to be unpacking boxes, I instead was thrown into the deep end of one of the biggest food safety crises in U.S. history.

It turns out when you are thrown into the deep end, you can either sink or swim, or be thrown a life preserver. A life preserver is what I was given in the form of strong research funding to develop innovative technologies to control this pathogen.

Later, I transferred to Texas Tech University, which is in the heart of the cattle-feeding industry. I partnered with other faculty to conduct several feeding studies to determine if a cattle probiotic I had developed controlled pathogens in the feedlot. To make a long story short, it did work. After several studies, we found that *E. coli* can be reduced up to 50 percent in live animals; thus, reducing the

risk of product contamination. This product has been commercialized and is used in many feedyards across the United States.

Many other things happened in the beef industry to improve safety, including the implementation of HACCP and the use of antimicrobial interventions. I was able to set up a pathogen processing lab at Texas Tech where we developed and validated many interventions and simulated food processing environments. We formed a strong research team in the International Center for Food Industry Excellence, adding additional faculty and moving into new facilities.

When you jump ahead to 2015, there is great news. Investment in food safety research in the past 20 years has saved lives. In the early 1990s, we were scrambling for solutions to control *E. coli,* but Federal investment in translational research delivered effective controls. The FSIS testing shows that ground beef contamination has fallen more than 90 percent, and the CDC reports that the human incidence has been cut in half. However, the food safety problem is far from being solved. The incidents of *Salmonellosis* remains steady, and illnesses associated with *Campylobacter* are actually rising. Antibiotic resistance actually decreases our ability to treat many of the illnesses associated with these pathogens. The availability of funds for food safety research has decreased, which leaves scientists scrambling for limited resources.

Research at Texas Tech can address problems on both the pre- and post-harvest side of food processing. For example, recent data indicates that the probiotic that reduces *E. coli* in cattle also reduces *Salmonella* in lymph nodes, which is a significant source of beef contamination. We have several studies underway, studying the mechanisms associated with the emergence of antibiotic resistance. And finally, we have molecular scientists who study detection technologies so we can react to problems quickly. We are well poised and ready to meet emerging food safety challenges. Also, of critical importance, is a transfer of our knowledge to our stakeholders. We have engaged social scientists as a key part of our research team to study human behavior in the food plant environment in order to effectively implement useful technologies. I am finding that more scientists like myself are engaging with social media to provide clarity to consumers. I personally have a a site on social media, *The Food Doctor,* which can be found on Facebook, where I provide science-based information to the public.

In summary, investments in research and education save lives. There is a need to address food safety issues in the U.S. and globally to improve the quality of life, and to protect public health for our population. Funding is the key to develop new technologies to control emerging pathogens, and to communicate science-based information to our final stakeholders.

Thank you very much, and I will be happy to answer any questions.

[The prepared statement of Dr. Brashears follows:]

PREPARED STATEMENT OF MINDY M. BRASHEARS, PH.D., PROFESSOR OF FOOD SAFETY AND PUBLIC HEALTH, TEXAS TECH UNIVERSITY; DIRECTOR, INTERNATIONAL CENTER FOR FOOD INDUSTRY EXCELLENCE, LUBBOCK, TX

Food Safety Research

I would like to introduce myself as a Professor of Food Safety and Public Health and the Director of the International Center for Food Industry Excellence at Texas Tech University. I received my B.S. in Food Technology at Texas Tech University and my M.S. and Ph.D. in Food Science with a specialization in food microbiology at Oklahoma State University. I began my career as an Assistant Professor of Food Safety at the University of Nebraska and moved to Texas Tech University where I have been conducting research and developing food safety and security educational programs for the past 14 years. Food safety and protecting public health has been the focus of my career. I currently serve as the Director of the International Center for Food Industry Excellence at Texas Tech University. My primary academic appointment involves research and outreach with an emphasis on food safety microbiology.

Contamination of food with pathogenic organisms creates an enormous social and economic burden on communities, industry, and health systems all over the world (Ajayi, *et al.,* 2011). In the United States alone, the Centers for Disease Control and Prevention (CDC) estimate that each year, one in six Americans suffers from foodborne illness attributed to one of 31 major pathogens transmitted through food (Scallan, *et al.,* 2011). The CDC estimate these pathogens are responsible for approximately 9.4 million foodborne disease episodes, 55,961 hospitalizations, and 1,351 deaths in the U.S. every year (Scallan, *et al.,* 2011). Non-typhoidal *Salmonella, Clostridium perfringens,* and *Campylobacter* appear in the top five most common bacterial pathogens, causing 11, 10 and 9% of illnesses, respectively (Scallan, *et al.,* 2011). Furthermore, O157 and non-O157 Shiga toxin-producing *Escherichia coli* (STEC) account for approximately 176,000 foodborne illness cases annually (Scallan, *et al.,* 2011).

Data from the Foodborne Disease Active Surveillance Network (FoodNet) show that in 2013 alone, 818 foodborne disease outbreaks were reported, resulting in 13,360 illnesses, 1,062 hospitalizations, 16 deaths, and 14 food recalls. Outbreaks caused by *Salmonella* increased 39% from 2012 (113) to 2013 (157). Outbreak-associated hospitalizations caused by *Salmonella* increased 38% from 2012 (454) to 2013 (628) (CDC, 2015). A study conducted by the U.S. Department of Agriculture Economic Research Service found that foodborne pathogens impose over $15.5 billion (2013 dollars) in economic burden on the U.S. public each year (Hoffmann, *et al.,* 2015). Eighty-four percent of the economic burden from pathogens is due to deaths. This reflects both the importance the public places on preventing deaths and the fact that the measure of economic burden used for nonfatal illnesses (medical costs + productivity loss) is a conservative measure of willingness to pay to prevent nonfatal illness.

At Texas Tech University we have assembled a team of research scientists to address global food safety issues. In addition to myself, the team includes the following faculty members: Dr. Guy Loneragan, Dr. Kendra Nightingale, Dr. Todd Brashears, Dr. Alejandro Echeverry, Dr. Leslie Thompson, Dr. Mark Miller, Dr. Chance Brooks, Dr. Marcos Sanchez and Dr. Henk Den-Bakker. Our team is a diverse group of scientists who have been strategically selected to address issues related to food safety and public health in the U.S. and around the world. Addressing food safety challenges involves a comprehensive farm-to-table proactive approach with regard to research and educational efforts. Our efforts do not stop in the laboratory or with a research publication. No research study will have impact on reducing illnesses if the final results are not transferred to the end user and therefore, in our of our research efforts, we strive to connect with our stakeholders. Most of our research has focused on beef safety, but we have also expanded to other commodities.

It is important to note that Federal funding was responsible for early funding for the International Center for Food Industry Excellence (ICFIE) and the research and educational activities involved in this center. Our faculty team within ICFIE was able to leverage this money each year for a 5:1 or greater research match on the funding from competitive USDA, industry, commodity and other government sources. The funding has had a tremendous impact on the overall safety of the food supply in the U.S. and was responsible in part for most of the studies I will discuss in this testimony.

Investment in food safety research over the past 20 years has saved lives. In the early 1990s, we were scrambling for solutions to *E. coli* O157 in ground beef. Federal investment in translational research delivered effective controls. The FSIS's testing shows that ground beef contamination has fallen more than 90%. The CDC

reports that the human incidence has fallen in half and met the healthy people 2010 goals. Investment can now help solve other food safety challenges. *Campylobacter, Salmonella,* and other emerging pathogens continue to injure too many people. Moreover, Antimicrobial Resistance (AMR) makes it harder to treat some of these illnesses. Investing in Federal research programs will provides solutions and reduces the number of people injured by these pathogens, but continued progress is threatened by reduced funding of transformative ideas.

Over the past several years, the availability of funds for food safety research at the Federal level has decreased which leaves scientists scrambling for limited resources from industry, foundations and other sources. Recent outbreaks and emerging pathogens can be controlled and even stopped through funding and educational efforts. Centers such as ICFIE are well positioned to solve food safety problems given the proper resources. In recent years, Federal funding has been awarded in large amounts to a small number of scientists limiting the application of the intellectual capacity that exists in the U.S. in the food safety arena. Additionally, the majority of food safety research addressed in the research conducted with these large funds has been directed towards STECs which are responsible for much fewer illnesses and deaths compared to *Salmonella* and *Campylobacter. Salmonellosis* has remained constant with little change and recent data indicate that *Campylobacter* is prevalent in many food products with increasing numbers of illnesses each year. We are unable to quickly react to emerging problems such as antibiotic resistance, *Campylobacter* and others due to the lack of funding available to address these problems. It is imperative that funding be available and even increased for food safety research and educational efforts in order to protect public health. I will highlight some of the research that has had a direct impact on improving the safety of the beef supply that has been conducted at Texas Tech University and with collaborating institutions.

Research Highlights from Texas Tech

Pre-Harvest Food Safety

Beef is a staple product in the American diet. The beef production chain begins on the farm, prior to harvest. Cattle can harbor foodborne pathogens such as *Salmonella* and Shiga-toxin producing *E. coli* (STEC) such as *E. coli* O157:H7 that can be transferred to the carcass during harvest and can potentially threaten public health. The cattle's hide is the primary source of contamination of the final product but the carcass can also be contaminated through the environment, the employees or direct contact with the contents of the gastrointestinal tract. Industry groups such as NCBA provide educational opportunities to producers on best practices to follow on the farm which create a clean and healthy environment to raise cattle. Research at Texas Tech in the pre-harvest realm has targeted interventions that reduce pathogens prior to harvest.

Over the course of my career, a primary focus of my research has been on the development of a pre-harvest intervention that reduces foodborne pathogens in cattle prior to harvest. The intervention is a *Lactobacillus*-based cattle direct-fed microbial (DFM) which is basically a cattle probiotic. The cattle feed additive containing the selected cultures has been commercialized and sold under the brand names of Bovamine and Bovamine Defend and has been widely implemented in the beef and dairy industries in the U.S. This product contains a specific strain of *Lactobacillus* (NP51) that has proven to be effective in reducing pathogens in the live animal prior to harvest in many research studies over the past 15 years. I have been involved in this work from the beginning and its initial development but the work has also been validated by other scientific groups. Funding for this work was provided by the Beef Checkoff and commodity groups such as NCBA and AMIF, direct industry support, the State of Nebraska, and funding from the Federal Government. I will summarize many of the studies and results of our work in this area.

The microbial flora is an important component of the gastrointestinal tract and certain bacteria have long been recognized for beneficial properties and good health. Mechanistically, beneficial bacteria can prevent harmful bacterial colonization by competitively excluding, producing antibacterial compounds, and/or promoting healthy immune function (Berry, *et al.,* 2010). DFM are live bacteria fed to a host to elicit a beneficial response, and are typically, but not limited to, *Lactobacillus spp.* strains. Numerous DFM have been identified and tested for efficacy against *E. coli* O157:H7 in cattle (Callaway, *et al.,* 2009; Loneragan and Brashears, 2005; Sargeant, *et al.,* 2007). The overall goal of our strategy was to identify bacteria that are competitive with, or antagonistic to, pathogenic bacteria that could be fed as a supplement to the cattle diet without having a detrimental impact on animal performance.

In one of the first large-scale, feedyard studies (Brashears, *et al.* 2003), we evaluated 180 steers for shedding of *E. coli* O157:H7 on arrival at the feedlot, just before treatment with the DFM, and every 14 days until slaughter. The prevalence on hides and carcasses at slaughter was also evaluated. *Lactobacillus acidophilus* NP51 decreased the shedding of *E. coli* O157:H7 in the feces significantly during the feeding period. *E. coli* O157:H7 was approximately twice as likely to be detected in control animal samples as in samples from animals not receiving the supplement. In addition, DFM supplementation significantly decreased the number of *E. coli* O157:H7-positive hide samples at harvest and the number of pens testing positive for the pathogen. The results of this first study suggested that feeding a *Lactobacillus*-based DFM to cattle decreases, but not eliminates, fecal shedding of *E. coli* O157:H7, as well as contamination on hides.

Younts, *et al.* (2004) described the prevalence of *E. coli* O157 in the feces and on the hides of finishing beef cattle fed a standard diet and those fed diets supplemented with a DFM. Two hundred forty steers received one of four treatments: (1) control: (2) HNP51: high dose of *L. acidophilus* strain NP51 (10^9 CFU per steer daily) and *P. freudenreichii* (10^9 CFU per steer daily); (3) HNP51145: high dose of NP51 (10^9 CFU per steer daily), *P. freudenreichii* (10^9 CFU per steer daily), and *L. acidophilus* NP45 (10^6 CFU per steer daily); or (5) LNP51145: low dose of NP51 (10^6 CFU per steer daily), *P. freudenreichii* (10^9 CFU per steer daily), and NP45 (10^6 CFU per steer daily). Samples were collected from each animal and analyzed for the presence of *E. coli* O157 on day 0 (feces), 7 days before harvest (feces), and at harvest (feces and hide). At the end of the feeding period, cattle receiving HNP51 were 57% less likely to shed detectable *E. coli* O157 in their feces than were the controls. Cattle supplemented with a high dose of NP51 had reduced *E. coli* O157 prevalence in both fecal and hide samples, again indicating that this treatment may be an efficacious pre-harvest intervention strategy.

A follow-up study by Younts, *et al.* (2005) evaluated the effects of three doses of *L. acidophilus* strain NP51 and a combination treatment of strains NP51 and NP45 on prevalence of *E. coli* O157 in cattle. Three hundred steers were assigned randomly to 60 pens and received one of five treatments: (1) control; (2) HNP51, high dose of NP51 at 10^9 CFU per steer daily; (3) MNP51, NP51 at 10^8 CFU per steer daily; (4) LNP51, low dose of NP51 at 10^7 CFU per steer daily; and (5) NP51145, NP51 at 10^9 CFU per steer daily and NP45 at 10^6 CFU per steer daily. All DFM treatments included *P. freudenreichii* at 10^9 CFU per steer. Individual rectal fecal samples were collected on arrival and every 28 days throughout the feeding period. Cattle receiving HNP51, MNP51, and LNP51 had a lower prevalence of *E. coli* O157 throughout the feeding period compared with the controls, and the dose response for NP51 was a linear decrease in prevalence with increasing dose. No decrease in prevalence for cattle receiving the combination NP51145 was detected compared with controls. *E. coli* O157 prevalence values averaged across collection times were 23.9, 10.5, 9.9, 6.8, and 17.3% for cattle in the control, LNP51, MNP51, HNP51, and NP51145 groups, respectively. We concluded that the greatest decrease in *E. coli* O157 carriage was achieved using NP51 at 10^9 CFU per steer.

Two further subsequent studies demonstrated the effectiveness of NP51 in the control of *E. coli* O157:H7 shedding in cattle. In a study conducted by Stephens, *et al.* (2007), 500 yearling steers were housed in pens of ten animals each. Upon arrival, steers were randomly allocated to one of five cohorts. Four of the cohorts were fed various strains and dosages of *Lactobacillus*-based DFM throughout the feeding period. Fecal samples were collected from the rectum of each animal immediately prior to shipment to the abattoir. The prevalence in the controls (26.3%) was significantly greater than that in cattle supplemented with *L. acidophilus* strains NP51, NP28, or NP51–NP35 (13.0, 11.0, and 11.0%, respectively). The greatest *E. coli* O157 concentration was observed in the controls (3.2 log most probable number, MPN/g of feces); this concentration was significantly greater than that observed in positive animals receiving NP51, NP28, or NP51–NP35 (0.9, 1.1, 1.7 log MPN/g of feces, respectively). We demonstrated that specific strains of *Lactobacillus*-based DFMs effectively reduced the prevalence and concentration of *E. coli* O157 in harvest-ready cattle. Another subsequent study we conducted (Stephens, *et al.* 2007b) evaluated the effectiveness of DFM in reducing *E. coli* O157 and *Salmonella* in beef cattle. Steers (n =240) received one of four treatment concentrations: control (lactose carrier only); low (10^7 CFU per steer daily *Lactobacillus acidophilus* NP51); medium (10^8 CFU per steer daily *L. acidophilus* NP51); and high (10^9 CFU per steer daily *L. acidophilus* NP51). All diets included 109 CFU per steer *Propionibacterium freudenreichii* NP24. Feces were collected from each animal at allocation of treatment and found to have no variation between cohorts concerning *E. coli* O157 recovery. No significant dosing effects were detected for *E. coli* O157 recovery from feces at the medium dose or from hides at the medium and high doses. *E. coli* O157 was

74% and 69% less likely to be recovered in feces from animals receiving the high and low diets, respectively, compared with controls. Compared with controls, *E. coli* O157 was 74% less likely to be isolated on hides of cattle receiving the low dose. No significant dosing effects were detected for *Salmonella* recovery from feces at the medium and low doses or from hides at any doses. Compared with controls, *Salmonella* was 48% less likely to be shed in feces of cattle receiving the high dose.

Finally, Pond and Brashears (2013, unpublished data) evaluated the effect of feeding *L. animalis* strain NP51 on the prevalence and concentration of non-O157 STEC serogroups O26, O45, O103, O111, O121, and O145. In one study, conducted in a commercial feedlot, approximately 1,800 cattle were randomized upon arrival into treatment and control pens. The control pens were fed routine feedlot diets whereas treatment pens received a diet that only differed by the daily supplementation of 10^9 CFU of NP51 and 10^9 CFU of *Propionibacterium* NP24. Twenty-five fecal pats were taken from each pen (n = 600 samples) prior to transport to a regional abattoir for slaughter. A second study was conducted in a research-dedicated feedlot. One-hundred twelve cattle were blocked by weight and randomized into treatment or control pens at a research feedlot. Fecal grabs were collected from the rectum of each animal prior to transport to a regional abattoir for slaughter. In the commercial feedlot, *E. coli* O157 was detected in 45% fewer fecal pats compared to the contemporaneous control cohort. Within positive samples, the concentration of *E. coli* O157 was 1.23 $\log_{10}$ CFU/g lower among treated animals compared to controls (P = 0.02). Genes encoding serogroups O26, O45, O103 and O121 were detected 53.2% (P = 0.01), 41.2% (P < 0.01), 34.6% (P = 0.03) and 47.4% (P = 0.02), respectively, less frequently among treated animals compared to controls. In the research feedlot, *E. coli* O157 was recovered from 75% fewer treated cattle compared to controls. However, no differences were detected for the non-O157 serogroups evaluated. The results of this study show promising evidence that the use of DFM may be effective in reducing the prevalence and concentration of non-O157 STEC, along with a proven effectiveness for the reduction of STEC O157 and *Salmonella* in the feces and lymph nodes of beef cattle.

As previously stated, many other research groups have evaluated the efficacy of NP51 in reducing pathogens in the gastrointestinal tract of cattle. In a recent study published in *Zoonosis and Public Health* (Wisener, *et al.,* 2015), they conducted a Meta-analysis of 16 independent research studies related to pathogen reduction in cattle when fed NP51. From the 16 studies, they concluded that the NP51 significantly reduced *E. coli* O157:H7 prevalence and when used in cattle feeding systems could prevent human illnesses from beef products.

While pathogen contamination in the GI tract is a concern, we have also generated significant data in recent years indicating that *Salmonella* can be harbored in the lymph nodes of the animals and can be incorporated into ground beef thus posing a public health risk. During the past 3 years, several studies have been conducted in the Food Safety Laboratories at Texas Tech University to evaluate the effect of DFM on the prevalence and concentration of *Salmonella* and STEC in bovine feces and lymph nodes. A study conducted in our lab (Vipham, *et al.,* 2015) evaluated a total of 112 steers blocked by weight in a research feedlot with 14 pens/treatment and 4 steers/pen. Cattle were randomized to either a control group or a treatment group with 10^9/head/day *L. animalis* NP51 supplementation. Immediately after slaughter, LN were acquired from the steers (n=107). *Salmonella* prevalence in bovine subiliac LN from control cattle was found to be 34.0%. A significant reduction in *Salmonella* prevalence of 88.0 % was observed between control cattle and cattle fed NP51. *Salmonella* concentration in treatment cattle were more likely to be low (at 1 log CFU/g or below the level of detection) while higher (4 log CFU/g) concentrations were more likely to be found in control samples. The results from this study indicated that supplementation with 10^9/head/day NP51 as a pre-harvest intervention will successfully reduce both the prevalence and concentration of *Salmonella* in bovine lymph nodes.

Guillen and Brashears (2015, unpublished data) evaluated the effect of *L. acidophilus* NP51 at a rate of 10^9/head/day (NP51) on the reduction of *Salmonella* prevalence in cattle lymph nodes. Approximately 1,800 cattle were randomized into two treatments in a commercial feedlot with 12 pens/treatment and 75 head/pen. Subiliac lymph nodes were obtained from approximately 25 animals/pen (n= 600) at the slaughter facility. *Salmonella* was recovered from 25% fewer LN for cattle fed NP51 when compared to controls. Quantitatively the NP51 cattle had significantly less *Salmonella* in lymph nodes (3.1 vs. 4.2 $\log_{10}$ cfu/lymph node) and per gram of lymph nodes (1.9 vs. 2.9 $\log_{10}$ cfu/g). Control samples were more likely to have a higher concentration of *Salmonella* in lymph nodes with 10.4% vs. 11.7% between 3 and 4 $\log_{10}$ cfu/g; 13.7% vs. 6.4% between 4 and 5 $\log_{10}$ cfu/g, and 7.5% vs. 2.1% greater than 5 $\log_{10}$ cfu/g. The results of this study indicated that supplementation

with NP51 is an effective pre-harvest intervention to reduce the prevalence of *Salmonella* in cattle lymph nodes, which may lead to a decrease in the *Salmonella* prevalence if ground beef.

Recently, a study was conducted to examine the efficacy of using *Lactobacillus animalis* and *Propionibacterium freudenreichii* (NP24) to control *Salmonella* within PLNs of feedlot cattle (Gragg, *et al.,* 2013). Cattle were randomly allocated into either control or DFM treatment groups. Diets of treated cattle were supplemented with 10^9 CFU/head/day of the DFM, while control groups received no DFM supplementation. During slaughter, one subiliac lymph node (SLN) per carcass was collected from 627 carcasses from one study and 99 carcasses from a second study. In the first study, effects of DFM supplementation varied across slaughter days. On the first and second slaughter days, the prevalence of *Salmonella* was significantly reduced by 50% and 31%, respectively. In the second study, *Salmonella* was 82% less likely ($p = 0.008$) to be recovered from SLNs of treatment cattle. While a greater relative risk reduction was observed in the latter study, absolute risk reductions were similar across studies. Once again, the results indicated that NP51 and NP24 supplementation may aid in reducing the prevalence and concentration of *Salmonella* in SLNs and, therefore, serve as an effective control measure to reduce *Salmonella* in ground beef products.

Post-Harvest Food Safety

At Texas Tech University we have a very specialized set up to evaluate processes in simulated industry settings. More than 100 food processes have been validated in our pathogen processing area in which results are proprietary to protect specific companies. This validation service is offered for companies with a need to determine if their processes result in adequate reduction of pathogens during processing. In general, we have validated safe procedures for the production of cooked products, fresh products and even pet foods. We have also utilized this research laboratory space to a conduct research that addresses food safety issues to generate data that are directly applicable to the industry and can be used to make process decisions to produce safe food products.

We have generated data on reducing the food safety risks of needle tenderized beef products. In one study, we evaluated three different intervention strategies (lactic acid, lactic acid bacteria, and acidified sodium chlorite) to control *E. coli* O157:H7 and *Salmonella* in mechanically tenderized and brine-enhanced beef strip loins when applied to the steaks prior to packaging and shipment for processing. After tenderization, lactic acid bacteria reduced internal *E. coli* O157:H7 loads 1.2 to 2.2 log cycles, while the acidified sodium chlorite and lactic acid reduced them between 0.8 and 3.0 log, respectively. *Salmonella* was also reduced internally after application of all interventions between 0.9 and 2.2 log. The application of antimicrobials to the steaks prior to packaging and shipment on day 0 was effective in reducing internalization of both pathogens in non-intact beef products. (Echeverry, *et al.,* 2009) In a similar study, our aim was to validate the use of lactic acid bacteria (LAB), acidified sodium chlorite (ASC), and lactic acid (LA) sprays when applied under a simulated purveyor setting as effective interventions to control and reduce *E. coli* O157:H7 and *Salmonella* prior to tenderization. LAB and LA reduced internal *E. coli* O157:H7 loads up to 3.0 log, while ASC reduced the pathogen 1.4 to 2.3 log more than the control ($P < 0.05$), respectively. *Salmonella Typhimurium* DT 104 was also reduced internally 1.3 to 2.8, 1.0 to 2.3, and 1.4 to 1.8 log after application of LAB, LA, and ASC, respectively. (Echeverry, *et al.,* 2010).

We also evaluated the impact of various interventions on the reduction of pathogens during ground beef production. These data are important to inform producers on the proper use of interventions in industry settings. We conducted a study to determine if acidified sodium chlorite (1,200 ppm) and acetic and lactic acids (2 and 4%) were effective in reducing foodborne pathogens in beef trim prior to grinding in a simulated processing environment. The reduction of *Salmonella Typhimurium* and *Escherichia coli* O157:H7 at high (4.0 log CFU/g) and low (1.0 log CFU/g) inoculation doses was evaluated. All antimicrobial treatments reduced the pathogens on the trim inoculated with the lower inoculation dose to non-detectable numbers in the trim and in the ground beef. There were significant reductions of both pathogens in the trim and in the ground beef inoculated with the high inoculation doses. On the trim itself, *E. coli* O157:H7 and *Salmonella Typhimurium* were reduced by 1.5 to 2.0 log cycles, with no differences among all treatments. In the ground beef, the organic acids were more effective in reducing both pathogens than the acidified sodium chlorite immediately after grinding, but after 1 day of storage, there were no differences among treatments. Overall, in the ground beef, there was a 2.5-log reduction of *E. coli* O157:H7 and a 1.5-log reduction of *Salmonella Typhimurium* that was sustained over time in refrigerated and frozen storage. Very few sensory dif-

ferences between the control samples and the treated samples were detected by a consumer panel. (Harris, 2006)

In a similar study we compared the effectiveness of two application methods (dip *versus* spray) of 4.4% lactic acid for reducing pathogens on inoculated beef trim and in ground beef. Beef trim inoculated with cocktail mixtures of *E. coli* O157:H7, non-O157 Shiga toxigenic *E. coli* (STEC), or *Salmonella* (10^5 to 10^6 CFU/g) at separate times was subjected to five treatments: lactic acid spray (LS), lactic acid dip (LD), water spray (WS), water dip (WD), and untreated control (CTL). The dip treatment reduced all pathogens significantly ($P < 0.05$); *E. coli* O157:H7 was reduced by 0.91 to 1.41 log CFU/g on beef trim and ground beef, non-O157 STEC by 0.48 to 0.82 log CFU/g, and *Salmonella* by 0.51 to 0.81 log CFU/g. (Wulf, *et al.,* 2012)

While the use of interventions is prevalent in the beef industry, mechanical interventions are also valuable. I have also been involved in the development of a spin-off company of Texas Tech University, MicroZap which is a technology company which has several U.S. and international patents on a process that utilizes the use of microwaves in unique configurations to solve a number of world problems including killing of MRSA (*Methicillin* resistant *Staphlococcus aureus*) (Laury, *et al.,* 2011), pasteurizing eggs (Lakins, *et al.,* 2008, 2009), improving water safety for third world countries and extending the shelf-life of bread by eliminating the molds thus decreasing food waste (Lakins, *et al.,* 2008). The current goal of the use of the MicroZap system is to kill *Salmonella* in peanut butter. Overall, the microwave technology uses radio waves in the microwave spectrum in a novel and controlled process to reduce pathogens in foods without damaging the food. Pathogens and other microorganisms are killed without cooking the food when the microwaves are properly applied because in addition to the killing action of the temperature itself, the energy generated from the microwaves also cause a non-thermal killing effect which allows treatment at lower temperatures than simply using temperature alone.

The MicroZap system kills of *Salmonella* on peanuts (Laury, *et al.,* 2011) and we found that 99% of the *Salmonella* was killed on the surface of the raw peanuts after treatment in the MicroZap chamber. We can also achieve a 3 log reduction (99.5%) of *Salmonella* in peanut butter in the jars. The use of the MicroZap system was highlighted by the BBC in 2012 and there are many potential applications of the technology with the reduction of *Salmonella* in peanut butter being at the top of the list. The specific production parameters of the technology must be optimized to kill pathogens and also to preserve the quality of the food itself.

Safety of Imported Products and Food Security

Much food safety research in our program has focused on improving food safety and security in Latin America and the Caribbean. Foodborne diarrheal illness is the number one cause of death in children under five in Mexico. This is a preventable problem as the key need is education. We do not need a new technology, we need to educate the industry and consumers on proper food handing. Currently we have active projects in Mexico, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Bahamas, the Dominican Republic and Haiti. The bulk of the work is in Mexico, Honduras and the Bahamas. In our international program efforts, we have developed relationships and partnerships to improve food safety, security and public health through research and education. Our goals are to improve technical knowledge, share research innovations across borders, invest in international development of third world countries and to increase market access for U.S. industries.

Of key importance is the validation of the safety of products from plants that export to product to the U.S. We have conducted validation studies in beef slaughter plants in Mexico, Honduras, Nicaragua and Costa Rica to validate the efficacy of the process with regard to *Salmonella* and STEC contamination. This was of key importance to the U.S. industry and to the company. In a Honduran beef plant that exported product to the U.S., the total *Salmonella* detected on hides was 17.5%, pre-evisceration carcasses contained 6.7% samples that were positive while there were none found on the final carcass (Maradiaga, *et al.,* 2015). In Mexico, we evaluated both *Salmonella* and *E. coli* O157:H7 prevalence during beef harvest. With regards to *Salmonella,* the hides were 80% positive, the pre-evisceration carcasses had 15% of the samples positive for *Salmonella* while none of the samples from the cooler were positive. In the same facility in Mexico, 6% of the hides were positive for *E. coli* O157:H7 while none of the carcass samples at any sampling point were positive. The study was repeated in Nicaragua where 90% of the hide samples tested positive for *Salmonella* and none of the carcass samples were positive for the pathogen. We tested the prevalence of the non-O157:H7 O groups from the hide samples in Honduras and Nicaragua and found the majority were O26, O131 and O45. A similar trend was found in plants that export product to the U.S. in Costa Rica. The focus of this study was non-O157:H7 STECS. The hides were up to 96% positive, but very

little pathogen contamination was found on the final carcasses with only two of 90 testing positive. The prevalent O groups were O103 and O45. In all inspected facilities that export beef to the U.S. and are overseen by FSIS oversight, the prevalence of pathogens is very low and equivalent to the U.S. pathogen baselines. The FSIS oversight in these countries is working to prevent public health hazards.

In contrast, we also observed facilities and products from facilities that were not subjected to U.S. equivalency rules. These facilities are in desperate need of educational efforts. *Salmonella* prevalence in some of the facilities was up to 100% and poor dressing procedures were observed. These numbers correlated to high *Salmonella* prevalence in market samples with 80% being positive. Unfortunately, these markets serve the poorest, most vulnerable populations and there is a need to protect public health in these areas.

Communication and Outreach to Industry

Capacity Building

In the fall of 2012, we received a capacity building grant from the USDA–NIFA Non-Land Grant Capacity Building (NLGCB) program in the amount of $690,000. This money was leveraged for an equipment donation from the Pall Corporation for an additional $150,000. The title of this project is "Building Laboratory and Intellectual Capacity in order to Effectively Detect and Reduce *Salmonella* in the Food Supply." While much attention and funding has been directed at STEC detection and reduction in recent years, universities along the Southwest corridor are severely lacking in the equipment, knowledge and human capacity to effectively detect and mitigate *Salmonella* in foods, especially in the small ruminants and fresh fruits and vegetables that account for much of Hispanic diet in this region of the U.S.

This program was built on three underlying needs. First, non-land-grant universities such as Texas Tech have limited resources available to build research and educational capacity. Second, teams of scientists who can work to solve this issue must have the scientific skills to work in the laboratory and field, but must also have the relational skills to work effectively within multidisciplinary teams, and third, faculty teaching must constantly evolve and improve to meet the changing needs of the industry. In order to effectively address these three needs, our team proposed a multidisciplinary approach to efficiently meet four objectives.

Our first objective deals with our ability to build human capital in all STEM fields related to this problem of detecting and mitigating *Salmonella* in the food supply. In order to identify high-ability undergraduate students who would work in the U.S. and in Latin America, we created the SOWER Scholar program. SOWER stands for Sustaining our World through Education and Research. The concept is to recruit, train and return students to countries where their academic preparation and directly affect food production. In conjunction with partnering universities, we have hosted 35 students from Zamorano University in Honduras. This USAID agricultural school recruits the best undergraduates from Latin American countries and trains them in agriculture. During their final year, they are required to complete an internship. We take 10–20 students each spring and match them with a faculty member for an intense 4 month program. They range from food safety, meat science, soil and plant science, communications, economics and human nutrition. This program is design to improve English speaking and writing, research skills, laboratory skills as well as identify which of these students are best equipped to return in for graduate programs. We currently have nine graduate students who have come through this program and it continues to grow as we hosted 30 undergraduate interns this summer and have another 35 coming this fall for short-term experiences.

Our second objective focuses on developing those graduate students to be change agents by equipping them with the knowledge, skills and abilities to dramatically impact the region from a food security perspective. While technical skills are a necessity and can be provided in many universities, we wanted to go beyond the traditional technical training to produce students with the ability and the passion to have positive impacts in agriculture. We exceeded our grant activities of providing limited distance resources and created a graduate certificate in Global Food Security that can be delivered on campus or at a distance. This certificate includes two all-new introductory courses in food security and four tracks that allow a student to specialize their educational experience. These tracks align with the U.N.'s Pillars of Food Security: Access, Availability, Stability and Utilization. Our track areas within these pillars include Production, Food Safety, Human Nutrition and Program Development and Analysis. This graduate certificate has been approved at all levels at Texas Tech and is waiting on approval from the Texas Higher Education Coordinating Board, which we expect in October. When this program launches in January, we expect 30+ graduate students from Texas Tech University, San Angelo State and California State University—Fresno to make up the first cohort.

In addition to our two southwest regional partners, we have formed relationships with multiple universities and industry groups throughout the U.S. and Latin America. Our faculty continues to expand their knowledge and understanding of their role in improving food safety through training and professional development opportunities. Through the course of installing new equipment in laboratories at San Angelo State and CSU—Fresno, we have trained multiple faculty members and students on proper sampling and testing techniques. These training opportunities have also led to the expansion of our understanding of the breadth of the problem within the small ruminant population. Over a 14 month period samples were collected to determine a microbial prevalence for sheep and goats. Fecal samples were collected from the Bahamas, Mexico, Texas, New Mexico and California from abattoirs and farm locations. Fecal samples from small-ruminants were found to have 14.02% *Salmonella* prevalence (N=535), 15.30% *Escherichia coli* O157 prevalence (N=477) and 80.68% *Campylobacter* prevalence (N=176). Retail samples collected from the Bahamas and U.S. were found to have a *Salmonella* prevalence of 16.98% (N=106). This analysis was conducted and completed by students and faculty using skills and equipment that only exist as a result of this grant project.

Finally, this project has helped forge permanent collaborative partnerships at two levels. We have created horizontal connections focused on research, education and international experiences between the three universities in the southwest U.S. and better equipped them to detect and reduce *Salmonella* in the U.S. food supply. We have also created a wealth of vertical connections between our faculty and international partners in universities, government agencies and industry. The U.S. food supply is safer today because of the actions of this grant project that it would have been otherwise, but far more work is needed to protect consumers as markets continue to expand and globalize.

Consumer Education through the Media

There is a strong effort to communicate our findings to our stakeholders, we hold food safety workshops for stakeholders (cattle producers, food industry, consumers), have a website (*www.icfie.co*) and participate in dozens of industry conferences each year. It is important for scientists like myself and our team to help consumers understand the safeguards in place and their role in food safety. I'm finding more scientists like myself engaging with social media to provide clarity to consumers. I personally have a site on social media (The Food Doctor) which can be found on Facebook where I provide science-based information for the public. I recently appeared on the Today Show to negate negative information that was conveyed in a Consumer Reports article about the beef industry. It is important for consumers to have a readily-available science-based source of information in order to make informed decisions about agriculture.

In summary, investments in research and education save lives. There is a need to address food safety issues in the U.S. and globally to improve the quality of life and protect public health for our population. Funding is the key to develop new technologies to control emerging pathogens and to communicate science-based information to the consumer.

1. Ajayi, O., L.L. Williams, J. Oluwoy, J.U. Johnson, F. Okafor, O-G. Sanders, and T. Wilson. 2011. *Epidemiological Approaches to Food Safety.* FOOD PROTECTION TRENDS. 31, 560–568.

2. Berrry, E. and J.E. Wells. 2010. ***Escherichia coli*** *O157:H7: Recent Advances in Research on Occurrence, Transmission, and Control in Cattle and the Production Environment.* ADVANCES IN FOOD AND NUTRITION RESEARCH. 60, 67–117.

3. Brashears, M.M., M.L. Galyean, G.H. Loneragan, J.E., Mann, and K. Killinger-Mann. 2003. *Prevalence of* ***Escherichia coli*** *O157:H7 and performance by beef feedlot cattle given* ***Lactobacillus*** *direct-fed microbials.* JOURNAL OF FOOD PROTECTION. 66, 748–754.

4. Callaway, T.R., M.A. Carr, T.S. Edrington, R.C. Anderson, D.J. Nesbit. 2009. Diet, ***Escherichia coli*** *O157:H7, and Cattle: A Review After 10 Years.* CURRENT ISSUES IN MOLECULAR BIOLOGY. 11, 67–80.

5. Centers for Disease Control and Prevention (CDC). 2015. *Surveillance for Foodborne Disease Outbreaks,* United States, 2013, Annual Report. Available online at *http://www.cdc.gov/foodsafety/pdfs/foodborne-disease-outbreaks-annual-report-2013-508c.pdf.* Accessed on 09/23/2015

6. Chaves, B.D., A. Echeverry, L.G. Garcia, M.T. Brashears, M.F. Miller, and M.M. Brashears. 2015. *Seasonal prevalence of potentially positive non-O157 Shiga toxin-producing* ***Escherichia coli*** *(STEC) bovine hides and carcasses in Costa Rica.* MEAT SCIENCE. 110, 196–200.

7. Chaves, B.D., M.F. Miller, M. Maradiaga, M.A. Calle, L. Thompson, S.P. Jackson, T. Jackson, L.G. Garcia, A. Echeverry, H. Ruiz, and M.M. Brashears. 2013. *Evaluation of process control to prevent contamination of beef with non-O157 Shiga toxin-producing* ***Escherichia coli*** *(STEC) in U.S. export abattoirs in Honduras and Nicaragua.* FOOD PROTECTION TRENDS, 33(4):224–230.

8. Crim, S., M. Iwamoto, J.Y. Huang, P.M. Griffin, D. Gilliss, A.B. Cronquist, M. Cartter, M. Tobin-D'Angelo, D. Blythe, K. Smith, *et al.,* 2014. *Incidence and Trends of Infection with Pathogens Transmitted Commonly Through Food—Foodborne Diseases Active Surveillance Network, 10 U.S. Sites, 2006–2013.* MMWR. 63, 328–332.

9. Doores, S. 1999. *Food Safety: Current Status and Future Needs.* American Academy of Microbiology. Washington D.C. On-line version accessed on 03.06.15 at *http://academy.asm.org/index.php/food-microbiology/437-food-safety-current-status-and-future-needs.*

10. Echeverry, A., J.C. Brooks, M.F. Miller, J.A. Collins, G.H. Loneragan, and M.M. Brashears. 2009. *Validation of Intervention Strategies to Control* ***Escherichia coli*** *O157:H7 and* ***Salmonella Typhimurium*** *DT 104 in Mechanically Tenderized and Brine Enhanced Beef.* JOURNAL OF FOOD PROTECTION. 72, 1616–1623.

11. Echeverry, J.C. Brooks, M.F. Miller, J.A. Collins, G.H. Loneragan, and M.M. Brashears. 2010. V*alidation Of Lactic Acid Bacteria, Lactic Acid, And Acidified Sodium Chlorite As Decontaminating Interventions To Control* ***Escherichia coli*** *O157:H7 And* ***Salmonella Typhimurium*** *DT 104 In Mechanically Tenderized And Brine Enhanced (Non-Intact) Beef At The Purveyor.* JOURNAL OF FOOD PROTECTION. 73, 2169–2179.

12. Gragg, S.E., G.H. Loneragan, M.M. Brashears, T.M. Arthur, J.M. Bosilevac, N. Kalchayanand, R. Wang, J.W. Schmidt, J.C. Brooks, S.D. Shackelford, T.L. Wheeler, T.R. Brown, T.S. Edrington, and D.M. Brichta-Harhay. 2013. *Cross-sectional Study Examining* ***Salmonella enterica*** *Carriage in Subiliac Lymph Nodes of Cull and Feedlot Cattle at Harvest.* FOODBORNE PATHOGENS AND DISEASE. 10, 368–374.

13. Harris, K., M.F. Miller, G.H. Loneragan, and M.M. Brashears. 2006. *Validation of the Use of Organic Acids and Acidifed Sodium Chlorite To Reduce* ***Escherichia coli*** *O157 and* ***Salmonella Typhimurium*** *in Beef Trim and Ground Beef in a Simulated Processing Environment.* JOURNAL OF FOOD PROTECTION. 69, 1802–1807.

14. Hoffmann, S.B. Maculloch, and M. Batz. 2015. *Economic Burden of Major Foodborne Illnesses Acquired in the United States.* United States Department of Agriculture Economic Research Service. Available online at *http://www.ers.usda.gov/media/1837791/eib140.pdf*. Accessed on 09/23/2015.

15. Lakins, D., A. Echeverry, C.Z. Alvarado, J.C. Brooks, M.T. Brashears, and M.M. Brashears 2008. *Quality and Mold Growth on White Enriched Bread for Military Rations Following Directional Microwave Treatment.* JOURNAL OF FOOD SCIENCE. 73, 99–103.

16. Lakins, D., C.Z. Alvarado, L.D. Thompson, M.T. Brashears, J.C. Brooks, and M.M. Brashears. 2008. *Reduction of* ***Salmonella Enteritidis*** *in Shell Eggs Using Directional Microwave Technology.* POULTRY SCIENCE. 87, 985–991.

17. Laury A.M., K. Fermin, D. Stull, A. Neuber, J.C. Brooks, M.T. Brashears, C. Alvarado, and M.M. Brashears. 2011. *Reduction of Methicillin-resistant* ***Staphylococcus aureus*** *(MRSA) on towels utilizing targeted directional microwave technology.* 111th General Meeting of the American Society for Microbiology, May 21–24, New Orleans, LA.

18. Laury A.M., K. Fermin, D. Stull, A. Neuber, J.C. Brooks, M.T. Brashears, C. Alvarado, and M.M. Brashears. 2011. *Re-distribution of* ***Methicillin****-resistant* ***Staphylococcus aureus*** *(MRSA) during the laundering of cotton towels.* 111th General Meeting of the American Society for Microbiology, May 21–24, New Orleans, LA.

19. Loneragan, G.H. and M.M. Brashears. 2005. *Pre-harvest interventions to reduce carriage of* ***E. coli*** *O157 by harvest-ready feedlot cattle.* MEAT SCIENCE. 71, 72–78.

20. Mangen, M.-J., M.B. Batz, A. Kasboher, T. Hald, J.G. Morris, M. Taylor, A. Havelaar. I2010. *Integrated Approaches for the Public Health Prioritization of Foodborne and Zoonotic Pathogens.* RISK ANALYSIS. 30, 782–787.

21. Maradiaga, M., M.F. Miller, L. Thompson, A. Pond, S.E. Gragg, A. Echeverry, L.G. Garcia, G.H. Loneragan, and M.M. Brashears. 2013. ***Salmonella*** *in Retail Beef and Produce from Honduras and Mexico.* Submitted to the INTERNATIONAL JOURNAL OF FOOD MICROBIOLOGY (In Review). JOURNAL OF FOOD PROTECTION. 3, 498–502.

22. Narvaez-Bravo, C., M.F. Miller, T. Jackson, S. Jackson, A. Rodas-Gonzalez, K. Pond, A. Echeverry, and M.M. Brashears. 2013. ***Salmonella*** *and* ***Escherichia coli*** *O157:H7 Prevalence in Cattle and on Carcasses in a Vertically Integrated Feedlot and Harvest Plant in Mexico.* JOURNAL OF FOOD PROTECTION. 76, 786–795.

23. Sargeant, J.M., M.R. Amezcua, A. Rajic and L. Waddell. 2007. *Pre-harvest interventions to reduce the shedding of* ***E. coli*** *O157 in the faeces of weaned domestic ruminants: a systematic review.* ZOONOSES AND PUBLIC HEALTH. 54, 260–277.

24. Scallan E., Hoekstra R.M., Angulo F.J., Tauxe R.V., Widdowson M.-A., Roy S.L., *et al.,* 2011. *Foodborne illness acquired in the United States—major pathogens.* EMERGING INFECTIOUS DISEASES. 17, 7–15.

25. Stephens, T.P., G.H. Loneragan, E. Karunasena, and M.M. Brashears. 2007a. *Reduction of* ***Escherichia coli*** *O157 and* ***Salmonella*** *in feces and on hides of feedlot cattle using various doses of a direct-fed microbial.* JOURNAL OF FOOD PROTECTION. 70, 2386–2391.

26. Stephens, T.P., G.H. Loneragan, L.M. Chichester, and M.M. Brashears. 2007b. *Prevalence and enumeration of* ***Escherichia coli*** *O157 in steers receiving various strains of* ***Lactobacillus****-based direct-fed microbials.* JOURNAL OF FOOD PROTECTION. 70, 1252–1255.

27. Vipham, J.L., G.H. Loneragan, L.M. Guillen, J.C. Brooks, B.J. Johnson, A. Pond, N. Pond, and M.M. Brashears. 2015. *Reduced Burden of* ***Salmonella enterica*** *in Bovine Subiliac Lymph Nodes Associated with Administration of a Direct-fed Microbial.* ZOONOSES AND PUBLIC HEALTH. Article first published online: 17 MAR 2015. DOI: 10.1111/zph.12187

28. Wolf, M.J., M.F. Miller, A.R. Parks, G.H. Loneragan, A.J. Garmyn, L.D. Thompson, A. Echeverry, and M.M. Brashears. 2012. *Validation Comparing the Effectiveness of a Lactic Acid Dip with a Lactic Acid Spray for Reducing* ***Escherichia coli*** *O157:H7,* ***Salmonella,*** *and Non-O157 Shiga Toxigenic* ***Escherichia coli*** *on Beef Trim and Ground Beef.* JOURNAL OF FOOD PROTECTION. 75, 1968–1973.

29. Younts-Dahl, S.M., G.D. Osborn, M.L. Galyean, D.J. Rivera, G.H. Loneragan, and M.M. Brashears. 2005. *Reduction of* ***Escherichia coli*** *O157 in finishing beef cattle by various doses of* ***Lactobacillus.*** JOURNAL OF FOOD PROTECTION. 68, 6–10.

30. Younts-Dahl, S.M., M.L. Galyean, G.H. Loneragan, N.A., Elam, and M.M. Brashears. 2004. *Dietary supplementation with* ***Lactobacillus- and Propionibacterium****-based direct-fed microbials and prevalence of* ***Escherichia coli*** *O157 in beef feedlot cattle and on hides at harvest.* JOURNAL OF FOOD PROTECTION. 67, 889–893.

The CHAIRMAN. Thank you, Dr. Brashears.

Dr. Heithaus.

STATEMENT OF MICHAEL R. HEITHAUS, PH.D., ASSOCIATE DEAN, COLLEGE OF ARTS AND SCIENCES, FLORIDA INTERNATIONAL UNIVERSITY; EXECUTIVE DIRECTOR, SCHOOL OF ENVIRONMENT, ARTS AND SOCIETY, NORTH MIAMI, FL

Dr. HEITHAUS. Thank you. Chairman Davis, Ranking Member DelBene, Members of the Committee, especially our Florida friends, Congressman Yoho and Congresswoman Graham. It is an honor to be here to discuss some of the innovations advanced at Florida International University aimed at enhancing agricultural science and research nationwide.

FIU is Miami's only public research university, and is the fourth largest university in the country, enrolling 55,000 students and conducting over $130 million of research every year. We see FIU as a national resource for agricultural research at the USDA, who hired 50 of our grads last year.

Together with the state's land-grant institution, University of Florida, and Miami-Dade County's agricultural office, led by Charles Laprad, FIU is helping address three major agricultural crises in our service area, whose ag industry employs over 20,000 people, and produced more than $2.7 billion in economic impact each year for the county. So these risks to our subtropical and tropical crops and ornamentals include exotic pests and disease, like citrus greening and laurel wilt that are being introduced into the U.S. at alarming rates. They have cost Miami-Dade County billions of dollars in treatment, eradication programs, and lost revenue. Local weather patterns and climate are shifting, and it is going to affect the crops we can grow and threatens food security. This is compounded with the water management challenges to ensure that we balance the needs of urban, agricultural, and natural systems. Finally, agriculture is an industry with an aging workforce. We have to find ways to bring in more young people and to diversify.

I would like to share some thoughts on the unique ability of our country's Hispanic-serving agricultural colleges and universities, or HSACUs, of which there are 80 countrywide, to accelerate research and better complement the extension and teaching of our land-grants. In many ways, the collaboration and complementary roles played by FIU and UF are a metaphor for the future collaboration with HSACUs and what it should look like. As we see in Miami-Dade County, these agricultural challenges are too important to leave to a single institution. As a testament to FIU's efforts, it was one of the first universities in the nation to receive USDA's HSACU designation. And although FIU faculty staff and students are helping to address the challenges I mentioned previously, Federal partnerships and competitive funding are critical to ensuring that we maximize our impact.

I would like to highlight four of our impact areas. First, we are helping to develop more resilient crops. Our researchers are working with collaborators to develop new crop varieties like chickpeas, lentils, and mangos that are more resilient to changes in climate. The wild relatives of our domesticated crops are better able to survive variation in growing conditions like droughts or too much rainfall. By using cutting-edge genetic techniques, we can incorporate that hardiness of the wild relatives of the crops, while maintaining the benefits of the domestic varieties.

We are also helping to combat invasive pests. The aggressive Asian Redbay Ambrosia Beetle has Florida's multimillion dollar avocado industry in limbo. The insect spreads laurel wilt, which is deadly to avocado trees. And our researchers, led by our Provost, Dr. Ken Furton, have developed a unique detection program called Detector Canines that couples drone technology and canine scent detection. And this is a really important approach because it holds promise for detecting emerging diseases before they become so widespread that the cost of combating them just becomes crippling to an industry.

We are also working with the University of Florida to build an agribusiness incubator that will help generate high-tech solutions, and add value to raw agricultural products that will help overcome food waste challenges, while stimulating further economic activity.

Finally, we are training the next generation of farmers, particularly from underrepresented groups. The FIU Agroecology Program, with its partners, has trained hundreds of students and developed a veteran and small farmer training program.

So what is the future of our nation's Hispanic-serving institutions in agriculture? Congress and USDA have made important strides to engage with the greater Hispanic-serving community, and particularly the heavy lift by the National Institute on Food and Agriculture, and several of its leaders like Director Ramaswamy and Drs. Qureshi and Lawrence.

There are lots of examples with direct impact, but there are two thoughts on specific policy challenges. First, we have to build capacity at HSIs through the HSACU programs. Post-secondary Hispanic students are now enrolled mostly at HSIs, with over 60 percent of Hispanics nationwide at these institutions. Hispanics represent 50 percent of all farm laborers and supervisors, but only three percent of doctoral recipients in the biological agricultural and life sciences. So we are leaving a ton of talent untapped, and we have not funded any of the programs authorized in 2008 for the HSACU.

Second, we need to incorporate the Hispanic-serving institutions into the land-grant ecosystem. As UF and FIU have proven, collaboration between a land-grant and an HSI is a win for all involved. We need much more such collaborations around the country, and ways to incentivize better collaboration. There is tremendous opportunity in the future, and FIU looks forward to working with Congress and the USDA to accelerate agricultural research, extension, and teaching.

Thank you very much.

[The prepared statement of Dr. Heithaus follows:]

PREPARED STATEMENT OF MICHAEL R. HEITHAUS, PH.D., ASSOCIATE DEAN, COLLEGE OF ARTS AND SCIENCES, FLORIDA INTERNATIONAL UNIVERSITY; EXECUTIVE DIRECTOR, SCHOOL OF ENVIRONMENT, ARTS AND SOCIETY, NORTH MIAMI, FL

Part 1: Innovations in Research and Training Provided by a Member of the Hispanic-Serving Agricultural Colleges and Universities

Florida International University (FIU), Miami's only public research university, is finding solutions to some of the most challenging problems of our time. As the 4th largest university in the country, and the largest Hispanic-serving university in the United States, FIU enrolls more than 55,000 students and conducts over $132 million in research expenditures every year. FIU is an anchor institution in South Florida contributing $8.9 billion each year to the local economy.

FIU has been aggressively building agriculture and food-related research to complement and expand the local capacity offered by the state's Land Grant Institution, University of Florida. As testament to FIU's efforts in agricultural education and research, it was one of the first universities in the nation to receive the USDA's Hispanic-Serving Agricultural Colleges and Universities (HSACU) designation.

FIU is the largest producer of STEM degrees for Hispanics in the U.S. It is ranked as a top institution in the United States for granting bachelor's and master's degrees to Hispanics, with more than 60 percent of the university's 55,000 students coming from Hispanic populations. In 2013, FIU had the largest percentage of minority students in the U.S. with 61 percent Hispanics and 13 percent African-Americans.

Hispanic students graduating from FIU Environmental Studies, Sustainability, Dietetics and Nutrition, Biological Sciences have joined U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS), Natural Resources Conservation Service (NRCS) and other agencies. Hispanic and other minority students graduating from FIU have joined graduate programs in some of the nation's prestigious agriculture and forestry institutes.

FIU sees itself as a Solutions Center for the community—both locally and nationally. Our commitment to this mission is evident in our collaborative efforts to help solve the challenges of the agricultural industry in Miami-Dade County, one of the most diverse in the country. This important sector employs over 20,000 people and produces more than $2.7 billion in economic impact each year.

The industry includes many subtropical and tropical crops that can't be grown anywhere else in the United States; additionally, a large ornamental industry leverages our local climate. But the agricultural industry faces accelerating and unprecedented challenges which require innovative research, policy changes, and targeted training of the next generation for the agriculture industry. For example,

- Exotic pests and disease are being introduced into the U.S. at startling rates. These introductions, like citrus greening, emerald ash borer, Asian Long Horned Beetle, Redbay Ambrosia beetle and fruit flies, have cost Miami-Dade county billions of dollars in treatment, eradication programs and lost revenue.
- Local weather patterns and climate are shifting and will affect the crops we can grow and threaten food security. Rainfall and temperature are predicted to shift. For example, although predicting future changes in rainfall is one of the harder challenges of global climate models to resolve at the regional level, we expect shifts in the wet season to cooler times of year, which will increase heat stress to crops during the dry season. This is compounded with challenges in managing water to balance needs for urban, agricultural, and natural systems. In addition, sea level rise threatens to impact ground water and agricultural production.
- In south Florida, we also face a challenge in food waste. A large portion of some crops, although edible, is discarded because of imperfections. Changes in regulations regarding how this waste can be used or disposed of represents a difficulty—but also an opportunity—for the local community.
- Finally, agriculture is an industry with an aging workforce. We need to find ways to bring more young people into the industry and to diversify. Florida also has a large population of socially disadvantaged farmers. In a region with 20,000 unemployed veterans and nearly 44,000 migrant farmworkers, it's critical to work with the community to equip these individuals with technical and entrepreneurial skills, and access to government assistance which enables them to launch and sustain viable farm operations.

FIU faculty, staff and students are helping to address these challenges. The examples below show how Hispanic-Serving Agricultural Colleges and Universities can add to the expertise in our nation's Land Grant Institutions.

Developing More Resilient Crops

As part of the International Center for Tropical Botany (ICTB), Dr. Eric Bishop von Wettberg is working with collaborators around the country and world to develop new varieties of crops that are more resilient to changes in climate. The wild relatives of many of our crops are better able to survive variation in growing conditions including droughts or periods of excessive rainfall. Using cutting-edge genetic techniques, research teams can breed new varieties that retain positive the qualities of domestic crops that incorporate the hardiness of wild plants. Currently, Dr. von Wettberg works on chickpeas, lentils, and mangoes. But, this approach holds promise for many other crop species growing in areas that—like south Florida—will face large changes in weather and climate. This innovative approach to developing the next generation of crops also holds promise for responding to emerging diseases.

Combating Invasive Pests

The aggressive Asian Redbay Ambrosia Beetle currently has Florida's multi-million dollar avocado industry in limbo. The insect spreads laurel wilt, a disease so deadly that growers in affected areas can't ship or move any fruits or plants for fear that it could spread to other susceptible crops, potentially affecting 430 different fruits, vegetables and nuts (95 percent of the fruits and vegetables in the county).

Detection is a major challenge. Diseased trees can begin to wilt within 2 weeks, and by the time symptoms are visible, the fungus has likely spread to nearby trees. This is a particular problem in commercial groves, where trees are planted close together.

Florida International University researchers, funded by the Florida Department of Agriculture and Consumer Services, have developed a unique detection program, **Detector Canines,** which could have far-reaching applications for the agriculture industry.

This program, led by FIU Provost and Executive Vice President Kenneth G. Furton and Biological Sciences Professor DeEtta Mills couples drone surveillance with canine scent detection:

- Drones carry spectral thermal digital imaging instruments that search for stressed trees before symptoms are visible.
- Canines, which have up to 50 times more olfactory receptors than humans and can be hundreds to thousands of times more sensitive to detecting odors, have successfully identified infected trees that were not yet showing symptoms.
- DNA tests confirm that the dogs are able to detect the pathogen much earlier than any other method.
- Trees that are detected early can be given an infusion or injection of the fungicide "Tilt" to significantly increase their chances of survival.

To date, 85% of the pre-symptomatic trees identified have been saved and will continue to produce safe fruit for harvest. This is a stark contrast with 100% death rate of trees that are not detected early. The fungicide treatment is expensive but it protects the tree for 12 to 18 months. Waiting until symptoms appear jeopardizes not only the affected tree, but the entire grove. Prior to the development of this method, the main treatment method was removal of diseased trees and any surrounding trees.

More than 6,000 of Miami's 74,000 avocado trees have been destroyed due to laurel wilt. This isn't just a Florida problem. From California to Latin America, there are growing concerns about how to respond to this aggressive disease. The spread of infestation has already reached Texas in its march along the Gulf Coast. With the potential to spread into California, whose industry is ten times that of Florida, and Mexico, who produces 100 times that of south Florida, the impact could be devastating to growers and consumers around the world.

The approach pioneered at FIU holds promise for the early detection of emerging diseases so we can respond before they become so entrenched that the costs of treatment are crippling.

Adding Value

Adding value to the raw products grown by the agricultural industry in critical to the long term success of the community. Value-added products—like new foods, soaps, oils, supplements or medicines—provide avenues for reducing food waste, will create jobs, and enhance the local economy.

FIU has been a long-time academic collaborator with the University of Florida, and in 2013 entered a partnership to develop an Agribusiness Incubator. The concept was developed at the request of agricultural stakeholders in the Redland.

The agribusiness innovation center will:

- Improve agricultural products.
- Enter new markets and develop products.
- Provide market opportunities and information.
- Teach financial management skills and access to financing, technical information and training, and mentorship.
- Assist with regulations, standards and compliance.

Miami-Dade county commissioners have decided to unanimously seek state funding to support the Agribusiness Incubator, which will include:

- a biotechnology production facility with specialized clean labs including a contemporary tissue culture facility.
- a technology production facility with high quality infrastructure to accommodate flexibility in space uses such as moveable walls, a loading dock, and a "brainstorming room" that will be available for meetings on a regular basis for scientists, entrepreneurs and others to exchange ideas and concepts for forming new agribusinesses.
- a Food Venture Center that will be a high-technology service laboratory that contains numerous pieces of equipment that will assist new businesses in product development.

This facility will be staffed by highly trained technicians who will guide and direct adjustments needed in refining various value-added oil, drinks, medicines, *etc.* FIU will be the lead institution for the Food Venture Center, and STEM students will be intimately involved in the work conducted there as well as in labs at the Incubator.

The Agribusiness Incubator is estimated to generate $45 in local taxes for every dollar invested and have incubated business conducting $17M of business per year after 5 years. In addition, a new FIU Kitchen Lab will improve the well-being of under-served communities, including low income immigrant food entrepreneurs. They will be able to formalize and grow their businesses through affordable commercial kitchen space, industry-specific technical assistance and access to new market opportunities. The Kitchen Lab will provide opportunities to link new products to local restaurants and grocery stores. It will also provide a storefront for innovative new products, making it a focal point for visitors and a gateway to agritourism in South Dade.

Planning for the Future

An increasingly proactive approach to plantings is critical to the long-term sustainability of the industry in light of the myriad challenges outlined earlier. FIU's International Center for Tropical Botany—a collaboration with the National Tropical Botanic Garden—is working to not only enhance the genetic diversity of crops but to predict where crops will grow best in the future, what new crops or plants might be better adapted to future conditions, and combinations of plants that can be grown together to reduce unpredictability in economic yield for farmers and reduce susceptibility to pests and extreme weather.

K–12 Outreach and Workforce Pipeline

The FIU Agroecology Program has developed an institutional alliance with area USDA ARS, Miami-Dade County Public Schools, Miami Dade College (another HSI), local non-governmental agriculture research organizations, in addition to several organic farms.

Through FIU's organic garden, designated a USDA People's Garden in 2011, the Agroecology program conducts hands-on learning activities for over 500 K–12 students each year and hosts summer workshops for K–12 teachers. Organic garden activities draw students from disciplines across the University and throughout the community.

This training creates a pipeline for future recruitment of minority students into higher agriscience related education. Through summer internships at FIU, high school students get hands-on experience in agriculture and related sciences.

FIU researchers serve on the Miami-Dade County Public Schools Agriculture and Related Science Committee. Routine visits are conducted at area high schools to recruit minority students into agriculture and related sciences at FIU. These students participate in annual symposia, workshops, and conferences on agriculture and related sciences.

By thoughtfully incorporating Hispanic-Serving institutions into the network of Land-Grant and Extension centers, the USDA has added to their agricultural and environmental research, education, and outreach mission. Some examples of FIU education and training programs complementing our partner Land Grant include:

- Since 2005, the USDA has provided over $7 million in funding to the FIU **Agroecology Program** to support undergraduate and graduate student training and research on a wide range of topics related to agriculture and natural resources. The program has trained more than 500 students, with more than 40 going on to jobs at USDA or prestigious agriculture programs for graduate studies.
- The **Veteran and Small Farmers Outreach Program** is designed for military veterans, socially disadvantaged and beginner farmers, and nursery growers. The collaboration between FIU, community partners and the Dade County Farm Bureau is made possible by a grant from the U.S. Department of Agriculture's Office of Advocacy and Outreach, This program, lauded before Congress this past summer by U.S. Representative Carlos Curbelo, assists participants in learning technical skills through hands-on activities with tropical fruits, vegetables and nursery plants, beekeeping, composting, and disease management. Their training culminates with a farming apprenticeship at a local farm or nursery operation.
- The **Florida-Caribbean Consortium for Agriculture Education and Hispanic Workforce Development (FCCAgE),** led by FIU and in collaboration with Miami Dade College—North, St. Thomas University, and Universidad Interamericana de Puerto Rico, recruits and trains Hispanic students from communities that are under-represented in agriculture sciences and natural resource management. The multi-institutional consortium is funded by the USDA Hispanic Serving Institutions Grants Program and supports student travel, research, professional development workshops, summer internships, and job

placement. FIU, along with FCCAgE partners Over 80 students have benefited from internships since its inception.

Part 2: The Future of University Partnerships To Accelerate Agriculture Research, Extension and Teaching

In exploring opportunities for Congress and the United States Department of Agriculture to further accelerate the nation's agricultural research, extension and teaching priorities, it is important to consider the policy challenges facing the university research community.

Adequate support for agricultural research is critically important, especially as the community aims towards greater sustainability in the food production chain and an increasing need to respond rapidly to major challenges from introduced pests, shifting growing conditions, and economic volatility. In addition to leveraging Federal research dollars, universities must also increase the direct relationships with industry and commodity groups in helping fund cutting-edge research, even beyond any one particular commodity. And of course, maintaining well-funded, viable, long-term research programs engages undergraduate and graduate students, who will be the future of providing science-based solutions for agriculture.

I Continue to complement the extension network and regional collaboration

Extension is a critical mission of the nation's land-grant institutions and is built on the partnership between the land-grant colleges of each state, the Federal Government through the United States Department of Agriculture (USDA), and local county governments. Traditionally, each county of all 50 states has a local extension office, although some county offices have consolidated into regional extension centers. Today, there are approximately 2,900 extension offices nationwide. In south Florida, the University of Florida and Miami-Dade County, particularly Agriculture Manager Charles LaPradd provide outstanding extension services to the community. But, the needs of the community exceed the capacity. FIU, like other Hispanic-Serving Agricultural Colleges and Universities, have an important role to play in advancing the mission of extension by becoming part of the collaboration. In South Florida, FIU and UF have partnered on multiple initiatives to serve the community and have corresponded to build complementary expertise.

II The future of role of our nation's Hispanic-Serving Institutions in Agriculture

America's Changing Landscape and STEM Challenges

As of 2013, according to U.S. Census Bureau population estimates, there were roughly 54 million Hispanics living in the United States, making people of Hispanic origin the nation's largest ethnic or race minority, at 17% of the U.S. total population.

Increasingly, post-secondary Hispanic students are enrolled mostly at Hispanic-Serving Institutions (HSIs), which are defined in the Higher Education Act as institutions whose enrollment is made up of at least 25% Hispanic full-time equivalent (FTE) students. According to the Hispanic Association of Colleges and Universities (HACU), HSIs, like FIU, make-up 12.1% of nonprofit colleges and universities, yet enroll 20% of all students and 58.9% of all Hispanic students currently enrolled in higher education. The number of HSI's in the United States is rapidly growing. In 1990, there were 137 institutions; in 2005, 245 institutions; and since 2013 over 400 institutions. Looking towards the future, almost 300 institutions are "emerging HSIs" with Hispanic enrollments between 15% and 24.9%.

According to the United States Department of Agriculture (USDA), although Hispanics represented 15% of all U.S. wage and salary workers, as of 2012, Hispanics represented 50% of all farm laborers and supervisors in the U.S., only 16% at the management level. Looking at the Science and Engineering workforce, the source of many of our food scientists and engineers, only 3% of those doctoral recipients in the biological, agricultural, environmental and life sciences are Hispanic.

Hispanic-Serving Institutions and Agriculture

We salute Congress and the USDA for making important strides to engage with the greater Hispanic-Serving institution community. Notable efforts with ***direct*** impact on leveraging the research, outreach and educational missions of HSI's include:

- USDA and the Hispanic Association of Colleges and Universities have long been affiliated through a formal Memorandum of Understanding (MOU) and active leadership group meetings that recognize the need to include more HSIs in USDA programs and research.
- This past year at FIU, USDA piloted a new expedited Pathways recruitment strategy for interns and full-time employment targeting Hispanics, African Americans and other underrepresented minorities. By working with multiple

USDA agencies and other universities in the area, the agency placed 25 successful candidates after one full day of interviews on campus.

- USDA's **Hispanic-Serving Institutions National Program** and its leadership have ensured strategic partnerships between USDA and HSIs like FIU to provide improved access to employment, educational and institutional development opportunities.
- In particular, the **USDA HSI National Program's six regional offices** serve as important conduits for engagement and outreach to universities. The Miami office has served to create strategic partnerships between USDA and over 80 HSIs, serving as a valuable asset to our faculty and students seeking to assist students, faculty, and administrators in accessing USDA's educational, employment, and funding opportunities.
- National Institute of Food and Agriculture's **Hispanic-Serving Institutions Education Grants Program (HSI)** is a competitive grants program intended to promote and strengthen the ability of Hispanic-Serving Institutions to carry out higher education programs in the food and agricultural sciences. Funding for this important initiative is currently at just over $9 million and has made possible over 80 grants in recent years.
- The HSI Education Grants Program has made possible the **Florida-Caribbean Consortium for Agriculture Education and Hispanic Workforce Development** described in *Part I.*
- The **E. Kika De La Garza Fellowship Program** offers faculty and staff from HSIs the opportunity to work collaboratively with USDA to gain insight and understanding of the Federal Government. This uniquely tailored experience brings together HSI staff and Federal executives to address the spectrum of challenges faced in the development of a well prepared Hispanic workforce. Fellows spend 2 to 4 weeks in Washington, D.C. to increase their understanding of USDA and other Federal agencies, particularly at the national level, and be able to identify mutual collaborative interests. FIU has been fortunate to have had faculty and staff participate in this program.
- The **Multicultural Scholarship (MSP) Program and National Needs Fellowship (NNF)** Program have made an impact in attracting diverse students to agricultural professions. Many at FIU have benefited from this support because of diligent staff at USDA.

Going forth, we present some thoughts on specific policy challenges facing the research community in Hispanic-Serving universities:

1. **Creatively incorporating Hispanic-Serving Institutions into the land-grant ecosystem**

   As FIU and UF have proven, collaboration between a land-grant institution and Hispanic-Serving Institution is a win for all involved, and one which advances agricultural research, outreach and training. With only a handful of land-grants currently being Hispanic-Serving Institutions nationwide, the challenge for all involved is how to thoughtfully incorporate HSI's into the network.

2. Building greater capacity at HSI's through the **Hispanic-Serving Agricultural Colleges and Universities (HSACUs) programs**

   Laudably, the reauthorization of the Farm Bill in 2014 preserved the previously authorized programs for HSIs and Hispanic-Serving Agricultural Colleges and Universities (HSACUs) and added a new competitive grants program in support of Hispanic agricultural workers and youth. These programs are designed to strengthen the ability of HSIs to offer educational programs that attract, retain and graduate outstanding students who will enhance the nation's food and agricultural, scientific and professional work force. ***However, none of the HSACU programs authorized in 2008 has ever been funded by Congress and only the HSACU Endowment program has ever been included in the President's Budget Requests.***

   Authorized, yet unfunded programs include:

   - $20 million for the HSACU Equity Grants Program.
   - $80 million for the HSACU Endowment Fund.
   - $40 million for the HSACU Institutional Capacity-Building Grant Program.
   - $40 million for the HSACU Fundamental and Applied Research Grants Program.

- $40 million for the HSACU Extension Grants Programs.
- $5 million for the competitive grants program for Hispanic agricultural workers and youth.

HSIs receive 0.69¢ on the Federal dollar when compared to all other institutions of higher education. This funding inequity is evident in agricultural research and infrastructure development investment by the U.S. Government. HSIs enroll 60 percent of all Hispanic higher education students and that proportion is likely to increase.

Congress should then not be surprised by the under-representation of Hispanics in agricultural-related programs and academic opportunities. Congress must correct this trend now or our nation's future food security and economic development will be unnecessarily limited.

3. **Unintended consequences of the creation of the HSACU designation**

Considering the HSACU programs have not yet been funded and implemented, caution is urged in restricting universities that may be HSACUs from applying to other programs at USDA.

One example is with the non-land-grant college of agriculture program, which was also authorized in 2008 and has been funded. This year's competition awarded $4 million, yet HSACU applicants had to opt out of their respective designation to qualify as non-land-grant colleges of agriculture to be eligible for this program.

FIU looks forward to working with Congress and the U.S. Department of Agriculture to accelerate agriculture research, extension and teaching and thanks the Committee for providing the opportunity to share our perspective.

The CHAIRMAN. Thank you, Dr. Heithaus.

Dr. Lacy.

STATEMENT OF MICHAEL P. LACY, PH.D., PROFESSOR AND DEPARTMENT HEAD, DEPARTMENT OF POULTRY SCIENCE, UNIVERSITY OF GEORGIA, ATHENS, GA

Dr. LACY. Chairman Davis, Ranking Member DelBene, distinguished Committee Members, I am grateful for the opportunity to represent the University of Georgia College of Agricultural and Environmental Sciences, and all land-grant universities across the nation to talk about the intrinsic value and vital role public university research plays in keeping American agriculture strong, our economy growing, and the world adequately nourished.

I want to specifically thank Congressman Austin Scott, one of the University of Georgia's most distinguished alumni, for his support. He is a tremendous advocate for agriculture.

All agricultural research is important, however, in this brief testimony, it will be best for me to focus on my area of expertise; poultry science. Nowhere else is agricultural research so open and readily accessible to farmers and consumers as it is in the United States. This unique quest for and application of new information relevant to agriculture is directly attributable to our land-grant university system. The land-grant model, coupled with USDA–ARS form a powerful combination that is the envy of the world in its effectiveness at addressing the critical needs of food production.

A great example of that land-grant USDA collaboration can be seen in UGA and USDA efforts to address the threat of avian influenza. Earlier this year, the U.S. faced a renewed threat to our food security as AI spread through 21 western and central states, resulting in the loss of over 50 million birds, including 16 percent of the nation's egg-producing flocks. As waterfowl that carry the AI virus migrate south this fall, the threat of this disease intensifies. Because of the sheer size of the poultry industry in Georgia, a seri-

ous outbreak in our state would be devastating to our economy, and would impact the entire U.S. food supply. We have been conducting intensive programs to help producers strengthen biosecurity procedures to protect their poultry flocks. Our scientists have worked tirelessly on research related to response plans, humane euthanasia methods, composting mass-mortalities, in the event of a catastrophic AI outbreak.

The USDA Southeast Poultry Research Laboratory in Athens, Georgia, is recognized as one of the leading poultry disease research facilities in the world. The work done there is of a measurable importance to the health of the nation's poultry flocks. The need for funding, recommended to expand the research facilities at SEPRL, is strategic and vital, as the serious consequences of the current AI situation vividly highlight.

In concert with the biosecurity efforts focused on poultry producers, UGA 4–H is piloting a program with the Centers for Disease Control and Prevention to teach biosecurity principles to even our youngest citizens, helping them better understand and prevent disease transmission.

Continuing this poultry health theme, interest in minimizing the use of pharmaceuticals has spurred research at UGA on novel ways to protect poultry from diseases such as coccidiosis. Non-disease-causing variants of the protozoa that cause this disease have been isolated, that allow poultry to develop resistance without contracting the actual disease. These variants have been employed to produce an effective vaccine now used extensively by poultry producers.

Ag engineers and poultry scientists at UGA teamed up to address the serious problem of heat stress in fast-growing meat-type chickens. This work resulted in the development of ventilation and cooling systems which have eliminated both heat-related mortality and stunted growth during the hot summer months.

I could list scores and scores of additional research projects that have had significant impact in poultry genetics, nutrition, food safety, *et cetera,* but in the final minute I have, allow me to call attention to the recent National Academy of Sciences report titled, *The Critical Role of Animal Science Research in Food Security and Sustainability.* This report details the important accomplishments of animal agriculture research, and documents the alarmingly small amount of USDA funding focused on animal agriculture, relative to its economic importance and future expectations. As this report concludes, the need for additional investment in animal agriculture research is critical.

I do wish to thank the Committee for authorizing the extension of the Animal Health Research and Disease Section 1433 Program. Full funding of the 1433 Program is still needed. A well-thought-out research blueprint has been established. The animal agriculture research community and industry counterparts came together in 2012 and identified research priorities which were published in the *Farm Animal Integrated Research* report, FAIR 2012. We are prepared to meet the challenges facing the future of animal agriculture when research funding is available.

Again, I sincerely thank the Committee for your interest in and support of agriculture research. That support is never taken for

granted. Thank you for the foresight you have in regard to providing the investment required to make the advancements needed to assure food security for a growing global population.

[The prepared statement of Dr. Lacy follows:]

PREPARED STATEMENT OF MICHAEL P. LACY, PH.D., PROFESSOR AND DEPARTMENT HEAD, DEPARTMENT OF POULTRY SCIENCE, UNIVERSITY OF GEORGIA, ATHENS, GA

I am honored to have the opportunity to represent the University of Georgia College of Agricultural and Environmental Sciences and all land-grant universities across the nation and to provide to the Subcommittee on Biotechnology, Horticulture, and Research of the U.S. House of Representatives Agriculture Committee testimony on the intrinsic value and vital role public university research plays in keeping American agriculture strong, our economy growing and the people of the world nourished.

First, I want to thank you for your past support of our research programs, and I ask for your continued support of this critical component of our nation's economy and basic security. All agricultural research is important; however, in this brief testimony I believe it is best for me to focus primarily on my area of expertise, poultry science.

Nowhere else is agricultural research so open and readily accessible to farmers and consumers as it is in the U.S. This unique quest for and application of new information and ideas relevant to agriculture is directly attributable to our land-grant university system. The land-grant model, coupled with USDA–ARS, form a powerful combination that is the envy of the world in its effectiveness at addressing the critical needs of food production.

A great example of land-grant and USDA collaboration is the relationship between the University of Georgia and USDA in addressing the threat of Avian Influenza (AI). Earlier this year, the U.S. faced a renewed threat to our food security as AI spread across 21 western and central states, resulting in the loss of almost 50 million birds including 16 percent of the nation's egg producing flocks.

As the waterfowl that carry the AI virus migrate south this fall, the threat of this disease intensifies in Georgia. Because of the size and importance of poultry in Georgia, the leading producer of poultry in the U.S., a serious AI outbreak in our state would be devastating to our economy and impact the U.S. food supply.

Poultry scientists and veterinarians at USDA, the University of Georgia and at scores of other land-grant universities across the country have been conducting applied research and extension programs to help poultry producers strengthen biosecurity procedures to protect the nation's poultry flocks from AI. They also have been working tirelessly on research related to response plans including humane euthanasia methods and composting mass mortalities in the event of a catastrophic AI outbreak.

This unexpected threat to poultry production in the U.S. underscores the critical need for a strong animal/poultry research infrastructure to address and respond to future major threats to animal agriculture that no one can currently predict but are almost assuredly to occur.

The USDA Southeast Poultry Research Laboratory (SEPRL) in Athens, GA is recognized as one of the leading poultry disease research facilities in the world. The work done there is of immeasurable importance to protecting the health of the nation's poultry flocks. The need for the funding recommended to expand and modernize the research facilities at SEPRL is strategic and vital as the serious consequences of the current AI situation highlight vividly.

In concert with the heightened biosecurity efforts of Georgia's poultry producers, the University of Georgia's 4–H program is developing and piloting a program with the Centers for Disease Control and Prevention to teach biosecurity principles to even our youngest citizens, helping them better understand and prevent disease transmission between animals and from animals to humans.

Poultry and eggs are a major protein source important in providing vital nutrition for people around the world. We take the responsibility of producing safe, affordable and high-quality meat and eggs seriously, and will continue to be vigilant in our quest to address diseases that threaten the flow of food and commerce. By addressing biosecurity at all levels of our society, we are better protecting our people, our animals and our agricultural economy.

Other research innovations related to poultry health include one of the most promising long-term solutions to disease prevention—development of genetic resistance. At the University of Georgia, scientists are working at the basic level to enhance genetic resistance to viral respiratory diseases such as AI, Newcastle, Infec-

tious Bronchitis, and Laryngotracheitis. These diseases are a considerable threat to the U.S. poultry industry, but in developing counties they frequently devastate entire flocks and can wipe out farmers' hopes of feeding their families.

Land-grant universities are improving animal health and protecting the environment through better nutrition. Poultry do not have enzymes necessary to breakdown phytate phosphorous contained in typical corn/soy diets. Poultry nutritionists have identified and commercialized phytase enzymes that are now added to most poultry diets in order to improve the utilization of this previously unavailable phosphorous source. These enzymes reduce the need for inorganic phosphorous to be added to diets. They also reduce the amount of phosphorous contained in poultry manure, thereby improving the nitrogen-to-phosphorous ratio in the manure and making it a more effective organic fertilizer.

Animal production is an important user, and in many cases the only user, of byproducts of biofuel production, human food production and industrial production. The University of Georgia has been a leader in analyzing and providing research-based recommendations on the use of alternative feed ingredients in poultry feeds. These studies have effectively recycled byproducts, reduced costs for poultry producers and kept millions of tons of material out of landfills and other waste streams.

Food safety, water conservation and waste minimization as related to poultry processing are high priorities for the poultry industry. UGA and other land-grant laboratories, in partnership with Federal poultry labs, are developing new processing methods looking at a systems approach. Scientists and engineers from a number of institutions are collaborating to examine poultry processing from the hatchery to the marketplace to enhance food safety, energy efficiency, and environmental stewardship. Research conducted at land-grant universities has been key in reducing foodborne pathogens on poultry products.

Consumer and industry interest in reducing drugs and chemicals in poultry production has spurred research on vaccines to protect poultry from parasitical diseases such as coccidiosis. Variants of the protozoa that cause this disease have been isolated that allow poultry to develop resistance without causing the severe production losses associated with the disease. These variants have been successfully employed in safe and effective vaccines that are now used extensively in poultry production.

Essentially all the research done at universities these days is multidisciplinary. Agricultural engineers and poultry scientists at the University of Georgia teamed up to address the long-standing problem of heat stress in meat-type chickens (broilers). This work resulted in development of cost effective tunnel ventilation and evaporative cooling systems which have virtually eliminated heat related mortality and decreased growth and efficiency of broilers during the hot summer months. The value of this research to Georgia poultry producers is estimated at $15 million annually. These ventilation systems and poultry housing designs are now the standard throughout U.S. and the world.

As described clearly in the recent National Academy of Science (NAS) report, "Critical Role of Animal Science Research in Food Security and Sustainability," the importance of animal/poultry production to food security and economic development is significant. Animal protein products account for 60–70 percent of the total U.S. agricultural economy. Estimates are that the combination of increased population and rising middle class in numbers of developing countries will result in a 73 percent increase in animal protein demand by 2050.

The amount of research funding focused on animal/poultry research is alarmingly small relative to animal agriculture's economic impact and future expectations. USDA–ARS allocates 50 percent more to research related to plant crops and a greater percentage of its budget to environmental issues, food safety and nutrition than to animal production research. The NAS report referred to above states: "In the past 2 decades, public funding, including formula funding and USDA–ARS/NIFA funding, of animal science research has been stagnant in terms of real dollars and has declined in relation to research inflation rate." Further, "animal agricultural research has borne the brunt of decades of neglect," in regard to research funding.

Even so, the results of the modest public research investment that has been made in animal research are truly remarkable. For example, in 1960 it took over 100 days to grow a meat-type chicken to a market weight of 5 pounds; today it takes less than 45 days. During the same time period, feed efficiency improved from 2.5 pounds of feed required to produce a pound of chicken to just 1.7 pounds today; and poultry geneticists predict feed efficiencies will approach 1.2 in the next 2 decades. Annual egg production has improved from 230 eggs per hen in the 1960 to 300 eggs per hen currently. Similar improvements have been realized in poultry health and livability. These production and efficiency advancements have allowed for significant improvement in sustainability and amazing reductions in the environmental foot-

print of poultry production relative to water, feed and waste-per-pound of poultry meat and eggs produced.

The value of the application of the research findings produced by our land-grant universities is significant, but equally valuable is the undergraduate and graduate training provided by our scientists. This development of human capital and training of the next generation of scientists that our nation needs to assure continued progress and success in food security may be the most important byproduct of the research funding you provide. The NAS report emphasizes the need to "revitalize research infrastructure (human and physical resources)."

Because of the historic funding shortfall and the future demand for increased animal protein production, the need for additional investment in animal science research is nothing less than critical. I do wish to thank the Committee for authorizing the extension of the Animal Health Research and Disease Section 1433 program. Full funding of the Section 1433 program is needed to address the priorities of food security, One Health and environmental stewardship. When that funding is provided, animal and poultry scientists will use it wisely and efficiently. The animal science research community and industry counterparts came together in 2012 and identified research priorities detailed in the *Farm Animal Integrated Research* report (FAIR 2012). We have a well-thought-out blueprint and are prepared to meet the challenges and address the issues facing the future of animal agriculture.

I will conclude on an economic note. Poultry's estimated economic impact in the U.S. is over $150 billion annually; $30 billion in Georgia alone. Poultry provides over 120,000 jobs in Georgia and over 500,000 nationwide. Animal and poultry agriculture contributes over $43 billion annually to our nation's trade balance. Poultry and animal products are an important source of affordable, high-quality protein to feed the world. Enhanced funding for animal research is an investment our country needs in order for the U.S. to continue to be the global leader in poultry and animal production. Investment in animal agriculture research will continue to pay significant dividends in improved health, environmental sustainability, food security and prosperity for farmers, consumers and society.

As with any investment, there must be an expectation of return, and our track record in this regard stands out. More than 20 independent studies over the past few decades consistently show that for every $1 invested in agricultural research $10 is returned.

Again, I wish to express gratitude for this opportunity to provide testimony to the House Subcommittee on Biotechnology, Horticulture, and Research. Your interest in and support of agriculture research is appreciated by those of us working to help provide food security for our country and the world. The funding you provide is important; however, your acknowledgement, interest and encouragement in regard to the importance of our research, extension and education programs continue to inspire and motivate us. Thank you for the foresight you have in regard to providing the essential funding required to accomplish this critical work.

The CHAIRMAN. Thank you, Dr. Lacy. And we still respect the University of Georgia, despite of the fact you reminded us all that our colleague, Mr. Scott, graduated from there.

Dr. LACY. Go Dogs.

Mr. SCOTT. Go Dogs.

The CHAIRMAN. Dr. Buhler, please.

STATEMENT OF DOUGLAS D. BUHLER, PH.D., SENIOR ASSOCIATE DEAN FOR RESEARCH, COLLEGE OF AGRICULTURE AND NATURAL RESOURCES, MICHIGAN STATE UNIVERSITY; DIRECTOR, MSU AGBIORESEARCH, EAST LANSING, MI

Dr. BUHLER. Well, thank you. Chairman Davis, Ranking Member DelBene, Congressman Moolenaar, thank you very much for the opportunity to be here today, and represent the hardworking research scientists and prevention professionals at Michigan State University.

One of the benefits of going last is I can start out by saying I want to concur with all of the comments that have been made by the previous speakers. The critical nature of what we do has al-

ways been important to this country and the world, but I believe it is more important now than it has ever been as we look at the challenges of feeding a growing world, with the challenges that we face in terms of protecting our natural resources, *et cetera.*

Michigan State University is very, very fortunate to have very strong support from the State of Michigan and industry partners. That support is very important because it allows us to leverage the Federal investment in our research and outreach programs. And so I really wanted to acknowledge that.

Founded in 1855, Michigan State University was the first agricultural college of its kind in the country. It was actually founded as—it was called the Michigan Agriculture College. So we have very strong roots in agriculture, and if you look at the history of the institution, it is a very interesting history of starting from a state-based regional agricultural college, and growing into a world-class university, really starting and throughout the end of World War II to the present. Michigan is also a very heavily specialty crop state. And when you look at Michigan and you look at our geography, a lot of the places where we grow crops are very unique. And so when we talk about the importance of the Federal investment and the state investment in protecting our specialty crops, it is very critical because many of these crops depend on the university for support. These crops are very important locally, but they are not major crops on a national scale. And so you look at things like tart cherries, asparagus, things like that, that grow in a very unique environment, and so if the university is not there to support these industries, there is not a lot of back-up. And it is really important that we continue to support the public-sector research and outreach to support these important commodities.

I also want to point out that a lot of the work that we do is often difficult to quantify because a lot of it is protecting productivity as opposed to really generating new outputs. And what I am particularly talking about here is pest management. We have made a great deal of investments to protect the inherent productivity of our crops, and that is something that we really need to keep in mind as we look forward because a huge part of what we do, whether it is in the animal industries or the crop industries, is protecting the productivity that we have inherent in our genetics and our environments where we grow our crops.

So Michigan State University, as I said, is really rooted in agriculture. Many of the early pioneers at our institution were involved in things like helping to develop hybrid corn, some of the early plant breeding programs. Plant breeding and genetics continues to be a core of what we do, particularly in the specialty crops. For example, our edible Dry Bean Program has been producing a new variety that has been released into the industry at a rate of at least one per year over the last 20 years. We have also been very involved in processing, particularly in the dairy industry, and we will continue to work in those areas.

An area that I want to make a little bit of a point on, and it is really critical as we move forward, is that we look at the issues that are facing us in the future, they are very complex problems. And as we look at how do we attack some of these big problems like antimicrobial resistance, which has been mentioned, some of

the weather issues, and others, climate and so on, some of the water issues, we really need to draw a broader range of scientists into our agricultural fields. We really need to bring in fundamental plant science, fundamental ecology, and things like that, and build teams that can address these issues in a multidisciplinary way. This often requires different funding, and it often requires, and would be very much improved if we could provide more opportunities to work across Federal agencies, particularly NIH and NSF, to bolster some of our agricultural investments. And so we really look forward to continuing to build some of these programs because we think that it is really critical to moving forward in the future.

So I just want to wrap up by just making a point about the importance of the agricultural infrastructure and the facilities that we need simply to do our research. Agriculture, in many cases, is a little bit different than many of the other areas of science, in that we need long-term investments in things like animal herds, plant breeding programs, vineyards and orchards, to just give us the basic capacity to do our work. And that is really where, when you talk about why is agriculture different than other areas of science, I believe that is where that is rooted. We have to have these facilities available, often taking 20, 30, maybe even 50 years to build that capacity so that we can actually do our research. And so when I am asked why should agriculture have this more unique investment, that is the reason that I cite.

So thank you again for this opportunity, and we really appreciate your support, and we look forward to moving forward and addressing these important issues of our country and the world. Thank you.

[The prepared statement of Dr. Buhler follows:]

PREPARED STATEMENT OF DOUGLAS D. BUHLER, PH.D., SENIOR ASSOCIATE DEAN FOR RESEARCH, COLLEGE OF AGRICULTURE AND NATURAL RESOURCES, MICHIGAN STATE UNIVERSITY; DIRECTOR, MSU AGBIORESEARCH, EAST LANSING, MI

Chairman Davis, Ranking Member DelBene, Rep. Moolenaar, and other Members of the Subcommittee, thank you for the opportunity to testify on behalf of Michigan State University (MSU) at today's hearing to highlight research innovations achieved by our nation's agricultural colleges and universities.

I serve as both the Senior Associate Dean for Research in the College of Agriculture and Natural Resources, as well as Director of MSU AgBioResearch. It is my responsibility to oversee MSU's research portfolio in the areas of food, energy and the environment.

There is perhaps no greater time than now to be in involved in research pertaining to sustainable food production. Today, the world population is growing by about 80 million people each year and is expected to continue this upward pace for the next several decades. This presents immense challenges to food supplies. At the same time, natural resources are being depleted—soil is eroding, water tables are dipping and fish counts are declining. We need solutions that will keep our food supply safe and secure while protecting our natural resources. Like many other agricultural universities, MSU remains committed to discovering practical, adoptable solutions that address these very serious issues. And it is through research and outreach that these sustainable answers will continue to be unearthed, shared and put into practice at home and around the globe.

Background

Founded in 1855, MSU was the first agricultural college of its kind in the nation. It also served as a prototype for land-grant institutions under the Morrill Act, enacted by President Abraham Lincoln. In 1888, MSU also became one of the first U.S. institutions under the 1887 Hatch Act to create a network of agricultural experiment stations where research trials and field studies are conducted on behalf of farmers.

Today, MSU AgBioResearch operates 13 such outlying research facilities located in strategic growing and climatic regions throughout the state, in addition to numerous laboratories and other research facilities on campus. Key findings from research assist the food and agriculture industry, which contributes more than $100 billion of annual economic impact to Michigan alone. With more than 300 commodities produced on a commercial basis, Michigan is the second most diverse agriculture state in the nation (behind only California). The MSU College of Agriculture and Natural Resources, MSU AgBioResearch and MSU Extension work hand-in-hand with the commodity organizations to address the issues facing growers and producers throughout the state—solutions on everything from disease management to food processing. These research results are vital to providing healthy, nutritional food at affordable prices and with fewer environmental impacts.

Obviously, Michigan State has deep roots in agricultural research, some of which have even helped breathe vitality into modern-day farming. Some examples include:

- In the late 1800s, botany professor **W.J. Beal** was one of the pioneers in the development of hybrid corn, which doubled the yield for farmers. In 2014, Michigan farmers harvested the largest corn crop on record with total production exceeding 355 million bushels.
- In 1915, **F.A. Spragg** released the first navy bean variety, Robust. During the 20th century, 40 varieties of beans in eight commercial classes were developed at MSU and released. And in the first decade of the 21st century, ten new bean varieties were introduced under the direction of MSU researcher **James Kelly,** who continues as one of the world's top bean breeders. MSU has helped Michigan become one of the leading dry edible bean producers.
- In 1929, dairy industry pioneer **G. Malcolm Trout** linked the processes of pasteurization and homogenization, finding that homogenized milk needed to be pasteurized first in order to have an appealing taste. He also developed new processes to make cheeses, yogurt and other products. Today, dairy is a leading segment of Michigan agriculture, contributing $14.7 billion to the state's economy.
- Horticulturist **Jim Hancock** has developed several blueberry varieties, some of which are the most widely planted blueberries in the world. For the past 70 years, Michigan has been the No. 1 state for blueberry production—largely in part to Hancock's influence.
- In 1965, MSU partnered with the U.S. Department of Energy (DOE) to form the **MSU–DOE Plant Research Laboratory.** Researchers continue to look at ways to improve energy crop production and unravel the intricate mechanisms by which plants—the root of all biofuels—capture, convert and deposit energy. This effort continues today with the goal of meeting the cellulosic biofuel blending mark of 16 billion gallons by 2020—as mandated by Congress in 2007.

These achievements help to show how agricultural research can lead to economic, environmental and health benefits that transcend time and impact the industry for decades to come.

Recent Highlights

When **avian influenza** was detected in parts of the U.S. earlier this year, MSU AgBioResearch and Extension scientists immediately responded in an effort to assist farmers and educate the public. Educators worked in conjunction with both the Michigan Department of Agriculture and Rural Development and the Michigan Department of Natural Resources to ensure that appropriate steps were being taken to address this serious biosecurity threat. A website strictly devoted to avian influenza was developed, which included frequently asked questions and information, including a YouTube video for backyard farmers. In the end, Michigan's poultry population remained largely unaffected by avian influenza. This is just one example of how MSU works with state and Federal agencies, including the Centers for Disease Control and Prevention, to provide timely, fact-based information to minimize public concern and maximize human and animal health safety.

MSU has also long been involved with the battle against **soybean rust,** a serious disease in Asia for many decades that arrived in the U.S. in 2004. It was considered such a threat to agriculture that it was listed as a possible weapon of bioterrorism. Although it cannot overwinter in areas with freezing temperatures, it can spread rapidly and explosively over large distances. MSU scientists have been helping farmers put action plans in place and to define best practices in terms of early identification and treatment. While the disease has hit states in southern U.S., Michigan has remained free of the disease.

Through USDA funding, MSU horticulturist **Amy Iezzoni** led the development of the RosBREED project to help breeders working with the *Rosaceae* family (which includes apples, peaches, sweet and tart cherries, raspberries, plums, pears and strawberries) incorporate the latest genetic knowledge and tools in their work. Not only are new varieties of fruit being created more quickly and less expensively than ever before, the project is also improving disease resistance. By applying the latest genetic tools and knowledge, Iezzoni's team has been making advancements to reduce the crops' vulnerability and keep the nation's food system more secure. In Michigan alone, *Rosaceae* crops are valued at nearly $230 million per year.

Dr. Paolo Sabbatini, with funding from USDA, is leading efforts to alter grape cluster microclimates, thwart disease and improve grape quality. MSU has long worked on ways to keep grapes free of pest and disease, and are now also moving into more studies on new varietals conducive to the Great Lakes region. Each year Michigan's wine, grapes and grape juice products and related industries produce nearly $790 million of total economic value to the State of Michigan, pay more than $42 million in state and local taxes in Michigan and an additional $42 million in Federal taxes. The industry also accounts for 5,000 jobs across the state and a payroll of more than $190 million.

And with the boom of microbreweries within the state, MSU is working to help farmers fulfill the need to grow hops and barley to meet escalating demand for locally grown ingredients. Researcher **Russ Freed** recently was able to resurrect 80 year old barley developed by an MSU plant breeder in 1916. Fittingly called "Spartan," the cultivar had higher production capabilities and superior quality and by 1950, was found on farms around the country. Eventually, Spartan was surpassed by other barleys and the seeds locked away in a USDA gene bank in Utah. Now a team of MSU researchers is growing Spartan barley in trials in the northern region of the Upper Peninsula. And Michigan brewers are expressing interest. Today, more than 2,300 craft brew businesses are in operation around the nation, representing more than 104,000 jobs and a nearly $20 billion industry.

MSU's Multidisciplinary Appeal

Not only does MSU have a rich agricultural history, it is a university steeped in multidisciplinary efforts. Faculty members are encouraged to collaborate beyond college and department lines, reach across disciplines and work together to achieve results with lasting impacts. There are many examples, a few of which are described below:

Felicia Wu, a John A. Hannah Distinguished Professor in the departments of Food Science and Human Nutrition and Agricultural, Food and Resource Economics, came to MSU in 2013 because of its robust agricultural research coupled with strong medical programs—a rare combination for a land-grant university. With funding from USDA, NIH, USAID and other sources, Dr. Wu is now heading up a new center aimed at studying the overall implications agricultural practices have on human health. The **Center for Health Impacts of Agriculture (CHIA)** focuses on three pathways by which agriculture affects human health: nutrition, which includes the quality, macro- and micronutrient content, and diversity of food; economics also play a pivotal role, particularly in underdeveloped areas where resources are at a premium; and the unintended negative consequences of agriculture on human health and the environment.

Antibiotic resistance, declared a major public health threat by both the Food and Drug Administration and the World Health Organization, is a high priority topic within CHIA research as well as other laboratories at MSU. Increasing and occasionally inappropriate prescription of antibiotics has led to significant bacterial resistance in humans. In animals, the use of antibiotics to promote growth, in addition to fighting bacterial infections, decreases the drug's ability to efficiently eradicate illness when needed. When used in excess, antibiotics end up in the environment—in the air, water and soil—and humans can become exposed not just to the antibiotics but to antibiotic-resistant bacteria. A goal is to illuminate these pathways of exposure by studying the transportation and fate of antibiotics and antibiotic-resistance genes in the environment.

David Kramer is another example of a researcher who came to MSU because of the university's multidisciplinary research culture. His laboratory is reminiscent of a start-up business, a convergence of diverse minds and skills with the same end goal—to improve plant science. Funded by USDA, NSF, USAID, MSU and others, his group is looking to solve some of the worldwide challenges related to human population growth and the need for more food. The John A. Hannah Distinguished Professor in Photosynthesis and Bioenergetics is leading a team of scientists, engineers and software developers in a project called **PhotosynQ** that is changing the way farmers and researchers think about collaboration. Growing better crops using

new management strategies relies heavily on how researchers approach information collection and analysis, particularly with small-scale farming.

The scientists have developed a prototype instrument, which costs around $100, and includes sensors that measure the temperature, relative humidity, carbon dioxide, chlorophyll content and several other facets of plant health. Adaptability is essential, so the sensors can be easily changed for a wide range of projects. Once data is collected, it is instantly uploaded to the PhotosynQ website and available for all users. Researchers can even post a project and instructions that allow other scientists to contribute. This vast plant science social network illustrates extraordinary possibilities. There are roughly 200 devices currently in use around the world. To date, more than 600 users have taken in excess of 100,000 measurements. The volume of data is growing exponentially and allowing farmers to make more accurate predictions about yields, which varieties to use, and when to apply fertilizers.

Entomologist Rufus Isaacs is another fine example of an MSU researcher who is leading work that transcends barriers—this time of the geographical sort. He is leading a multi-state, multi-institutional project that impacts crops from apples to pickling cucumbers. As honey bee populations decline, Dr. Isaacs is looking at alternative pollinators to help maintain the vitality of U.S. crops that are pollinated every spring and valued at more than $14 billion annually. Major funding from Dr. Isaacs program comes from USDA, MSU Project GREEEN and industry organizations.

Dr. Isaacs and several colleagues are also addressing ways to control the Spotted Wing Drosophila (SWD), an invasive species that seriously threatens fruit crops such as apples and cherries. Unlike most pests, the SWD mandible is so strong it is able to burrow its way into unripe fruit, leaving irreparable damage to the fruit and unavoidable economic loss to the grower. The Asian insect is believed to have come to the U.S. via food crates and has become one of our region's greatest fruit production threats.

MSU's **Bruno Basso,** an expert in precision agriculture, is leading an initiative funded by USDA and industry organizations involving an unmanned aerial vehicle (UAV), or drone, that collects data by flying over the field. Attached sensors measure plant nutrients, temperature and size. Using the data, a grower can determine how to apply the right amount of fertilizer at the right place and time. The research covers nearly 20,000 acres across the Midwest. Once data is collected, Dr. Basso uses a modeling software developed at MSU called the System Approach to Land Use Sustainability. He can then input soil, water and nutrient data to model crop performance by simulating weather patterns across several years.

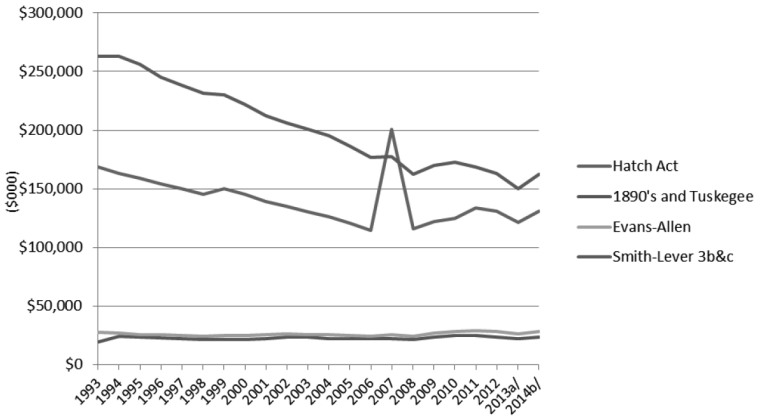
But as issues, such as emerging invasive species and drought resistance, continue to mount, investments in agricultural research have unfortunately begun to dwindle.

Facing Challenges

Funding for Formula Programs has declined. These funds, commonly termed capacity funds, provide critical infrastructure at State Agriculture Experiment Stations and for Cooperative Extension that facilitate the success of the U.S. agriculture system. According to USDA–NIFA data, capacity fund programs have lost as much as 40 percent in buying power over the last 20 years (*Figure 1*). These reductions have been exacerbated by differential budget cuts to Agriculture Experiment Stations and Extension in many states. Simply put the same or new innovations cannot be provided with fewer funds.

Figure 1 (Data Provided by NIFA, constant 1993 dollars)

NIFA Appropriations in Constant 1993 Dollars, 1993–2012



The top Federal funding priority for State Agricultural Experiment Stations and Cooperative Extension organizations is maintaining steady increases in capacity funds, ideally at least recovering lost buying power. There are few other Federal programs where limited funds have been leveraged at least five to six times with state funds annually over a period of decades, in this case to yield ongoing positive impacts on the nation's food and fiber system, as well as related issues such as alternative fuels, environmental sustainability, economic development, and health and well-being of our citizens in both urban and rural settings.

While there have been marginal increases in Agriculture and Food Research Initiative competitive program, the current level of $243 million is woefully short of the authorized $700 million and is insufficient to meet current demand. The most recent AFRI Annual Synopsis for 2010 indicates that there were over *$2.6 billion* in highly meritorious proposals that would have been awarded if funds were available. Unfortunately, only 403 proposals could be funded from the available $232,649,478. Inadequate funding of NIFA competitive and capacity programs jeopardizes the world's most productive and successful Agricultural Research and Cooperative Extension system.

We are thankful that Congress has long agreed with the land-grant systems' proposition that strong Hatch Act funding is critical to maintaining vibrant food and agriculture sector, strong national emergency response capability and research infrastructure required to meet both U.S. imperatives and global food security requirements. Investments in agricultural research have a huge impact on agricultural productivity. From 1970–2004, the marginal rate of return on investment was approximately 50 percent annually. Today's farmers also grow twice as much food as their parents—using less land, energy and water—while promoting environmental stewardship.

Predicted world population growth, higher incomes and energy demands will require a further doubling of global food supply by 2050. Investing in agricultural research pays off in home-grown jobs: agriculture is one of the nation's largest employers, with more than two million farmers and some 19 million in allied industries—and where the jobs pay $2,600 more per year than other private sectors.

National Endeavors

The USDA's flagship competitive grants program—Agriculture and Food Research Initiative—benefits the nation by providing America's farmers and foresters with genomic data and biotechnology tools to expand good and fiber production, processing and international trade; healthcare professionals with insight into the relationships between diet and health; farmers, landowners and ranchers with expanded knowledge about soil and water quality; university funding to train new generations of food, agriculture, natural resource scientists and cooperative Extension educators.

The U.S. has been able to adopt policies promoting the production of **renewable fuels and other bioproducts** to improve national energy security. This is an area that continues to need additional funding to assess the effects on water use, soil fertility and other environmental conditions. Economic analyses are needed to better understand how food, feed and fuel prices are interrelated.

As the U.S. struggles with **obesity and diabetes** epidemics, expanded research is necessary to more scientifically inform nutrition education and guidance programs and improve the nutritional value and availability of crops, fruits and vegetables and other food.

There is an urgent need to educate and support more young men and women—especially those from diverse backgrounds and ethnic communities—to conduct agricultural research and outreach, and to lead public and private sector organizations. Today, there are two jobs available for every qualified candidate in many fields of agriculture. We need people who want to serve the nation as the next farmers, foresters, ranchers and bioenergy producers.

More funding is also urgently needed to fight plant and animal diseases that threaten public health and agricultural output and food security. Many important challenges exist for managing and protecting our water resources as well.

Moving Forward

A new national center is being established on the campus of Michigan State University. The **Center for Research on Ingredient Safety (CRIS)** is a partnership between the food, beverage and consumer products industries, in association with the Grocery Manufacturers Association and MSU. This independent, academic, science-based center will serve as a reliable and unbiased source for information, research, training and analysis on the safe use of chemical ingredients in consumer packaged goods including foods, beverages, cosmetics and household consumer products.

- Ensuring the safety of food products—and maintaining the confidence of consumers—continues to be a top priority at MSU. We continue strong collaborative efforts like this one that combine our leading programs in packaging and food processing to agricultural economics and toxicology.

CRIS will work to achieve the following goals:

- Expand the opportunity to conduct basic and applied research on the safety and toxicology of ingredients in food, packaging, cosmetics and household care products.
- Develop and validate testing methods and strategies for evaluating the safety of ingredients in food, packaging, cosmetics and household care products.
- Establish a graduate training program that prepares scientists for a career in assessing the safety and toxicology of ingredients in food, packaging, cosmetics and household care products that includes training in risk assessment and U.S. and international regulatory policies.
- Inform the public, health professionals, regulators and the scientific community on research matters reflecting the state-of-the-science pertaining to the safety and toxicology of ingredients in food, packaging, cosmetics and household care products.

Maintaining the Momentum

Like other agricultural universities, we look forward to continuing to generate and disseminate new knowledge and educate young people to work in the ever-important areas of food production. As the world population is expected to reach nine billion within the next few decades, our work is more important than ever.

While we have been incredibly successful for many decades, the system faces major challenges. The declining buying power of appropriations referenced earlier in this document make it difficult to maintain the long-term programs essential to addressing many agricultural issues. The cost of research is rising and funding limitations not only slows progress of scientists in traditional areas of agricultural research, but it also impedes our ability to bring a broader array of scientists to address agricultural problems. Low levels of funding in competitive grants programs has resulted in extremely low funding rates, leaving meritorious projects undone and discouraging young scientists from entering the field. In short, it is creating a system that is not welcoming to the best and brightest young scientists. If this continues, it will erode our ability to respond to the challenge of feeding the world.

We look forward to continuing our tradition as a strong land-grant university—educating future generations to meet the growing demands and discovering and sharing advancements that will benefit our state, the nation and the world. Agriculture is America's oldest career, and today it is arguably one of the most complex, technology-driven, knowledge-based industries in the world. We've come a long way, but there continues to be so much more to do.

Thank you for this opportunity and your support.

The CHAIRMAN. Thank you, Dr. Buhler.

I am going to follow a practice that has become standard in this hearing room. I am going to ask one question, and then I can get back to my follow-up questions so that we can get to my fellow Members that much more quickly.

My question, obviously, is for Dr. Hauser. Thanks again for coming in from Champaign-Urbana.

According to the U.S. Census, the average age of a farmer is 58, despite large participation in positive experiences in programs like 4–H, and it just seems the passion for ag begins to dip as kids grow older. Why do you think that is, and why aren't there more young people choosing ag as a profession?

Dr. HAUSER. Well, fewer and fewer students come from the farm, the demographics are clearly in that direction, but what isn't recognized, regardless of where they come from, is the breadth of what we have to offer in colleges that are represented here. We are talking about food production and feeding the world, and that is much more than cows and plows and things that the "kids" tend to think about these days when they think about programs. That is particularly related now, we fear, to crop sciences, the focus of my remarks. There is just not that much that is sexy about crops and plants and things that involves—until they get there and they learn there are jobs. And as soon as they start learning there are jobs is when we start seeing transfers come in and getting those seats filled.

The CHAIRMAN. So they may be going less to the farms and more to the agribusiness sector to——

Dr. HAUSER. Agribusiness, processing, distribution, trade, policy.

The CHAIRMAN. Yes. One quick follow-up question before I turn it over to the Ranking Member. When Congress created NIFA, the clear construction intent was for an independent scientific policy setting agency for the good and ag sciences sector. Do you believe this intent, Dr. Hauser, has been achieved?

Dr. HAUSER. It has been achieved. We continue to do the scholarship that that legislation had in mind when it was created. I think that the difference is that we now do it in much more of a partnership than we did when it began.

The CHAIRMAN. Great, thank you, Dr. Hauser. I will yield back, and I now recognize the Ranking Member for 5 minutes.

Ms. DELBENE. Thank you, Mr. Chairman, and thanks to all of you for your testimony.

Dr. Moyer, you mentioned gathering genomic data and gene sequencing, and how critical that was, and I wondered if you could elaborate a little bit more about really why this information is so important and what it is used for.

Dr. MOYER. Well, the plant genome is foundational to all of the information that makes up a productive variety. And we know that the pressures that are being placed on our agricultural production, particularly as we look forward in the demands between now and 2050, we are going to have to produce more abundant yields than we ever have before. For rapid advances, we have to have the technology to identify the specific genes in the genome that are responsible for the traits that we are breeding for, and then we have to have the efficient tools to use that information in order to rapidly

integrate and reduce the time that it takes to make a variety that is adopted by the farmers.

Ms. DELBENE. Okay. And then you also talked about the research being done on biodegradable plastic fabric, and that it led to a second project on non-woven polymers to help manufacture biodegradable mulch. Do you find regularly that one project leads to another, and that that is how research builds on itself?

Dr. MOYER. Yes. I think it is extremely important. I wouldn't say it is rare, but it is certainly a hallmark of a successful project when it receives a second round of funding. It shows the success. That is why it is even a measure of success of the SCRI Program, bringing together teams that are, in fact, actually contributing to the solutions of complex problems.

Ms. DELBENE. Yes.

Dr. MOYER. And so, like I said, it is a winnowing process, but getting that second round of funding is a hallmark of something that really is truly having impact. And also this is just not peer reviewed, but in order to get the call back from a preproposal, it undergoes stakeholder review. So this is a two-tiered process. The rigor is pretty—the bar is pretty high, and yes, that is a very positive sign.

Ms. DELBENE. Okay. Thank you. This is a question for all of you. There have been multiple studies that have looked at the need for more agricultural research funding or making changes in how we actually fund agricultural research, and as someone on the frontlines, what are your experiences in addressing the funding question, as well as the best type of funding mechanism for competitive awards? And by funding mechanism, I am referring to whether collaborative, long-term, larger grant funding is the way to go, or if, given the amount of ag research funding, whether smaller grants, not just focused—whether smaller grants might be helpful, not just focused on multi-institution work. What do you think is the best bet, or what feedback would you give all of us on how to best structure funding? And anyone who wants to respond.

Dr. HEITHAUS. I will jump in, coming from a somewhat unique position of being a non-land-grant institution. And the answer is a mix. I think that having these large, multi-institution grants are very beneficial, especially long-term as we are facing changing conditions. And we really need to be projecting what the needs are going to be 5 or 10 years from now, rather than reacting to what worked best last year. And I think that the collaborative grants do allow us to bring expertise from multiple institutions, and help catalyze that collaboration that I think would help bring in expertise from outside the traditional land-grants while really teaming it up. But I think that you do still need those mix of the small, more targeted grants that don't require collaboration as well because so many of these challenges are very local, and you don't want to kind of throw the baby out with the bathwater on that.

Dr. HAUSER. May I speak on behalf of my friend from Michigan State?

Ms. DELBENE. I guess that is a question for him.

Dr. HAUSER. He made the point at the end of his remark, which is an excellent one, and that is, agricultural research often involves very land-intensive, capital-intensive infrastructures that have to

be maintained, regardless of what kind of projects you are doing. It is like farming; you have to have land, you have to have capital, you have to have equipment, regardless of what you are doing, and that for us is often the most challenging part of maintaining the operation that we need to do the scholarship that is expected of us. And so it is a combination of competitive grant running the right way, plus the ability to be at the right capacity level.

Ms. DELBENE. Thank you.

My time has expired. I yield back, Mr. Chairman.

The CHAIRMAN. Thank you, Ranking Member DelBene.

The gentleman from Georgia is recognized for 5 minutes.

Mr. SCOTT. Thank you, Mr. Chairman.

Dr. Lacy, I will be stepping out after my questions because I have an Armed Services Committee as well at the same time, but I do want to thank you for being here and I appreciate your kind comments. My professors might take issue with you at the University of Georgia. But we are the leading producer of poultry in the U.S., and as you testified in your opening statement, a serious outbreak of avian influenza would be devastating to our state's economy, and especially to certain regions of our state and our food supply. This avian influenza has been around a long time. It is something that we just now seem to be coming to grips with that it is here in our country and a major risk for us. Can you explain in more details the work that you are doing to help the producers to help protect the poultry flocks from avian influenza, and what other potential diseases are there that we see in other countries that have not yet made it to America?

Dr. LACY. Thank you. The avian influenza is a disease that has been around, I think it was identified in the early 1900s, and we have had outbreaks of avian influenza in the United States. I remember in Virginia and Pennsylvania in the 1980s, and Texas a few years ago. But our industry is so sophisticated and so on top of being able to diagnose avian influenza that we are able to stamp it out quickly in the past. This particular year we weren't able to stamp it out as we have in the past. It caught us by surprise. So our efforts have been to educate growers, to educate the industry on the seriousness of the present situation, and to redouble our biosecurity efforts to try to keep the virus from entering the commercial chicken houses, commercial chicken production.

Other diseases that cause us problems in poultry production are, actually, mostly respiratory diseases, as avian influenza is; infectious bronchitis, laryngotracheitis, those are two particular diseases. Those we can control by vaccine. Avian influenza, because of trade implications, we have chosen not to vaccinate for avian influenza in the United States.

Mr. SCOTT. What is the difference this year and in prior years? Why did it get ahead of us this year instead of us controlling it the way we had in the past?

Dr. LACY. Another really good question, and again, the importance of that Southeast Poultry Research Laboratory in Athens, Georgia. They have been able to determine that this particular variant of the avian influenza virus is different than what we have encountered before. Like the human flu virus, it is a flu virus, it changes each year. So this particular strain of high-path avian in-

fluenza is unusual, it is definitely more of a problem in our turkey and layer flocks than what we have experienced before, and I think that that coupled with the fact that we haven't had an avian influenza outbreak in some time, again, caught us a little bit by surprise.

Mr. SCOTT. Have you been able to partner with the ARS facilities and other universities on this, or did you speak to potentially CDC and other government agencies, and how you are able to coordinate and work together?

Dr. LACY. We are—it is amazing in Georgia, and I can't speak for other states, but the response there has been superb. The response of all state agencies; USDA, CDC, and our state's Department of Natural Resources, Department of Agriculture, Environmental Protection, all of those agencies have come together, FEMA, come together to plan for a worst case scenario that we hope never happens, but the amount and the effectiveness of that state and Federal collaboration has been amazing.

Mr. SCOTT. Well, I want to thank all of you for being here. And, Mr. Chairman, this just reemphasizes the value of not only research in agriculture, but extension, that protects the food supply of the United States and, quite honestly, the largest food supply in the world.

So thank you all for what you do. I certainly appreciate you being here, and I hope to see you in Athens.

The CHAIRMAN. Thank you to my colleague from Georgia. And I also want to give him a thanks because he is my predecessor in this chair for this Subcommittee, and did a great job during the last Congress too, so thank you.

I tried to avoid the next questioner by going to Mr. Peterson, but, Jim, he didn't have any questions, so I am going to you.

Mr. MCGOVERN. Thank you. I appreciate it.

And I really don't have any questions either, other than to say thank you to the panel. I think it is really important that you are here and talking about the incredible research that you are all doing; because, for a lot of Members of Congress, especially those who are not on this Committee, they don't quite make the connection between our agricultural colleges and universities and what they contribute in terms of agriculture, but in terms of business and in terms of the economy. So I appreciate you being here.

I have seen firsthand how important our land-grant universities are and the incredible work they are doing. I am proud to represent the flagship campus of the five-campus University of Massachusetts system, the UMass Amherst, in Amherst, Massachusetts. And over the years, UMass has expanded into a major research university that covers many areas of research and education, including cutting-edge research and advanced materials and manufacturing, applied life sciences and health data science, and security and many other important fields, driving economic growth in Massachusetts and across the country. But through all that transformation, the school has never forgotten its proud history and roots as an agricultural institution. And I have seen firsthand some of the most innovative and exciting projects revolve around agriculture. Some of you pointed out that some of what you do is unique to the states and areas that you live in. In Massachusetts

I have seen this incredible cutting-edge research on cranberries out of UMass. But what is equally exciting to me is the work that they are doing to help, not only protect our food here in the United States, but help find ways to feed the hungry around the world, and to deal with plant diseases and animal diseases, and all the kinds of stuff that oftentimes result in catastrophes.

So I am just here to say thank you. I support our investment in all of you, and it is important that we brag about it a little bit more because I am not always sure that people get it. When you think of agriculture, oftentimes people don't automatically think about colleges and universities; they think of people working on a farm. But, like I said, I have seen firsthand in my own state, and you have all talked about it here today, unbelievable research. It is worth every penny. And it is cost-effective and you have saved lives in the process too. So anyway, I just wanted to say thank you.

I yield back.

The CHAIRMAN. Thank you. And I echo the comments from my colleague, Mr. McGovern. And thank you for those comments too.

Mr. Moolenaar, is recognized for 5 minutes.

Mr. MOOLENAAR. Thank you, Mr. Chairman. And I also want to thank all of you as panelists for being here, and especially appreciate Dr. Buhler from Michigan State University. We are very proud of Michigan State.

And I wanted to just direct some of my questions to you if that is all right, and then maybe have one question for the entire group. But first of all, thank you for testifying. And Michigan State has really played a lead role in our country, and especially in our state, in agricultural research. And I had a few questions for you based on the understanding I have, and these are kind of technical questions, but one of the questions would be on the Hatch Act, requiring dollar-for-dollar matching funds from state-appropriations. Also requires each state to use 25 percent of its Hatch Act funds to support multi-state or regional research. Do you believe those percentages should be modified at all, or is that the right approach?

Dr. BUHLER. Well, I am very comfortable with the percentages as they stand because one of the things that we need to do, and we are doing much more effectively, is working across state boundaries. One of the positive impacts that we have had in recent years over some of our tough budget times has really driven us to speak more seriously about how we work across state-lines, how do we move information back and forth. So the requirement to use a sizeable portion of the money that way makes a lot of sense, and it is really on the backs of people like us to make sure that we are working with each other. As a matter of fact, the meeting that I left, and I am going back to, is our annual meeting of the directors of research at the land-grant universities, and one of the things that we do at that meeting is talk about how we can more effectively collaborate. So I believe that continuing to put an emphasis on the collaboration—you heard many examples here of how we already work with each other, we need to do more of that.

Mr. MOOLENAAR. And then in your comments you also mentioned working across agencies. Could you speak to that a bit more also?

Dr. BUHLER. Yes. I believe that we are quite fortunate in Michigan is that we have very good relationships with our Department

of Agriculture and Rural Development. For example, the Department of Environmental Quality, as well as the Department of Natural Resources. And so we have very good interactions there. We also have many very strong commodity groups that we interact with very closely. Many of those groups have their own research funding programs that we work with collaboratively. Actually, most of those programs are actually administered through my office, and so we provide that assistance to those groups.

We also have a state-funded program called Project GREEEN, which is specifically a grassroots program that provides funding annually for mostly applied research, with support of the plant and agriculture industries of Michigan, and it is very much integral with the commodity groups. They sit on our review panels, they provide priorities every year, and it has been a very, very successful program, and it is a very, very good example of how universities and industries and state government can work together in an effective manner.

Mr. MOOLENAAR. Along those lines, USDA recently began implementing a two-stage review process for competitive grants, that relevancy is considered under that as well as peer review. Do you think this emphasis on relevancy can improve the producers' support for these programs?

Dr. BUHLER. I very much believe that it can, and I really come from the experience that I just referenced in terms of working with this Project GREEEN Program. The fact that we have the producers at the table in every stage of the process, and they are actually there in the room and understand the interaction of their priorities with strong science, and balancing all of the different priorities of all of the different industries is really critical. So I think it is really important maybe more how it is done. I am more in favor of maybe an integrated program where everybody is kind of reviewing things together so that the science and the relevancy are reviewed together, but the bottom line is I support it, particularly as it relates to programs that relate to applied research, and then moving those results into our community.

Mr. MOOLENAAR. Okay. And then I want to ask you a little bit about cooperative extension, improving communications to constituents involving our food supply. One of the things I wanted to ask all of you is, as we did this GMO labeling bill, it was clear to me that a lot of the advances in biotechnology are being viewed with fear or suspicion, and I just wonder what your universities' role or cooperative extension might play in that.

Dr. BUHLER. Well, just real quickly, we are working very hard to try to get our arms around that. For me personally, we have really gotten the confusion of the technology of genetic modification with some of the discomfort, with some of the specific products that have come from that, and we have really got to figure out how we help people understand. We are talking about new ways of doing it because we don't feel that we are being effective with where we are. So we have to step back and be honest with ourselves, and relook at some of the things we are trying to do.

Mr. MOOLENAAR. Thank you.

Mr. Chairman, I know we are out of time, I don't know if any of the others wanted to comment on that topic, or if you have additional questions.

The CHAIRMAN. Let's get to some of the other Members——

Mr. MOOLENAAR. Okay.

The CHAIRMAN.—and we can go back to that——

Mr. MOOLENAAR. Thank you very much.

The CHAIRMAN.—if possible.

Dr. BUHLER. Thank you.

The CHAIRMAN. Thank you.

Mr. Yoho.

Mr. YOHO. Thank you, Mr. Chairman. And I appreciate you all being here. And, Dr. Heithaus, I appreciate you being a fellow Floridian and doing the research you guys do.

Working off Congressman Moolenaar here, aside from the communications on the success of ag research, how do you believe we can help elevate the importance of ag research? You guys are doing incredible research. I mean it is phenomenal. I look at what we have done in Florida, like on the Papaya Ringspot Virus. It was done over 10 years ago but yet we haven't been able to market it because of the threat of GMO. And, to do the research is great, but if we can't market that—I would like to hear from you guys. What are your thoughts on how we can do that better, because we are constantly being bombarded, and there is a lot of false science out there and a lot of fear, and, of course, there are people that are fueling that, and it is crippling the end-use of what you guys have created. So I will start with you, Dr. Heithaus.

Dr. HEITHAUS. Well, I think that the first thing is that, unfortunately, a lot of scientists like to put their head down, do the work, and get the satisfaction of knowing that they have helped the industry and helped solve a problem. And we need to be very intentional about how we market and communicate about these issues. I think that it is really important that we do this. In south Florida, a lot of people don't know how important ag is, even as an industry. I mean they just think of beaches and tourists, but the ag industry is critical to the success of south Florida, and is really important nationwide. So I think that we need to be very intentional and targeted in how we talk to not just the local agricultural community, but the wider consumer community about what we are doing. And as we build this agribusiness incubator with the University of Florida, one of the components that we are going to be working to train community members in and farmers that work there is in the marketing of their products and how do we talk about this specifically.

Mr. YOHO. Dr. Moyer, did you want to weigh-in on that?

Dr. MOYER. Yes. I think one of the things that we really need to do, and one of the things we have learned from the GMO situation that has now been going on for over 25 years, is that the importance of involving the social scientists in the integration of new technology, and the push on—or the suggestion—strong suggestion of many of these grants of having that multidisciplinary team and involving the social scientists in the project, and then conducting those studies that will hopefully anticipate some of the problems

that might arise, and thereby facilitate the integration of new technologies. And that is something that we have to do.

Mr. YOHO. I agree. And it needs to be a concerted effort that when a new product comes out, we need to blast that throughout the media and not have a television personality coming out and saying, "Oh, this is bad," and it just starts. Dr. Hauser?

Dr. HAUSER. So that raises an interesting communication issue. The emotion associated with biotech and a lot of things in agriculture is communicated how? It is mostly through social media. So while it is good to get social scientists involved, and I am one of those, I am glad to hear that suggestion, it is also good to start thinking about how we communicate, and we are not very good in academia, of getting it out into the forum that people are paying attention to.

Mr. YOHO. Well, and you bring up a good point there because last week, we had a discussion on the Freedom of Information Act——

Dr. HAUSER. Yes.

Mr. YOHO.—how these researchers are doing the research, and then these groups are going after them, making them look like the devil not even in disguise. And they are squashing the researchers' desire to go out and do that.

Let me move on to something else. Dr. Lacy, you were talking about the vaccines that we are not using for avian influenza. I am a veterinarian by trade. I have been around ag pretty much my whole life. Are you guys doing anything in conjunction with NIH about the avian influenza or—not the avian influenza, but the DNA recombinant vaccines that are multivalent? They are using a fraction of the inside cell code to glycoprotein to produce that. Are we working on that with the avian species?

Dr. LACY. There are veterinarians that are working on that. The issue with trade is that if you vaccinate a chicken for avian influenza, you can't really tell whether——

Mr. YOHO. Right.

Dr. LACY.—whether they had the disease——

Mr. YOHO. If they are a carrier or not——

Dr. LACY.—or whether they just have the——

Mr. YOHO.—yes.

Dr. LACY.—antibodies from the vaccine. So there is work going on to try to be able to show that, okay, this chicken is protected from avian influenza but it is not because it had avian influenza.

Mr. YOHO. Okay. And, Dr. Brashears, I just wanted to give you a shout-out for your great research on probiotics. I mean it has been—it has changed the whole industry and I commend you for doing that, especially cutting down the *E. coli.,* the incidents with 90 percent in humans, it dropped it down to about ½ as far as infection. So I thank you for your research. And if the Chairman will let you respond, that would be great. Nothing like being put on the spot. And if not, I am sure he will later.

The CHAIRMAN. Go ahead. Make it quick. I will——

Dr. BRASHEARS. Okay.

The CHAIRMAN. I will take it out of Mr. Newhouse's time.

Dr. BRASHEARS. Okay, great. Yes, well, thank you. We have invested quite a bit in developing the cattle probiotic, and like I said, we have found that it does reduce *E. coli* in cattle by up to 50 per-

cent, which obviously doesn't eliminate it, but through the food processing system, it is an elimination or reduction of risk——

Mr. YOHO. Yes.

Dr. BRASHEARS.—from each step. And that is the importance of taking a farm-to-table approach, whether it be with an animal product or a fruit and vegetable product, every segment of the industry counts with regard to reducing the risk, all the way down to the consumer. And we have to get that information to the consumer so that they know how to properly handle foods, and to ensure public health. But thank you. We have done a lot of work in that. Like I said, it is commercialized and we are very happy with the outcome of that research.

Mr. YOHO. Thank you. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Dr. Brashears. My colleague, Mr. Yoho, takes advantage of our niceness all the time. No, no problem, Ted.

And Mr. Newhouse is recognized for 5 minutes.

Mr. NEWHOUSE. Thank you, Mr. Chairman. And I appreciate having Mr. Yoho in my debt for over 1 minute, let the record show. But thank you very much for having this hearing. I want to welcome Dr. Moyer and his participation here today. As a WSU alumnus myself, I have a soft spot for Washington State University, and really appreciate your being here to participate today.

Some of the—I don't know if you even know this, but some of the research that is happening at WSU is—there is a small project on my own farm where Dr. Michelle Moyer and—I don't think any relation, and her research team, part of which is my own daughter, Jensina, is working on some wine grape projects on our own farm. So I am very much personally aware of the importance of ag research. As the former director of agriculture for the State of Washington, also very happy to have been a great partner, our agency and—as Washington State University, and so appreciate everything that you do. With all of our representatives here from research universities around the country, I don't understand why the line isn't out the door this morning to listen to some of the exciting things that are happening in agricultural research. Every one of us, as Americans and citizens of the world, are a part of agriculture at least three times a day, and this is very exciting, the important stuff that we are working on.

Dr. Moyer, you talked a little bit about the Specialty Crop Research Initiative Program, and I helped to administer that, was responsible for making sure that projects that were worthy were selected, and important enough to get the funding. I wanted to give you a little bit of an opportunity to elaborate on the importance of that, maybe help explain to some of my colleagues who may not be as informed on what the Specialty Crop Program does and can do?

Dr. MOYER. Well, first of all, the Specialty Crop Research Initiative is a relatively recent addition to the farm bill, and it targets those crops that may have been, or were, under-served. I think the—a lot of the research—the federally funded research was at—either at the very basic pioneering discovery end of the spectrum, or it tended to focus on the big three; wheat, corn, soybeans, and there was this whole body of other crops that were languishing because there was not a vehicle to get that pioneering research into

practice. And so with the Specialty Crop Research Initiative, it really fills a unique void. It is that gap, some called it the valley of death, between pioneering research and the day-to-day real world immediate needs of the commodity groups we are funding. And so to get new innovations into practice, there needed to be a vehicle. And I think the insight then to get this done was a very high level of involvement from the stakeholders, as well as targeting these groups. And the groups were ready to do exactly what I described, because it took these teams to really tackle the complex problems. It is a unique project——

Mr. NEWHOUSE. Yes.

Dr. MOYER.—program and it is great.

Mr. NEWHOUSE. Well, thank you. I agree. It is very important. It has been very significant in some of the things that resulted from that. Could you also help us understand the National Clean Plant——

Dr. MOYER. Yes.

Mr. NEWHOUSE.—Network?

Dr. MOYER. The National Clean Plant Network, also relatively new, it is part of the effort to make germplasm available to users. It is a program that facilitates the storage—it is like a germplasm repository for cultivars.

Mr. NEWHOUSE. Yes.

Dr. MOYER. There are several centers around the nation; Cornell, Davis, Washington State. They each have responsibilities for specific crops. Again, they are vegetatively propagated crops, as opposed to seed crops. Again, this was a void. There really wasn't——

Mr. NEWHOUSE. Yes.

Dr. MOYER.—Federal funding to support vegetatively propagated crops. And so they provide the grower with pathogen-tested, true-to-type varieties that they can rely on. They know that the variety is what they say it is, and that it is void of harmful pests.

Mr. NEWHOUSE. Yes.

Dr. MOYER. And so this is a national network. And again, these vegetatively propagated crops tend to be specialty crops.

Mr. NEWHOUSE. Yes. Very important part of the economic fabric of agriculture.

Dr. MOYER. Extremely critical.

Mr. NEWHOUSE. Yes. Well, thank you very much. And again, I thank all of you this morning for being here with us.

Thank you, Mr. Chairman.

The CHAIRMAN. Well, now Mr. Yoho only owes you 20 seconds.

Okay, Mr. Thompson.

Mr. THOMPSON. Thank you, Chairman. Thanks to all of you on the panel. This is a very important topic. The research that you do, or universities do. I have to do a shout-out to my university where I graduated, Penn State University, their agricultural sciences. What you all do is about national security. I would say it is one of the number one important things we have for national security, but it is also about combating hunger.

And so my first—Dr. Brashears, is there an estimate in terms of the work from biotechnology of essentially—I mean just cut to the quick, how many lives that have been—how many people have been prevented from starvation because of the result of bio-

technology being applied in agriculture? Are there any estimates at all?

Dr. BRASHEARS. I don't have an exact number of how many lives have been saved, but we do know that biotechnology does save lives. It increases our ability to produce crops and more abundance in certain environments where, in the past, we could not have done that because of the resistance to disease. It allows us to feed animals and provide protein to the different groups of people that need it. So the number of lives saved is tremendous.

As you know, this week there were some new goals set forth of zero hunger, zero poverty over the next several years. And do I believe that that is achievable? Yes, because I don't think that you should set a goal—or you should set your goals very high, and that you can do things to achieve it. And that can be done through research. We do have the issue of dealing with public perception and getting that knowledge to the individual who doesn't understand science. And I am guilty as well of looking at the consumer and thinking, well, here is the data, how come they don't believe that. But this involves engaging our social scientists and understanding what motivates them to make that decision. And it becomes more of understanding the knowledge and having it, and understanding that person as an individual and what motivates them to make those decisions. It becomes a part of their belief system. And we are gaining more information on that through research on vaccines and why people choose to vaccinate their children or not. One of the classic examples we use is raw milk. People perceive that raw milk is healthier, but it can contain deadly pathogens. If you feed it to your children they can get sick and even die. And that is the bottom line. Getting that message out becomes difficult because parents think I am doing something healthy, something better for my children, and which piece of scientific information do I believe.

So yes, biotechnology saves lives. We need to continue to develop technologies to improve crop production, animal production, around the world in order to achieve these new goals of zero hunger, zero poverty around the globe.

Mr. THOMPSON. Very good. The rest of the panelists, is there any research that has made an attempt to quantify kind of a ballpark of lives impacted by technology anybody is aware of?

Dr. LACY. I am not aware of any. There should be if there is not. But, in addition to saving lives, one of the great things about genetically modified organisms and biotechnology is the decreased impact that we have had on the environment——

Mr. THOMPSON. Right.

Dr. LACY.—in order to reduce the amount of pesticides used, the amount of water, fertilizer inputs, that type of thing, that is just huge. To me, we ought to label everything as genetically modified because everything has been genetically modified since the first time we planted a corn kernel or a wheat kernel, we have been doing it for thousands and thousands of years. I would argue that we actually know more about what we are modifying now than we did previously, which should be a positive thing from a safety standpoint.

Mr. THOMPSON. I have run out of time on this, one of the things that Dr. Brashears—to come back, how do you get the outcomes,

your findings, how does that get disseminated into research so that the end-users; the consumers, the producers, the processors, can actually use that information?

Dr. BRASHEARS. We take multiple approaches. A lot of our work is directly applicable to the food industry. So we work through our commodity groups, such as AMI or NAMI and NCBA, they have been very supportive of our work, and they can help us reach our stakeholders, either through workshops that we can do at Texas Tech or on-site for different companies or organizations, or even cattle producers. So workshops, our website, social media. As I said, I have a social media page where I try to convey information to producers as well as consumers. So we utilize these different resources we have in order to get our research results to the public, and we work with our communications group to put those messages, to tailor those in a way where they understand, so we are not too scientific and going over their heads where we are going to turn them off, to make the message appealing to the general population and our stakeholders.

Mr. THOMPSON. Thank you very much. Thanks to the panel. Thank you, Mr. Chairman. I appreciate you charging any overtime I have to Mr. Yoho.

The CHAIRMAN. Gladly. Done. Hey, actually, I want to thank the Ranking Member, Ms. DelBene, too. Traditionally, we go back and forth, back and forth, but she wanted to make sure everybody here on our side that was still here got a chance to ask questions in case they had another hearing to go to, and because of that, I want to say thank you, and I am going to recognize you for 5 minutes for follow-up questions.

Ms. DELBENE. Thank you, Mr. Chairman. And I just actually had one general question for all of you, which is, the impact from the recent farm bill on funding for your institutions and for the work you are doing, any feedback that you have for us, positive and negative, on how that has gone so far? And anyone? Dr. Moyer?

Dr. BUHLER. I—if nobody—I guess I would say that——

Ms. DELBENE. Okay.

Dr. BUHLER.—we are very pleased that the Specialty Crop Research Initiative, was reauthorized with the new farm bill. That was very, very critical, and I see a nod down there because I believe Washington State, Michigan State, and University of Florida have probably gotten more money than anybody else. So for us, it really is a good complement to some of our state funding, and so we really appreciate that because that has really been an important tool for us to advance our specialty crop work. So we are very thankful for that.

Ms. DELBENE. Okay, thank you.

Dr. MOYER. Yes. Eighty percent of our Federal funding in our college comes from USDA. So having the farm bill funded, we are very reliant on those competitive funds. So we are highly dependent on our agricultural and natural resource research on the funding that is authorized by the farm bill.

Ms. DELBENE. Any other feedback? Dr. Lacy, I see you trying to turn on the microphone.

Dr. LACY. Didn't want to jump in too quickly. We are very grateful to the support that the Agriculture Committee has given to re-

search through formula funds and through competitive research. And I mentioned the Section 1433 funding. We were really grateful that that was authorized at $5 million. We were hoping that maybe, if there were more research funds available in the future, that that might jump up to $10 million in the future. And there is a formula there where a certain percentage of that goes to formula funds, and then the rest goes to competitive funds. That would be a huge help to that shortfall in animal agriculture research.

Dr. HAUSER. Just one particular, like the others, we were grateful for what was—the general outcome for research, but the farm bill also allowed us to take the lead on educating producers about the new farm bill and the new policies, and that was a huge success. Translating the farm bill is often a challenge, to say the least, and with Congressman Davis' help, we were able to get a structure and a process set up to very much do that across—in our case, across the Midwest.

Ms. DELBENE. Yes.

Dr. HEITHAUS. And I would say there are lots of successes in there. As you have heard, the return on investment in research is really high, so what we see in south Florida is a general need for greater investment in research. Also I would just kind of like to echo that comment that the Hispanic-serving agricultural colleges and universities have multiple programs that were authorized but haven't been funded. So funding those would certainly help us maximize our impact and add to what is going on in the land-grant institutions.

Ms. DELBENE. Great, thank you very much. And I will also say, having that long-term visibility I know is critically important because when we make sure that farm bill is in place and that we have it for multiple years so you can plan, and researchers know—those researchers are going to be available. I know is very, very critical. We can't start and stop research very easily, and so that is something else I know is important for all of us to keep in mind for you to be able to do that great work.

So thank you again. And I yield back, Mr. Chair.

The CHAIRMAN. She yielded back time, Ted. Wow. No, thank you, Suzan.

Since we are starting our second round of questions, I am going to go ahead and go.

I had one for you, Dr. Heithaus, in regards to the Hispanic-servicing ag colleges and universities. The establishment of the Capacity Grant Program, when first authorized, the number of institutions qualifying was expected to be relatively low. That number has increased dramatically so that now approximately 100 institutions would divide the funding. Should the eligibility criteria be amended so that funding, if appropriated, would have a significant impact on the institutions that receive it?

Dr. HEITHAUS. Well, I think that, yes, at the base level, yes, funding this, and even if it has to be divided many ways, it would have an impact. A lot of our universities are very used to making very efficient use of funds, and so it would have a real impact. However, the designation level for what qualifies might be something that we need to create a new funding mechanism, or multiple

criteria, so that the allocation of those funds is done in such a way that it will maximize its impact in terms of the areas where there is the greatest need. But there certainly is that need for capacity funding, and there are also some of the unintended consequences of this designation where we can't qualify for certain non-land-grant funding unless we give up that designation. So I think that we do need to do some tweaking on it to make sure that these universities are able to access funding, and that it is allocated in a mix of competitive grants and then capacity-building funding.

The CHAIRMAN. Great. Thank you, Dr. Heithaus.

Dr. Hauser, you mentioned that you had to cut budgets at four research centers recently. Can you expand on that a little bit as to why and what you did?

Dr. HAUSER. It is related to a point that I made about capacity funding, and that Doug made as well. Facilities such as that require a lot of investment, they are fixed costs, and so competitive grants do not help to recoup those costs. As funding has gone down at the state level for us in particular, we have had to reduce expenditures, and reduce expenditures, and reduce expenditures over the last 5 to 10 years, actually. We have not gotten to that point where we are actually taking away research fund capacity, until now. But now we are here. And it is unfortunate, but it also speaks to, again, the need that we have heard several times today expressed which is the capacity and an infrastructure that has to really be emphasized when you are thinking about research in the food and agricultural area.

The CHAIRMAN. Thank you. And you also emphasized the importance of partnerships with the private-sector in doing crop research. When is that appropriate?

Dr. HAUSER. Wow, that is a question that could take the rest of the afternoon.

The CHAIRMAN. We will charge Mr. Yoho.

Dr. HAUSER. There are a lot of gaps, if you will, in the private research arena that can be addressed by the public and by research institutions represented here, whether it relates to market incentives, such as profits in the short-run that they are dealing with, whether it relates to public goods, there are lots of partnerships. And 20 to 30 percent of our research portfolio in my college is in partnership with corporations and the private-sector, and it is very, very useful as long as you can be extremely transparent about everything you do, as long as you are very objective, and as long as you apply the best science and scholarship, if you have those three things, that partnership with the private-sector and corporations works out wonderfully, and we hope to do even more.

The CHAIRMAN. Great. Dr. Hauser, thank you.

I will yield back the balance of my time, and recognize the gentleman from Florida for 5 minutes.

Mr. YOHO. Thank you again, Mr. Chairman. And before my time starts, how is your dog doing, Mr. Chairman?

The CHAIRMAN. Mr. Yoho has——

Mr. YOHO. Thank you.

The CHAIRMAN.—utilized his veterinary services to help me solve a problem with my Yorkie. So thank you, Mr. Yoho——

Mr. YOHO. Thank you, sir.

The CHAIRMAN.—publicly.

Mr. YOHO. Getting back to some of the stuff we were talking about. Of course, George Washington said that you can't have a secure nation if you don't have a secure food source. And I commend again all the research you guys do that you bring to market. And the question comes up, how much is GMO—how many lives has it saved, and all we need to do is look at Dr. Borlaug with the genetic GMO wheat. Billions of people have been saved in the world because of that, and that is a marketing campaign we could do a retrospective study and just look at the results of what we had. But what I wanted to ask you three questions. One is, the funding mechanism, you have the formula and competitive grants, you guys have all experienced both of these, if you could rewrite how universities get their money, do you have ideas that you would just like to throw off, or write a response to us and give us ideas? Dr. Brashears?

[The information referred to is located on p. 63.]

Dr. BRASHEARS. I want to jump in just real quick. Texas Tech University does not get the traditional agriculture formula funding because we are not land-grant. I think that not at the expense of other universities, the land-grant institutions, I do think that there are many large agricultural universities who do not qualify for the formula funding that could benefit from a program that provides some sort of baseline funding for the work that we do. In the words of our Dean, Dr. Mike Galyean, he says that Texas Tech has a much larger research footprint than many of our land-grant counterparts, and it would be very beneficial for us to move ahead in the research arena if the non-land-grant ag-related programs could have some type of program to support them on a very basic foundational level. And I just wanted to jump in and give that before everyone else makes their comments.

Mr. YOHO. I was just curious because, I don't want to take anything from the land-grant, coming from the University of Florida——

Dr. BRASHEARS. Absolutely, yes.

Mr. YOHO.—and IFAS, we are very proud of what we get and the research they do, but yet if there is a better mechanism where we think outside of the box about how we can get the money to the researchers and take that research again to the marketplace, if you have thoughts on that, feel free to contact our office or anybody on the Agriculture Committee.

The other thing is biosecurity research, this is something—there are a lot of people that don't like our lifestyles of liberty and freedom and it is something with the conflicts going on in the world and the unstable political structure of today's world that we have always have to be vigilant about that. Are you guys doing research on somebody contaminating our water supply or our food supply, grain elevators, is there any active research—anybody doing that, and if not, is that something you would be interested in doing, sounds like crickets.

Dr. LACY. We—this is something that we have thought long and hard about after 9/11, and there were meetings and studies done in terms of trying to identify those critical industries in Georgia, and I am sure across the country, that needed to be protected, that

we needed to think about what we would do from a security standpoint. And in Georgia, the poultry industry was definitely one of those things that we took a long, hard look at. I don't think that there have really been any research studies done that I am aware of. It has been more on the practical side, trying to determine where the weaknesses were in those security issues and address those.

Dr. BUHLER. Just to add real briefly, there is a network, it is a Plant Diagnostic Network though, it is not quite as striking as some of the animal issues, but there is the Plant Diagnostic Network that does work on issues that would look at, for the example, of purposeful release of plant pathogens to destroy food production, things like that. So that actually came out after 9/11, and continues today in Michigan State as one of the regional hubs in that system.

Mr. YOHO. Okay, thank you. And I yield back, Mr. Chairman.

The CHAIRMAN. Thank you, Mr. Yoho.

Any questions, Chairman Conaway? Are you good?

Well, again, I want to say thank you to all the witnesses here. I hope you understand how important ag research is to all of the Members of this Subcommittee. Many of us have land-grant universities in our districts. We have grown up around some of the progress that land-grant universities have given us. And it was great to hear other stories about universities getting similar designations, and working in areas that may not be like mine in central Illinois.

I want to thank Chairman Conaway for allowing us to have this hearing to talk about this important subject. And again, each and every one of you deserves our thanks for spending the time and the energy it takes to get out here to Washington, D.C., and talk about agricultural research and its importance to America's ag economy. So the Ranking Member DelBene has left, but she wanted me to also echo her thanks for you all being here today.

And I have to say, under the rules of the Committee, the record of today's hearing will remain open for 10 calendar days to receive additional material and supplementary written responses from the witnesses to any questions posed by a Member.

This Subcommittee on Biotechnology, Horticulture, and Research hearing is now adjourned.

[Whereupon, at 11:45 a.m., the Subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]

SUPPLEMENTARY MATERIAL SUBMITTED BY ROBERT J. HAUSER, PH.D. AND DOUGLAS D. BUHLER, PH.D.

Mr. YOHO. Getting back to some of the stuff we were talking about. Of course, George Washington said that you can't have a secure nation if you don't have a secure food source. And I commend again all the research you guys do that you bring to market. And the question comes up, how much is GMO—how many lives has it saved, and all we need to do is look at Dr. Borlaug with the genetic GMO wheat. Billions of people have been saved in the world because of that, and that is a marketing campaign we could do a retrospective study and just look at the results of what we had. But what I wanted to ask you three questions. One is, the funding mechanism, you have the formula and competitive grants, you guys have all experienced both of these, if you could rewrite how universities get their money, do you have ideas that you would just like to throw off, or write a response to us and give us ideas? Dr. Brashears?

As a follow up to last Tuesday's (September 29, 2015) Subcommittee hearing, attached please find a supplemental statement jointly prepared by the Dean of Urbana's College of Agricultural, Consumer and Environmental Sciences as well as the Senior Associate Dean for Research at MSU's College of Agriculture and Natural Resources. The statement is in response to a question posed by Representative Ted Yoho regarding funding mechanisms for formula and competitive grants.

ATTACHMENT

Supplement to Statements Submitted to the U.S. House of Representatives Agriculture Subcommittee on Biotechnology, Horticulture, and Research

Robert J. Hauser, Ph.D., Dean, College of Agricultural, Consumer and Environmental Science, University of Illinois; and

Douglas D. Buhler, Ph.D., Senior Associate Dean for Research, College of Agriculture and Natural Resources, Michigan State University; Director, MSU AgBioResearch

At the conclusion of the Committee hearing held last Tuesday, September 29, 2015, Representative Ted Yoho of Florida posed a question about the funding mechanisms for formula and competitive grants [administered by USDA's National Institute of Food and Agriculture]. He asked the panelists for suggestions concerning the existing mechanisms and how they could be rewritten in future legislation [for increased effectiveness].

Based on our respective experiences within the land-grant university system, and on behalf of the University of Illinois and Michigan State University, we would like to offer a few relevant thoughts.

- Capacity [formula] funding is critically important to the land-grant universities in each state, because it serves as a stable source of revenue, upon which universities and their state agricultural experiment stations can base long-term decisions about their research infrastructure needs, which have substantial fixed cost components. This is particularly relevant in the food and agriculture sector, where significant investments are needed to build and maintain research infrastructure, ranging from fundamental bench science to applied field research and development, and where a large number of producers and firms are involved across multiple value chains. In such a fragmented industry environment, notable gaps in scientific knowledge exist, creating opportunities for substantial returns on public good investments.
- Inherent in the Federal-state partnerships that underpin the USDA's formula support of state agricultural experiment stations, it is important to insure that Federal capacity funding is used appropriately—to support long-term investment in the fixed costs of research infrastructure and programs.
- For these reasons and to sustain our highly successful model for progress in agriculture and related sciences, Congress should maintain the current level of research capacity funding for state agricultural experiment stations.
- Beyond that base level of Federal formula funding for research capacity, it is imperative that competitive funding levels be increased, commensurate with the indispensable requirements for an abundant and safe food supply and proper stewardship of our resources. Criteria for competitive research funds should direct resources to opportunities for the highest returns on investment and to selectively address the most strategically important problems in the scientific do-

mains that are aligned with the missions of USDA, state agricultural experiment stations, and eligible universities.

The relationship between the Federal Government, the states, and their universities has proven to be extraordinarily effective for advancing science in agriculture and related subject areas. We suggest that Congress build upon that firm foundation and give incentives to our most ingenious minds to solve the problems we face in the future.

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