

**AGRICULTURAL RESEARCH AND SECURING THE
UNITED STATES FOOD SUPPLY**

HEARING

BEFORE THE

**COMMITTEE ON AGRICULTURE,
NUTRITION, AND FORESTRY**

UNITED STATES SENATE

ONE HUNDRED SIXTEENTH CONGRESS

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AGRICULTURAL RESEARCH AND SECURING THE UNITED STATES FOOD SUPPLY

WEDNESDAY, DECEMBER 2, 2020

U.S. SENATE,
COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY,
Washington, DC.

The Committee met, pursuant to notice, at 2:34 p.m., in SD-G50, Dirksen Senate Office Building and via Webex, Hon. Pat Roberts, Chairman of the Committee, presiding.

Present or submitting a statement: Senators Roberts, Boozman, Hoeven, Ernst, Hyde-Smith, Braun, Grassley, Thune, Fischer, Stabenow, Brown, Klobuchar, Gillibrand, Casey, and Smith.

STATEMENT OF HON. PAT ROBERTS, U.S. SENATOR FROM THE STATE OF KANSAS, CHAIRMAN, U.S. COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY

Chairman ROBERTS. I call this hearing of the U.S. Senate Committee on Agriculture, Nutrition, and Forestry to order. Today, I am honored to hold what will probably be my final hearing as Chairman of this Committee, but you never know.

During the four decades I have served in Congress, I have been a member of the Agriculture Committees in both the House and the Senate. Both of the Agriculture Committees regularly work in a truly bipartisan effort to develop policies that best serve the diverse and dedicated industry that is American agriculture.

When I assumed the gavel nearly six years ago, I made it a priority that this Committee would be a platform for America's farmers, ranchers, growers, small businesses, rural communities, school children, and the hungry. Over 80 hearings and meetings later, I believe this Committee has done exactly that. We have deliberated on a variety of issues that directly impact our constituents, including farm and nutrition programs, trade policy, rural economic development, and conservation practices, just to name a few.

I would be remiss if I did not take just a moment to also give a heartfelt thanks to all of my colleagues, and a special thank-you to all of our staff. We set out to accomplish and achieve our goals, but none of our success would be possible without the work and dedication of our staff members that support us. Thank you again.

With all of the challenges and opportunities that our agriculture producers face, it is fitting that the topic of this hearing is agricultural research and securing the United States food supply.

During my time in public office, the United States has witnessed one of its greatest untold success stories, Federal policies that have fostered a scale and efficiency of the U.S. agriculture system that

would have been unimaginable to our predecessors. Agriculture research drives change, efficiencies, and productivity. It is the foundation that supports our modern food system miracle. It is essential, considering the growing chaos, hunger, and malnutrition in our world.

Since the establishment of the land grant university system in 1862, the country has valued and prioritized agriculture innovation. Kansas State University, the first land grant institution created under that act, is no exception. Needless to say, I am so proud of our policy record on behalf of American agriculture.

Working together, we have provided certainty and predictability by transitioning to a market-oriented farm policy. We have also fostered continuous improvement in research, science, and new technologies such as biotechnology. In Fiscal Year 1981, when I began my service in the House, \$1.4 billion in public funding was provided for U.S. agriculture research. By 2015, that annual investment more than tripled to \$4.5 billion. Even more impressive, private sector investment in food and agriculture research rose over 660 percent over that same period, from \$1.6 billion to more than \$12 billion per year.

Given the benefits this research has delivered to both urban and rural constituencies, every member of Congress should appreciate the wisdom of continuing to build on a strong foundation of agriculture research in the United States. This has been quite a year for American agriculture, and certainly so for our American consumers. Perhaps for the first time since the Great Depression, the significance of food security has resonated throughout the entire agriculture and food value chain, impacting nearly every kitchen table around the country and our world.

We continue to learn hard and much-needed lessons about safety and security as we persevere through the COVID-19 pandemic. For years there have been research efforts devoted to the threat of animal and plant disease. We have taken significant and important steps in agricultural security, especially as it relates to animal disease preparedness. We have worked to meet these challenges by identifying vulnerabilities and enacting policies that allow the agriculture and food sector to be better prepared and more secure.

Still there is a great deal to do. We must take a fresh look at what agriculture security means, in terms of the defense of our agriculture sector and our food supply. This begins with continued support for agricultural research. Agricultural research has been a priority in all of the eight Farm Bills that I have had the privilege to work on. In a period of tight budgets and flatlined discretionary spending, the 2018 Farm Bill, with 87 bipartisan votes, provided an increase of \$780 million in mandatory funding for agriculture research over 10 years. The Farm Bill also established new authorities and investments to bolster research and scientific understanding related to the security of our food supply.

Authorities like the Agriculture Advanced Research and Development Authority, AGARDA, now allow the Department to carry out advanced research and to develop cutting-edge technologies and research tools. It is vital that we have the necessary authorities, capabilities, and scientific understanding of zoonotic diseases, such as COVID-19, to prevent and combat these diseases, protect the food

production and supply chain, and meet the nutrition needs of a growing and ever-changing population.

There is no doubt that we are in a better place today because those who came before us recognized the need for research and innovation in agriculture. I look forward to hearing from our panel about what these past efforts have meant and, more importantly, where we should go from here.

With that I recognize Senator Stabenow for her remarks.

**STATEMENT OF HON. DEBBIE STABENOW, U.S. SENATOR
FROM THE STATE OF MICHIGAN**

Senator STABENOW. Thank you, Mr. Chairman, for holding this important hearing. Thank you to our witnesses who will be testifying today. Mr. Chairman, of course, I want to start by recognizing this is our last hearing together. While we will deeply miss your leadership, your wit, and your determination on the dais, you will always be watching over us through your newly unveiled portrait that is in our Committee room. Since I will be looking at you, I wanted to return the favor as well by presenting you with this.

Chairman ROBERTS. You better not tell anybody about this.

Senator STABENOW. I know.

Chairman ROBERTS. You are going to get in trouble. Thank you very much.

Senator STABENOW. You are welcome.

From showing you around Michigan to marking up the bipartisan Farm Bill, it has always been an honor to be your partner on the Committee as well as your friend. Looking back on all we have accomplished, I know your legacy will live on through the words you have written into law and the relationships you have built as you have carried on your work.

In recognition of your dedication and hard work, on behalf of the entire Committee I would like to present you with the Chairman's gavel.

Chairman ROBERTS. Thank you.

[Applause.]

Senator STABENOW. Thank you for your leadership and your partnership. I know that you will be leaving the Committee in good hands. I am looking forward to working with my friend, Senator Boozman, in the next Congress.

For our last hearing together it is only fitting we reflect, as you said, on one of the most impactful issues we have worked on together—agriculture research and the important role it plays in protecting our food supply. Mr. Chairman, the importance of research to your home State certainly will not be lost on this Committee, particularly today, given the fact that we have three Kansans testifying today including former USDA Secretary Dan Glickman, who is a great friend of both of ours.

While there is no shortage of support for agriculture research, as we both know, for too long the need for investment has outpaced the funding available. That is why we worked together closely in 2014 Farm Bill to create the Foundation for Food and Agriculture Research, which carries on today. Dollar for dollar, it matches public investments with private funds to support every corner of agri-

culture, from animal disease preparedness to pest management for fruit growers, to growing techniques for urban farmers.

When we were working on the 2018 Farm Bill, it was a no-brainer for us to expand research, including The Foundation's innovative public-private partnerships, which are critical to addressing one of the greatest threats to agriculture, the climate crisis. Today we will hear from General Mills about their partnership with the Foundation to conduct critical climate research and expand regenerative practices for grains in Kansas and dairy in Michigan.

We know that accelerating agriculture research is vital to feeding a growing global population and addressing the climate crisis which threatens farmers' livelihoods and our entire food supply. From floods to droughts, farmers are already seeing the devastating impacts of extreme weather. In fact, the GAO estimates that climate change will result in crop losses that could cost up to \$53 billion in the coming years.

Fortunately, there is momentum to scale up research that helps our farmers not only adapt but be part of the solution to the climate crisis. Last month, a new coalition of farm and environmental groups, led by the American Farm Bureau, National Farmers Union, and the National Council of Farmer Cooperatives issued 40 different recommendations to address climate change, including substantive new funding for agriculture research.

I am very proud that this Committee has not only focused on this issue but we have been the one Committee that has done two bipartisan hearings on this issue, and I am very grateful that we have been able to do that.

Again, Mr. Chairman, I so much appreciate the opportunity I've had to work with you, and I am going to miss you. It has been my great pleasure to have the opportunity to get to know you and Franki personally, and to understand all that you bring to not only the job but to life. I wish you the best as you go forward in your next steps and with what you and Franki are going to be doing. I wish you only the best. Thank you very much for everything.

Chairman ROBERTS. Thank you.

I now recognize the distinguished Senator from Arkansas, who has been our pulling left guard in everything that we have done. Please, Senator.

**STATEMENT OF HON. SENATOR JOHN BOOZMAN, U.S.
SENATOR FROM THE STATE OF ARKANSAS**

Senator BOOZMAN. Thank you, Mr. Chairman, and in a second I am going to sneak off for just a little bit, and either come back or catch the rest of the hearing on Zoom. One of our dear colleagues, Senator Enzi, is giving his farewell talk, as you know.

I just wanted to take a second. You know, I have always been blessed. The Lord has always blessed me with coaches and teachers that made me better than I really wanted to be, at times, just by pushing me and helping me. Certainly, I do appreciate the fact that you have taken me under your wing these last several years and really just been so, so very helpful.

I also want to thank our Ranking Member, Debbie Stabenow. I think the example that you just gave, you know, of the gifts that you gave, the pictures, says it all. We are blessed. We have a very,

very bipartisan Committee, and as a result, you two have done a tremendous amount of work. The Farm Bills, we know how difficult those are. I think most of Congress understands how difficult, but for you all to get the last one out—and it was not perfect, but it was awful good—and to have a record number of votes truly is remarkable.

Not only the Farm Bill, but so many other things that you all have been able to set the example for the rest of the Committee. I know, Senator Roberts, and Senator Stabenow, not only taking care of yourselves and each other, but taking care of the rest of the Committee, which is so, so very important to your members.

To say that we are going to miss you is an understatement. Your experience, you have been around long enough that the modern Farm Bill—and this is not an exaggeration—the modern farm legislation that has been written, you have had a hand in either writing it or helping to write, and that really is remarkable, both on the House side and the Senate side.

Again, thank you so much for the great work that you have done, and as Debbie said, we are going to look up and see you a great deal, hanging on the wall. Thank you very much.

Senator STABENOW. Mr. Chairman, we do look forward to hanging you as we enter the new year.

Chairman ROBERTS. We have already had the hanging, or the unveiling. Unlike Senator Leahy's portrait, whose eyes keep following us, I have not quite got that down yet, at any rate.

Let me introduce the witnesses, if I might, and bring back every word that our great friend and Senator from Wyoming, Senator Enzi, says, so at least I will get to read it on the same day that he gave it.

Our first witness, Mrs. Amy France, hails from Marienthal, Kansas, where she farms alongside her husband, Clint. Their row crop and livestock operation includes grain sorghum, corn, wheat, soybeans, and Black Angus cattle. They are diversified. Mrs. France currently serves on the National Sorghum Producers board of directors, as well as on the board of the Kansas Farm Bureau Foundation, and President of the Wichita County Farm Bureau.

Amy and Clint are proud parents to five children, one granddaughter, and a second grandchild on the way. Welcome back, Amy. It was great to hear from you when we kicked off our farm bill hearings in Manhattan, and I look forward to hearing from you again.

Next we have Secretary Dan Glickman, who served as our U.S. Secretary of Agriculture from March 1995 until January 2001. Previously, he represented the Fourth congressional District of Kansas for 18 years in the U.S. House of Representatives, where he was a member of the House Agriculture Committee.

He currently serves as Vice President of The Aspen Institute. He also serves as a member of the boards of the Foundation for Food and Agriculture Research, the World Food Program, Food Research and Action Center, and the Chicago Mercantile Exchange.

Dan happens to be one of my very best and dear friends, and I welcome him today. I thought about thinking of something funny to say, Dan, prior to introducing you, but this is a serious hearing

and I think I will just let that go. Welcome and thank you for participating in today's hearing.

Our next witness is Dr. Stephen Higgs. He is the Director of the Biosecurity Research Institute, the BRI, and Associate Vice President for Research at Kansas State University. He has conducted and directed research on multiple topics, including novel methods of virus infection and transmission.

Dr. Higgs earned a doctorate from Reading University in the United Kingdom and a bachelor of science with honors in zoology from King's College in London. Dr. Higgs was recently awarded the prestigious Harry Hoogstraal Medal for outstanding achievement in medical entomology. Congratulations for the award and we welcome you, Dr. Higgs. We look forward to your testimony.

Now Senator Klobuchar plans to introduce Dr. Rosenzweig, and if she cannot attend the hearing, I will. Senator Klobuchar, I recognize you at this time.

**STATEMENT OF HON. SENATOR AMY KLOBUCHAR, U.S.
SENATOR FROM THE STATE OF MINNESOTA**

Senator KLOBUCHAR. I am here, Mr. Chairman, thank you.

First of all, I am glad that we broke the glass ceiling to have one non-Kansan here at your last hearing, for Dr. Rosenzweig. Before I introduce him, I just wanted to say to you, Senator Roberts, how grateful I have been for your chairmanship, how much I have enjoyed personally, like every member of this Committee, working with you on so many different things, from ag machinery to the food supply. I have so enjoyed your sense of humor, and we are going to miss that so much. As noted, we will see you there every single day when we are in the hearing room.

One other thing I wanted to add, having been at your portrait unveiling, it was just incredible the outpouring of love for you from your former staff, from members, former members, and that is a legacy that not everyone can have. So congratulations, and I know you are going to have a great retirement, and I have a feeling we are going to see you again.

Dr. Rosenzweig, our one and only Minnesotan here, is with us to talk about the work that Minnesota's General Mills is doing to invest in and promote regenerative agriculture as a way to overcome the challenges that are facing our farmers and food industry. He serves as Senior Agricultural Scientist at General Mills, where he leads research and outreach programs across North America to support farmers in implementing regenerative agriculture and to better understand how these systems impact the environment and also our farm economy.

Both Senator Smith, who also serves on this Committee, from the State of Minnesota, and I welcome you, Dr. Rosenzweig. Thank you very much, and thank you, Senator Roberts.

Chairman ROBERTS. Amy, thank you very much for those very kind comments. It is good to have you back, and thank you for your co-sponsorship or cooperation in regards to FFAR. I think that was a real step forward, so I appreciate that.

It is time now for our first witness, Mrs. Amy France.

Amy, why don't you proceed.

**STATEMENT OF AMY FRANCE, PRODUCER, NATIONAL
SORGHUM PRODUCERS, MARIENTHAL, KANSAS**

Mrs. FRANCE. Thank you, Chairman Roberts, Ranking Member Stabenow, and members of the Committee for this opportunity to present the view of National Sorghum Producers regarding agricultural research and securing the U.S. food supply. My name is Amy France and I farm near Marienthal, Kansas, alongside my husband, Clint, and our five children. We grow grain sorghum, corn, wheat, soybeans, and cattle. I hope my testimony as a farmer, on behalf of NSP, will be helpful to you and the Committee.

First, Mr. Chairman, thank you for all you have done for farmers like me and my family. Your authorship of the Freedom to Farm Act acknowledged a trust in the American farmers to assess and meet the needs of the global marketplace. As a fellow western Kansan, I thank you for your legacy of leadership.

The U.S. sorghum industry encompasses approximately six million acres, yielding over 350 million bushels of grain, supplying both domestic and international markets. We have witnessed challenges brought by COVID-19 and recent international trade disputes. Yet, sorghum farmers have persevered. Perhaps more concerning are extreme weather challenges in recent years, which could threaten our ability to grow a crop. Fortunately, with its inherent heat tolerance and robust root system, sorghum sequesters carbon and builds healthier soils, making it a sustainable model crop.

Sorghum producers have craved innovation, and not just to respond to the challenges of today, but to prepare for challenges ahead. We applaud this Committee for establishing AGARDA. Sorghum producers have seen how investments and not just cutting-edge, but bleeding-edge science can result in significant leaps forward.

In 2014, the Department of Energy launched ARPA-E to facilitate a government role in the financial risk to develop transformational technologies in the energy sector. One of these programs was Transportation Energy Resources from Renewable Agriculture, or TERRA, which selected sorghum as the model crop for its drought tolerance and genetic variability.

In plant breeding, sequencing DNA is the easy part. It is confirming what genetic changes do in the field that slows new variety development. TERRA utilized advanced sensing technologies and high-performance computing to rapidly identify changes in the field. Building on the successes of TERRA, ARPA-E launched a program called ROOTS, to take what was being done above ground and deploy it below.

We have learned more about sorghum genetics and root development in the last six years than we have in the previous six decades, and agriculture is just one small portion of the overall ARPA-E investment. Imagine what U.S. agriculture could accomplish with AGARDA if properly resourced and utilizing the ARPA-E philosophy.

Often, the mile between scientific discovery and my seed bag is most challenging. This is why, in 2016, sorghum farmers participated and partnered with Kansas State University to create the Collaborative Sorghum Investment Program. To date, CSIP has es-

tablished technology transfers for advances like herbicide tolerance and pest resistance toward seed innovation for sorghum.

Remaining hurdles to innovation are frequently regulatory in nature. Gene editing, or CRISPR, for example, allows breeders to quickly make direct edits to the genome, changes that otherwise could take years or even decades to accomplish through conventional breeding.

Last spring, USDA published their SECURE Rule, updating their biotechnology regulations. While not perfect, we believe this rule encourages the pursuit of innovations.

In October, EPA took initial steps to modernize their Plant Incorporated Protectants regulations, and while we appreciate their efforts, the proposal falls short. In it, EPA acknowledges the precision of gene editing and its inherent low risk, but the proposal creates too many hurdles and stifles innovation. EPA's proposal regulates based on the process rather than the product, which is in contrast to the USDA approach and the recommendation of the National Academy of Sciences.

We encourage this Committee to consider these regulations closely and engage with EPA and USDA on development. We must get this right. We have to tackle the environmental and food availability issues ahead.

Sorghum farmers have long known the value of sound science. We have witnessed research at the local level to identify risk for crop insurance purposes and groundbreaking results to tackle global sustainability efforts. Looking forward, we are hopeful for a robust research portfolio and what we can accomplish with AGARDA.

Again, thank you to the Committee and Ranking Member Stabenow for the opportunity to share these perspectives, and to Chairman Roberts, I especially want to thank you for your decades of service and unbridled support to Kansas farmers like me and my family. Thank you.

[The prepared statement of Mrs. France can be found on page 38 in the appendix.]

Chairman ROBERTS. Amy, thank you very much, especially on the reasonable approach to regulations that affect all of agriculture.

The Honorable Dan Glickman, Secretary Dan Glickman, please.

STATEMENT OF THE HONORABLE DAN GLICKMAN, EXECUTIVE DIRECTOR, THE ASPEN INSTITUTE, WASHINGTON, DC

Mr. GLICKMAN. Thank you, Senator Roberts, thank you, Senator Stabenow, and thanks to all the Senators here. You know, the Roberts-Stabenow relationship has been a wonderful marriage, a perfect marriage of bipartisanship, working together, and a real legacy, not only for Pat and Debbie but for the whole Congress. I just want to commend you. It was this Committee that 25-1/2 years ago confirmed me as Secretary. I do not think any of you were there in this capacity, although Pat and I served together in the House with Senator Dole, Senator Leahy, Senator Lugar, and others. What a great Committee and what a legacy you all have put together.

I hope my entire statement will appear in the record. I just want to mention a few things. I think there are six goals in agriculture

research. One is really to have the resources and the prioritization of food and agriculture research generally. This is important stuff, and it needs to have the kind of priority and funding for the future. It needs to focus both on basic and applied research and it really needs to provide an opportunity for human talent for a new generation of young, bright scientists to enter the picture.

No. 2 is to sustain farming and productivity, which Amy talked about and which all farmers want. No. 3 is to encourage consumer trust in the food supply. No. 4 is to fight hunger, and we are seeing hunger is a much more serious problem today than even two or three years ago, because of COVID. No. 5 is worker safety. That is worker in agriculture writ large. No. 6 is to promote sustainability and environmentally friend agriculture, in an era of climate and weather volatility.

Let me just—and, by the way, the Foundation for Food and Agricultural Research, which Debbie and Pat were actively involved with, and so was Amy and others on this Committee, I think is really a profound—will have a profound impact on the future of agriculture.

First COVID. COVID has been a disaster for the country and agriculture, with 260,000 people dead, 100,000 people in the hospital today. COVID is an example of an animal disease that jumped to the human side of the picture, and it has caused chaos in human health, in the food and agriculture system writ large, agriculture workers, businesses, and a frightening increase in domestic hunger that we see.

As we look at these viral-related diseases, we really need to dramatically increase the research and focus on that. A lot of this is being done at Kansas State University, but this is going to have to, again and again and again—and, Dr. Higgs, I think you may talk about this a little—but we must give it the attention that it needs, because the risks involved are just monumental, dealing with this.

The second issue I would talk about is the issue of nutrition and health. Diet-related diseases are the leading cause of poor health and early mortality of not only people in the United States but around the world, and contribute to hundreds of billions of dollars of public and private spending to deal with preventable diseases like type 2 diabetes. I think the relationships, especially on the research side, between food, health, agriculture, and medicine are often neglected.

The Federal spending alone for type 2 diabetes is over \$160 billion a year, and chronic diseases are the fastest growing part of the Federal budget. Agriculture needs to be a key player in discussing these issues of nutrition, both in Federal feeding programs as well as the basic research that is being done.

Exactly 51 years ago today, President Nixon hosted the first White House Conference on Food Nutrition and Health, and this was a seminal event to bring people together to look for ways to improve nutrition in America. Out of that grew almost all of our feeding programs. Much of our Nation's poverty is still impacted by too much hunger and too poor of a diet in this country, but agriculture needs to play a key role in that.

I believe the Committee and the Congress should encourage the next administration to hold another White House Conference on Food Nutrition and Health, bringing together the Nation's food and agriculture leaders and scientists and people in the food industry and the medical community to better understand the issues of nutrition.

Third is in the area of climate change. I am really glad to see that there is bipartisan cooperation in the farm community to look at these particular issues, how weather, volatile weather and climate—drought, floods, heat—is critical to deal with the health of the agricultural system. It affects almost all crops across the world, but wheat and rice are particularly affected as is animal health, and the terrible damage done by the increasing number of forest fires in this country.

I would add that more and more farmers and ranchers and others in the ag industry are working together on these issues, recognizing that climate change is real, not political, but we have to work together to find ways to develop sensible, reasonable, and impactful solutions.

You know, I am one who believes that ag research and food-related research deserves a much higher priority, and it is more important than sometimes people outside of agriculture give it credit for. With all the vexing problems impacting agriculture, it is really important that there be an across-the-board system in our government to give priority to these issues.

The National Academy of Sciences Breakthroughs 2030 identifies innovative emerging scientific advances for making our food and agriculture more efficient, resilient, sustainable, and provides a good analysis of those things that could destroy the ability to produce the food supply. They asked two real good questions. What are the big questions in ag research that need to be answered in the next decade? What are the strategies needed to produce adequate food supplies sustainably to feed a hungry and healthy world, and how do we best achieve these new, enhanced technologies, that Amy talked about, in a safe and transparent manner, with the necessary human capital, people power, to get all these things done?

I just might want to comment on two other things before I finish. The Foundation for Food and Agriculture, which you all were responsible for creating, particularly this Committee, was authorized in 2014. It has received nearly \$400 million in Federal funds to date. It has engaged over 400 outside funders, the epitome of public-private partnerships. The work on all the issues that we have talked about has been leading the way in a new Agriculture Climate Partnership. Dr. Sally Rockey and her team have been extraordinary in advancing these new technologies. It is my hope that you will consider ways to provide more secure funding in the future for FFAR.

I also want to commend the work of the Chicago Council on Global Affairs, where I serve as a Distinguished Fellow, which has been a seminal force in tying global and domestic hunger and research together. There are tens of millions of people in the world, the developing world, suffering from malnutrition and hunger, often facilitating violent ethnic and regional conflicts. The Feed the Future

initiative, which is in USAID, was in large part developed through the work of the Chicago Council in collaboration with the USDA and USAID, and it is really important that that research continues.

I might add that Feed the Future initiative, coupled with sustained U.S. financial assistance to the World Food Programme has continued to be transformation in feeding a hungry world during these turbulent times. It would be a mistake to give up on American assistance to hungry people around the world, and it is a mistake for America to go alone on these issues, whether eliminating hunger or fighting climate change at home or around the world.

Mr. Chairman, my full statement gives a lot of these provisions in greater detail. A lot of other folks have been involved in the issues that I have been working on, and I will be glad to answer any questions. Thank you.

[The prepared statement of Mr. Glickman can be found on page 43 in the appendix.]

Chairman ROBERTS. We thank you, Mr. Secretary. Our next witness is Dr. Stephen Higgs, who is in charge of the Biosecurity Research Institute at Kansas State University.

STATEMENT OF STEPHEN HIGGS, Ph.D., DIRECTOR, BIOSECURITY RESEARCH INSTITUTE AND ASSOCIATE VICE PRESIDENT FOR RESEARCH, KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS

Dr. HIGGS. Chairman Roberts, Ranking Member Stabenow, distinguished members of the Committee, I am honored to appear before you today on behalf of Kansas State University, K-State, for this hearing. I am Stephen Higgs, Director of K-State's Biosecurity Research Institute, the BRI, which, as you know, is housed in Pat Roberts Hall here in Manhattan.

In 2015, the bipartisan Blue Ribbon Study Panel on Biodefense concluded that the United States lacked leadership, a strategic plan, and a dedicated budget to address biological threats to U.S. agriculture. Nonetheless, with appropriate information and research data we can prioritize, predict, and perhaps anticipate pathogen introduction, and therefore focus resources or implement measures, and hopefully prevent an introduction.

If a pathogen is introduced into the U.S., early detection and accurate identification is critical so that countermeasures such as vaccines can be rapidly deployed to contain and eradicate the pathogen before dispersal. Unfortunately, surveillance is never perfect because you cannot look for everything everywhere, all of the time.

Open sources of information such as Promaid [phonetic] can provide us with the what, where, and when information, but research data, pathway analysis can direct surveillance and resources to high-risk locations.

Reagents provide the knowledge and understanding of pathogens that we need to develop reagents and technologies for rapid pathogen-specific detection. Countermeasures such as vaccines and therapeutics all depend on research. Research enables strategic planning to optimize the use of our resources. To illustrate the importance of research, I will, unashamedly, use a few examples from the BRI. It is a unique facility working on threats to plants, ani-

mals, post-harvest food products. These include zoonotic pathogens that can directly infect people and cause fatal diseases.

Research at the BRI has conducted evaluation of technologies to detect and identify pathogens that threaten our military by their food supply, and methods to control food-borne pathogens on livestock carcasses; development of wheat varieties resistant to wheat blast fungi; vaccines to protect birds from avian influenza and to protect swine from African swine fever virus.

Reagents to identify pathogens of swine, including rapid diagnostic test kits for African swine fever virus, ASFV, have been developed at the BRI. Studies have demonstrated that the virus can survive in animal-free products, but if imported from endemic areas could introduce the pathogens here.

Research on Japanese encephalitis virus has demonstrated susceptibility of North American mosquitos and of both domestic and feral swine. Research on Rift Valley fever has developed diagnostics and studied these diseases in sheep, cattle, and white-tailed deer.

The National Agricultural Biosecurity Center, NABC, at Pat Roberts Hall, is leading efforts on threat assessment, disease response training and strategic planning, and communication networks needed to protect U.S. agriculture.

In March, research at the BRI was quickly refocused to improve our understanding of SARS-CoV-2. Research proved for the first time that the virus neither affects nor is transmitted by mosquitos. Research has evaluated swine in cats as hosts and hamsters as small animal models. Vaccine candidates and approaches to reduce infections in meat processing facilities will be evaluated in the coming months.

Complementing the research, the BRI has developed courses and training programs related to foreign threats to agriculture, several of which have now been completed for online delivery.

Looking to the future, much still needs to be done. For example, funding of the AgARDA program in the Farm Bill is needed to support research on threats to both plants and animals. Strategic bio- and agrodefense legislation and enhanced congressional oversight is needed to develop and support long-term strategic approaches to protect U.S. agriculture and our food supply. This Senate Committee should lead these efforts to protect U.S. agriculture and food from natural and intentional biological threats.

Research is absolutely essential in order for the U.S. to defend itself against foreign threats to U.S. agriculture and our food supply. However, funding must be strategic to support research that will provide the information, knowledge, understanding, and practical technologies that are needed.

As we have seen with SARS-CoV-2 and other pathogens, biological threats can emerge with little if any warning and spread far and fast. Funding must not only sustain what we have but build on this and give us what we need so that we can quickly respond and combat known and unknown future threats.

The erosion of our capabilities through a lack of long-term strategic funding results in management-under-crisis conditions. Nature will not wait for us to get our act together, and those who wish us harm may take advantage of our lack of preparedness.

Thank you for giving me the opportunity, and my personal thanks to everything that you have done, Senator, Roberts, for our country.

[The prepared statement of Dr. Higgs can be found on page 46 in the appendix.]

Chairman ROBERTS. I appreciate that, Dr. Higgs.

Our next witness is Dr. Steven Rosenzweig. Doctor, please.

STATEMENT OF STEVEN ROSENZWEIG, Ph.D., SENIOR AGRICULTURAL SCIENTIST, AGRICULTURAL RESEARCH, GENERAL MILLS, GOLDEN VALLEY, MINNESOTA

Dr. ROSENZWEIG. Chairman Roberts, Ranking Member Stabenow, and distinguished members of the Committee, thank you for the invitation to testify here today and for your bipartisan legacy of supporting public agricultural research. Your accomplishments in the last farm bill's research title should be applauded, and Chairman Roberts, I would like to especially thank you for your distinguished leadership on agriculture, nutrition, and national security in Congress over the last 40 years.

When I was a Ph.D. student studying soil science, I never imagined myself working for a global food company, let alone testifying to this Committee on its behalf. The fact that positions like mine exist reflects the importance of agricultural research to every level of the food system, from farmers to consumers.

General Mills has been making food for over 150 years, but there are challenges facing agriculture today that threaten our ability to continue making food for another 150 years. Among the most urgent challenges include climate change and the continued degradation of natural resources. Unsustainable rates of soil erosion, biodiversity loss, greenhouse gas emissions, and water usage and pollution weaken the resilience of our agricultural systems, particularly in the face of climate change.

As a growing number of farmers and ranchers are demonstrating, focusing their innovation on restoring the soil and biodiversity of the farm ecosystem through regenerative agriculture creates positive, cascading impacts for the farm business, the environment, and society.

Regenerative ag is a farmer-led movement containing a diversity of ideas and beliefs, but at its core it is a holistic approach to farming and ranching that integrates principles of agricultural management that work to restore and enhance critical processes like water infiltration, carbon sequestration, and nutrient cycling. Farmers leverage these natural processes to reduce reliance on external inputs, leading to greater profitability and enabling the generation of a range of ecosystem services.

At General Mills, we consider regenerative ag to be our greatest opportunity for meeting our commitment to reduce our climate footprint by 30 percent by 2030. Agriculture makes up almost 60 percent of the greenhouse gas emissions in our value chain, making it essential that we address agricultural emissions.

Regenerative ag empowers farmers and ranchers to play an important role in the fight against climate change, and it can and should be a part of an economy-wide strategy for tackling this important issue.

General Mills is committed to advancing regenerative ag in one million acres by 2030. Over the last two years, we have worked to pilot a range of strategies for amplifying this farmer-led movement and accelerating adoption in key sourcing regions. To date, we have established pilots in Kansas, North Dakota, Minnesota, Michigan, and Canada. Across every pilot there is a variety of farmer experience levels and production types, including both organic and conventional farmers. Our pilot strategies include a mix of different resources and incentives for farmers, including education, coaching, cost share, payments for ecosystem services, expanding markets for alternative crops, including perennials, and supporting State-level soil health coalitions, and more.

We are leveraging a pilot social science research to identify the most effective and scalable strategies for promoting sustained adoption of regenerative systems, but we need more public research helping to identify effective strategies for increasing adoption.

We have also made investments in research to advance the science of regenerative ag and improve our understanding of its potential impact to the environment and the economy. Chairman Roberts and Ranking Member Stabenow, I want to thank you for your leadership in the creation of the Foundation for Food and Agriculture Research, or FFAR, in the 2014 Farm Bill. FFAR has built many public-private partnerships needed to help advance important research in the industry. Several of FFAR's flagship programs have been launched in partnership with General Mills, notably the Soil Health Initiative, Open TEAM, and the research arm of the Ecosystem Services Market Consortium, or ESMC.

General Mills, together with the Kansas Department of Health and Environment and the ESMC is carrying out one of the first pilots of this market in Kansas, and which will pay farmers for greenhouse gas reductions and water quality improvements and conduct the research necessary to create a scaled and efficient ecosystem service marketplace that benefits farmers and ranchers.

Despite the many challenges facing our food and agricultural systems today, there are reasons to be optimistic about the future. Farmers and ranchers are increasingly innovating to regenerate farm ecosystems and businesses, and more than ever the private sector is looking for ways to contribute. With emerging opportunities like ecosystem service markets and public-private partnerships for research and innovation, the food and ag industries have opportunities to invest in securing the resilience of the American food supply.

We encourage this Committee to consider more Federal investment, public agriculture research for public-private partnerships to address climate change and sustainability issues in U.S. food and agricultural.

Thank you for the opportunity to testify on these important issues, and we look forward to continuing to work with you all. I am happy to answer any questions the Committee members have.

[The prepared statement of Dr. Rosenzweig can be found on page 60 in the appendix.]

Chairman ROBERTS. We thank you for your testimony, and I will try to make my questions very brief, and I know others are waiting patiently.

Amy, let's start with you. The sorghum industry has shown a great deal of resourcefulness in pursuing both the traditional and non-traditional funding sources in sorghum research, in particular, the success of sorghum projects under the Department of Energy's Advanced Research Project Agency—we call that ARPA-E; everything in Washington has to have an acronym—inspired the creation of AGARDA in the 2018 Farm Bill. How do you believe the robust use of this advanced research and development authority at the USDA can benefit U.S. agriculture generally, and individual producers specifically? Feel free to talk again about overregulation.

Mrs. FRANCE. Sure. Thank you, Senator. I think just as Mr. Glickman alluded to, it is successful because it is the private-public efforts, and it has commercialized real-world results, which I think is a key factor in moving forward and really why it plays such an important role.

Sorghum has been already chosen to be part of the things that are moving forward because we already have so much on our side, water-sipping, things like that. The agency's choice of sorghum as a model crop is just an ag-related endeavor as well.

As we look at things that are—as I said in my testimony, oftentimes the final step is a hiccup in the regulatory steps, and I think it is really interesting and something to think about. We want technology moving forward in all areas. We want the best in technology from medicine. We want the best in technology or automobiles, and everything we use on a daily basis. Something like this would continue to move us forward as agriculture, and something that is very necessary and almost puzzling why agriculture is held back.

Chairman ROBERTS. I appreciate that very much. Thank you, Amy.

Dr. Higgs, we are still facing, obviously, the devastating impacts of COVID-19. That is, in fact, a zoonotic disease that has become a human health crisis. As we face this, in light of the pandemic, what are some ways in which the zoonotic disease research priorities have already changed, or should change, and let me emphasize the “should change,” both for the institutions here in the U.S. and globally?

Dr. HIGGS. Thank you for the question, Senator Roberts. You know, with respect to zoonotic disease research priorities, something that COVID-19 has shown us is that we never seem to be prepared. That is true even if the warning signs are on the horizon and heading our way.

Most of the emerging threats to human health are zoonotic, and jump from animals to people. It is really quite rare that we do not know something about these threats, even if it is about a closely related pathogen.

I think our priorities should really not be changed. We have to be vigilant. We have to have the tools and the people that we need. We have to have a strategic plan, and dare I say, like a Boy Scout, always be prepared. Knowledge is power and research provides that knowledge to combat these pathogens.

We need a system of sustained funding, not a system that has to be reinvigorated or, worse still, reinvented. Our sort of funding with a pattern of famine, to feast to famine, is just not a good strategy. We need sustained funding so that we cannot lose our ex-

expertise, our work force, and our abilities to deal with these pathogens.

Chairman ROBERTS. Thank you, Doctor.

Secretary Glickman, you bring obviously a broad perspective on how both public and private investment in ag research can leverage funding to have the greatest impact. As we continue to face our budgetary constraints, what recommendations do you have to encourage continued growth in private sector engagement and investment in ag research?

Mr. GLICKMAN. That is a great question. First of all, the private sector has a huge amount of resources they could offer in partnership. FFAR is an example where we have brought the private and public sectors together on issues like soil health, photosynthesis, using less water to produce crops, and stronger nutrition initiative that is part of our public health programs.

You cannot just rely only on the public sector because they just do not have the resources, even though I think USDA and the ag resources have been underfunded for several years, not because of what your Committee has done. Just because of the nature of the beast. I think that other parts of our national budget, with the NIH and the Department of Defense, have actually done a lot better on the R&D side, from a funding perspective, than USDA has done.

There is a lot of genius in the private sector. They have good ideas about how this will impact people. Just look at the development of the COVID vaccine. A lot of that work was done in the public sector, in terms of the basic research, but getting a vaccine into the hands of the people and doing the research that was necessary to find out if it was safe was done by the private sector.

The same thing is true in agriculture as well. You just have to work together, and FFAR has been a great example of how that is done.

Chairman ROBERTS. I appreciate that. Senator Stabenow.

Senator STABENOW. Thank you very much, Mr. Chairman, and thanks to all of our witnesses. First, Dr. Rosenzweig, in your testimony you mentioned that the Foundation for Food and Agriculture Research has been a critical partner for General Mills' efforts to help farmers adjust soil health and take advantage of carbon markets.

Can you talk a little bit more about the foundation's public-private partnerships and what they can do in terms of supporting the climate change research that we need?

Dr. ROSENZWEIG. Thank you, Ranking Member Stabenow, for the question and for your leadership in helping create FFAR, along with Chairman Roberts. Establishing the FFAR model in the farm system was a bold commitment to agriculture research, and they are a critical partner for us and others in the industry to advance climate change and agriculture research.

We are proud to have been the first company in any sector to set a goal approved by the Science Based Targets Initiative to reduce the greenhouse gas emissions across our entire value chain. There are now over 1,000 companies that have such a commitment. We have critical knowledge gaps to fill and new tools and insight we urgently need in order to help our sector fight climate change and meet the ambitious goals we have set, and further funding the

FFAR model to tackle climate change and sustainability with the private sector would help to accelerate progress and help our farmers thrive.

We need more tools and technology, like those we are developing at ESMC and Open TEAM, for measuring and verifying the impact that regenerative agriculture has on climate change, and water and biodiversity, and all of these other really important benefits.

Regenerative agriculture is also really context specific, so we need research on which practices work where. I also saw today that FFAR announced their support for the development of perennial crops that can sequester large amounts of carbon, and that is something that General Mills is collaborating with them on as well.

The research in the climate-agriculture intersection is fragmented, and FFAR can help create the collaboration between the farmers and ranchers, the scientists, the public sector, and private industry, so that we can address these issues as a coordinated force.

Senator STABENOW. Thank you very much, and I do have to use this as an opportunity to mention, as we are doing more on research and creating the technologies and information for our farmers. I see my good friend and partner Senator Braun here. Certainly what we are trying to do is establish a home for that information at USDA, develop technology and the technical assistance for our farmers. This information will help farmers and will create a commodity market on carbon that will be supportive of them as well as tackling climate. I think it is so important as we move forward that we have developed this structure at USDA.

Ms. Amy France, you have described the sorghum industry's success with utilizing the Department of Energy's ARPA-E research programs, which have significantly increased the public understanding of biotechnology and plants. Of course, as you and Chairman Roberts talked about the 2018 Farm Bill created AGARDA to accelerate the development of new research tools and agricultural techniques that enhance U.S. economic competitiveness and respond to threats to the food supply, like extreme weather events.

Can you talk a little more about how this new authority at USDA could help researchers and farmers mitigate and respond to the threats of the climate crisis?

Mrs. FRANCE. Yes. Thank you, Ranking Member Stabenow. Much like ARPA-E, AGARDA could be a commercialized and real-world program, and organizers would do well to study DARPA and ARPA-E significantly on the outset. Solving practical problems private industry cannot yet tackle is the very essence of the public-private partnership, and if AGARDA applies with concept as sustainability problems like drought tolerance and nitrogen use efficiency, the effort will be a success.

It is our ultimate goal to limit our footprint, but we do have a long ways to figure out sustainability and what that looks like. I can tell you, from a farmer perspective, if we do not have good soil we do not have a job. So, that is definitely something that I am excited to see. I have seen, first-hand, farmers continuing to see what they can do best, cut input costs, and it is encouraging to see those that have input and the funds that have been inputted into helping the farmers keep doing what we know we can do best.

Senator STABENOW. Thank you. Of course, the great news, as we discovered with our soil health projects in the 2018 Farm Bill, is that we want that carbon in the soil, so you have carbon-rich soil, that it is creating a situation where we have healthier, more productive crops and so on. We want carbon in the soil and not in the air, creating air pollution. It is a win-win that we are working on right now.

Dr. Higgs, in your testimony you mentioned several times that zoonotic diseases such as COVID-19 pose serious threats to agriculture and biological security. Given your extensive experience in the area, how is climate change impacting the prevalence of zoonotic diseases, and where are the gaps in understanding these diseases, and how has that been highlighted by COVID-19?

Dr. HIGGS. Thank you, Senator Stabenow, for the question. Most of the pathogens we are dealing with are not closely associated with climate change. Something close to my heart is blood-borne pathogens and other arthropod-borne pathogens, and they can be very sensitive to climate variation because they are poikilothermic and, therefore the warmer it is, the faster they grow and move, and the higher density the populations are those of arthropods. This is why the abundance of these arthropods and the diseases associated with them are seasonal, with peaks in the summer months.

Certainly that is something that we have to keep a very close eye on, because as environmental change is happening we may see a potential redistribution of those arthropods to areas which have become warmer. If you think of something like Zika and chikungunya and dengue, the mosquitos that transmit those have temperature tolerance levels, and with increasing temperatures they will spread, and that increases the potential threat to humans and animals. There is a pathogen called bluetongue virus, which we have in the United States, which has spread very widely in Europe, perhaps because culicoides midges, its major vector, may be spreading because temperatures have increased. To date, however, there are still no conclusive examples to indicate that climate changes has influenced the distribution and incidence of any of these diseases. Movements of people and commerce is a major factor in the spread of these diseases.

Senator STABENOW. Thank you. We have seen Zika in Michigan because of the increases in temperature, warmer weather in September, October, and it has caused deaths in Michigan, so I understand what you are saying.

Mr. Chairman, I know my time is up so I am not going to be asking Secretary Glickman any questions. You are safe, Dan. I just want to say welcome, as always. It is great having Secretary Glickman as part of our discussion.

Mr. GLICKMAN. Can I just comment, just quickly, on your last question, though, if I might?

Senator STABENOW. Sure.

Mr. GLICKMAN. Okay. What I have noticed, though, is that to focus on the issues of zoonotic disease, climate, and health, I noticed that in our all discussion about COVID there has been virtually no discussion by all the highly educated scientists at the highest level about the relationship between food, agriculture, and health. It just does not exist. Part of it is because a lot of people

stovepipe these positions into their own categories, and they all relate to each other.

I hope that in the future, the White House takes a whole-of-government approach to these issues, and this Committee works to include discussions with people in the human health field, because they relate to each other, and these are areas that I think have been under-discussed in the past.

Senator STABENOW. I very much agree. Thank you so much. Mr. Chairman?

Mr. GLICKMAN. Thank you.

Chairman ROBERTS. Senator Hyde-Smith.

Senator HYDE-SMITH. Thank you, Mr. Chairman, and before I get into the questions I just want to take a moment right now to just commend on your tremendous contributions and your career since you have been in Washington, DC. It has just been an honor to serve under your leadership. When I first got here and sat down in that chair, in the powerful Agriculture Committee, you were very kind, accommodating, and I will never forget that. I appreciate that in you, and certainly as a former Commissioner of Agriculture, the laws that govern agriculture and our food programs, they are much better since you have been serving in Congress. I wanted to say thank you, for you and your staff. You have accomplished so much, and I hope you are proud of that, because you should be.

Chairman ROBERTS. Thank you.

Senator HYDE-SMITH. My first question is for Dr. Rosenzweig. As we heard in your testimony and from other witnesses, the Foundation for Food and Agriculture Research, or FFAR, which was established, of course, in 2014 in the Farm bill, and reauthorized in 2018, has played such an effective role in leveraging private funds with Federal dollars to support research that we all know is so very critical.

I am really proud that Mississippi State University President, Dr. Mark Keenum, serves as chair of FFAR. He is chairman of the board. It is my understanding that General Mills, as a partner in this important public-private cooperative effort, has just gone beyond the call of duty, and I am truly grateful for that.

Would you please elaborate on some of the work General Mills is doing, in its partnership with FFAR, maybe some of the recent work that you have been doing?

Dr. ROSENZWEIG. Sure. I would be happy to. Thanks for the question.

You know, we are partners with FFAR on a number of the flagship programs, like I mentioned, the Soil Health Initiative to create one of the largest soil health research programs through funds to The Nature Conservancy, the Soil Health Partnership, and Soil Health Institute.

Right now we are in the midst of partnering with the Ecosystem Service Market Research Consortium, the research arm of ESMC, to figure out how we conduct the research and develop the tools and protocols we need to verify that farmers are, in fact, creating ecosystem services. When we are looking to pay farmers through an ecosystem service market for these types of services, we need assurance that they are actually being created. The work that we

are doing right now with ESMC and FFAR is to create those tools that can help us measure those outcomes.

You know, one of the critical objectives is to reduce the costs of those things, because that is really what is going to be limiting the funds going into farmers' pockets is how expensive it is to conduct those measurements. The work that we are doing is to reduce the costs while still maintaining the certainty of those estimates.

I am happy to expand on any of those other initiatives if you would like.

Senator HYDE-SMITH. Thank you very much. For Mr. Secretary, with the global demand for food on the rise and only a finite amount of agricultural land, we must continue finding safe and innovative ways to produce more on the land that we have, because they are not making any more land. Do you believe public-private partnerships such as FFAR are a model for the future of agriculture research?

Mr. Secretary? Mr. Glickman?

Mr. GLICKMAN. Yes. Can you hear me Okay?

Senator HYDE-SMITH. We can.

Mr. GLICKMAN. Okay. Yes, I am sorry. I was going to say Mark Keenum has been a great leader at FFAR, and I know he is from your home State, and he is a good friend of mine. I would say the answer to that is yes, there are a few areas.

First of all, these issues are global. They are not just United States. If you look at the rest of the world, problems of yields, problems of water utilization, they are particularly acute in the developing world, where your yields are half of what they are in the United States, and hunger is just prolific over there. We all share in this thing, and public-private partnerships have been very valuable overseas as well as in the United States. Whether it is in water utilization, soil health, or as I mentioned, photosynthesis, getting crops to grow faster, you are right, we do not have any more land and we have to make sure that soil health is at the top of our priority.

This cannot be done without public and private partnerships. I might add that at FFAR and other kinds of private-public partnerships, agriculture needs to be at the center of climate change mitigation. It is part of a comprehensive approach, I think, to coordinate science and adopt new techniques. All aspects of the supply chain need to be involved in this.

Clearly for agriculture to be at the center requires public-private cooperation, and it requires cooperation of people in the non-ag world as well.

Senator HYDE-SMITH. Thank you very much. That is all, Mr. Chairman. Thank you.

Chairman ROBERTS. Senator Braun.

Senator BRAUN. Thank you, Chairman Roberts. It has been a pleasure for the two-years I have been in the Senate to be on the Agriculture Committee. I've probably become the freshest of any Senator from participating in farming, as a tree farmer, and I have been an investor in land and deal with many farmers on a weekly basis, to the extent I still have time. The hearings that you have held on this Committee have been interesting to me because I can

draw so recently and vividly on experience I have had in the agricultural sector. Thank you for that.

We did hear earlier, Ranking Member Stabenow said we introduced the Growing Climate Solutions Act, which is, I think, kind of the first manifestation of coming together on something that makes so much common sense because it takes the good stewardship of tree farmers, of ag farmers, and tries to give them the portal of information to actually take advantage of voluntary markets that are out there. I think that is an important first step.

My first question is for Dr. Rosenzweig. I know that General Mills has done stuff with a definite interest in climate. I want to thank you for joining 50 other groups, including the American Farm Bureau, that endorses the bill that we have introduced, groups like The Nature Conservancy as well, and I think we are off to a good start.

I would like to ask you the question. Legislation like the Growing Climate Solutions Act helps farmers and companies like General Mills in research and implementing sustainable agricultural practices. How do you see that really benefiting what you have already done in your own effort to lower the footprint that General Mills has?

Dr. ROSENZWEIG. Thank you, Senator, for the question, and thank you for your work on the Growing Climate Solutions Act. We support the bipartisan legislation, like you mentioned, and this legislation would help to establish a greenhouse gas technical assistance provider and third-party verifier certification program through which the USDA would provide endorsement of third-party verifiers and technical service providers that help private landowners generate carbon credits through a variety of aggregate culture and forestry-related practices.

As the demand for carbon markets grows, it is important that we have qualified technical advisors working alongside farmers to help them develop the most beneficial practices for their land. That is why, in our pilot with ESMC and Kansas, we have provided farmers one-on-one coaching to help them develop and implement their own regenerative management plan and helping them navigate the data collection needed to access the market.

Building the capacity of service professionals that understand these market opportunities, protocols, and standards will support ecosystem service markets' operation at scale. I will add that a number of companies like ours have deeply invested in the ESMC, and we want to make sure that the implementation of the GCSA should be thoughtful and with input from the private sector. Thank you.

Senator BRAUN. Thank you. My next question is for Mrs. France. Before I ask the question, I want to acknowledge how important it is what family farms like yours do, that play into conservation and sustainability. Earlier in the year, we had Brent Bible, a Hoosier, who testified before the Committee and talked about, with an eye to soil health and to actually making the farm have a lower carbon footprint, it was interesting to see how much farmers are already doing.

In regards to, again, the Growing Climate Solutions Act, one of the things my bill would do is kind of give that one-stop shop,

website information, maintain that the USDA Farm Service Agency, which farmers are familiar with, interfacing with on a weekly, monthly basis. As you and other producers look toward innovations that are both economically and environmentally sustainable for your farm's next generation, do you believe that it would be helpful to have that singular point? What does that mean, especially with the familiarity you have already, working with the Farm Service Agency's part of the USDA?

Mrs. FRANCE. Thank you, Senator. FSA certainly does provide a hub for us. The individuals we work with, we worked with for years and generations before us, and I am sure they will have our children as well.

I think that would be very beneficial, you know, having one spot for our information. We already bring them so many records. They have, really, the bible of our farm at their desk. It seems like although I am not completely familiar with your potential bill, but from the sounds of it, initially, without digging in deeper, it does sound like that could be very beneficial to a farmer.

Senator BRAUN. Thank you so much, and keep up the good work on the farm.

Mrs. FRANCE. Thank you very much.

Chairman ROBERTS. Sherrod, are you there?

Senator BROWN. I am.

Chairman ROBERTS. Yes. In this Zoom world we live in, when we have two Senator Browns, spelled differently, of course—

Senator BROWN. Well, one is Brown and one is Braun.

Chairman ROBERTS. Yes, I understand that. I understand that.

Senator BROWN. I just want to go before Casey, Mr. Chairman.

Chairman ROBERTS. Well, you and Bob will have to work that out, but I am going to recognize you next.

Senator BROWN. Thank you, and first, thanks to Chairman Roberts for his decades of service to the people of Kansas. His stewardship of this Committee, I was privileged to serve for a little while with Senator Roberts in the House, and I have been on this Committee with him for years, and his commitment to ensuring this Committee, and in particular, the 2018 Farm Bill, remained bipartisan. I appreciated Secretary Glickman's work on—his work as Agriculture Secretary and his work with Chairman Roberts, but especially Chairman Roberts' work on that Farm Bill reminds us how major legislation becomes law. I appreciate the work that you did.

Secretary Glickman, thanks for your testimony today. A good reminder of the role that USDA and other Federal agencies play in driving the research that is critical to so many of the challenges facing our country and the world. We know that funding is flat or declining, despite the myriad challenges from COVID to climate change facing agriculture.

I appreciate the role that FFAR plays in bringing in the private sector, but I have two questions, Secretary Glickman. How should this Committee approach USDA research programs and funding levels, and together, absent a renewed focus and substantial funding increase for land grant and other research institutions, is our country at risk of ceding our role as the global leader in food and agricultural research, in your mind?

Mr. GLICKMAN. Yes, I think we are at risk. I think that the Chinese and the Brazilians have both shown an inclination to vastly increase the research in food and agriculture, and ours has been relatively flat. We fortunately have had some other good examples of the private sector getting involved.

Levels of research are important, but also the quality of research and how it is done. That is why I mentioned two things. No. 1 is we have to have human capital. We have to have a new generation of young scientists who are willing to tackle these problems, who find them sexy, who find them interesting, and they are going to be solving the problems of the future. That is really a critical thing, I think, in agriculture, and a challenge for both the land grant and the non-land grant community. I think it is a pretty important part of the mix.

The other thing I said is I mentioned this Breakthrough 2030, which is the National Academy of Sciences' report on what are the challenges for agriculture over the next decade. I think we have talked about some of them today. I think in food and agriculture policy, at home and globally, we need to really sit down and focus our resources on what the serious threats are, what I call the asteroids, that could come and wipe out agriculture, a pest that could destroy wheat across the world or rice across the world. Or answers to nutrition problems. What do we need to reduce the amount of preventable deaths that occur in this world as a result of bad diets? There are just a whole litany of answers. We cannot do everything in the public sector, and that is why these public-private partnerships are so important, because they give us the extra room for the public sector to focus on those really important threats that are facing the world.

Senator BROWN. Thank you, Secretary. We know that one administration is leaving, an administration that, frankly, and representing a political party that has mostly rejected science, from COVID to climate change, and we have an administration coming in, as you know, that believes in science, and that is why I appreciate having real scientists on this panel today.

This Committee can play, obviously, a key role in smart farming practices for climate. Talk to me about, if you would, how you see climate change affecting global food supplies and agriculture, particularly in the developing world, for decades to come. Less about what the solution is but just what you see as the effects of climate on agriculture internationally.

Mr. GLICKMAN. Well, look, in my judgment, Senator, agriculture is probably the most impacted industry to volatile weather and climate change. After all, droughts, floods, heat—those are the three things that are destructive of the ability to produce crops to feed the world. The responses have to be led by the United States, and your Committee has really done a great job of trying to highlight these issues. Unfortunately the funding base has not followed suit very well, and it is not just the Committee's fault. It has to do with the nature of Federal budgeting.

The main thing is to strategically look at what those threats are, both to American farmers and to the global agriculture system, and focus research on those particular things, and I think climate and nutrition are key parts of that particular discussion. Also, the

White House has to be very, very involved in this effort as well, you know, and sometimes agriculture just does not get the attention at the White House level. This is a bipartisan criticism, in my judgment. It takes leadership at the White House and leadership at the Department of Agriculture, and leadership in Congress to make this happen.

Senator BROWN. Okay. Thank you. Dr. Rosenzweig and Ms. France, thank you both for being here too. Thank you, Mr. Chairman.

Chairman ROBERTS. Bob Casey, you are up.

Senator CASEY. Mr. Chairman, thanks very much, and I want to thank you and Ranking Member Stabenow for this hearing. Chairman Roberts, we are all giving you kudos today as we consider this as your last hearing. I want to thank you, in particular, for your service in the Senate on behalf of farmers and ranchers, and I know the people of Kansas more broadly. I am also grateful for your leadership on the Committee, working with Senator Stabenow, as many of have noted, as you noted, the 2018 Farm Bill being one of the most recent indicators of that leadership. Thank you for that work. I want to thank our witnesses for joining us today. I will have a question for Secretary Glickman as well as Dr. Rosenzweig, and we will get to those in a moment.

I just wanted to start with what we are facing today. We know that our Nation is facing the greatest public health crisis in a century, and then a jobs crisis and an economic crisis on top of that. There is suffering all around. There is no question that these crises are significantly affecting our Nation's farmers and our agricultural communities.

We have long lines for COVID testing that are only exceeding by the long line for food assistance, all across the country, no matter where you live—big cities, small towns, rural areas, suburban communities. Our farmers, our farm workers, our meat processing workers, grocery store workers, food banks, and others who are helping our supply chains stay afloat are on the front lines every single day.

The farmers, their families, and the businesses I hear from in my home State of Pennsylvania tell me that more relief is needed and that relief is needed now, not three or four months from now. Right now. This month.

In addition to the immediate relief that Congress should provide, agricultural research plays a critical role in supporting the innovation that is essential for the resiliency of our food system and supply chains. We know that climate change is not just a challenge for our Nation, an existential challenge, but also we know of the role that farmers play in mitigating climate change.

I want to start with Secretary Glickman on food security, an issue that you have worked long, twilight hours on for many, many years, even decades now, and I appreciate that work. I appreciate your comments today regarding that undeniable linkage between and among poverty, hunger, nutrition, and health. I know that communities in Pennsylvania and across the country, as they continue to struggle with the devastating reality of food insecurity, we need to be addressing this challenge from all angles, including research investments. Especially concerning for so many of us is the

disproportionate impact we are seeing in communities of color, both in terms of the adverse impact of the virus, the depth and devastation of the virus, as well as the rising rates of food insecurity.

My first question, Secretary Glickman, is, could you elaborate on your perspective on the critical relationship between poverty, hunger, and nutrition, and in particular, how should we be thinking about research investments as it relates to food insecurity and the growing racial disparities across the country?

Mr. GLICKMAN. Well first of all, you have been an amazing leader in this area, particularly in the global food security area, and I want to compliment Senator Casey on that.

You know, everything is inextricably linked. Who would have thought that COVID, an animal virus, could have killed 260,000 Americans, put 100,000 people into the hospital right now? Thank God we had good scientists in all areas who were able to develop a vaccine, both here at home and around the world.

Good science is the key to certainly solving these problems in the short term. We have seen this rapid increase in hunger. Thank God we have the food stamp, the SNAP program. The levels of lines of people seeking relief on an emergency basis, we have never seen those kinds of numbers before.

All these issues are linked to each other. One of the interesting things that we have found is folks who suffer from COVID often are people who are victims of comorbidities often caused by bad medical conditions, so cardiovascular, diabetes, those kinds of things. Health, agriculture, food security, they all kind of relate to each other.

This whole COVID thing almost destroyed the meat and poultry industry in this country. Who would have thought anything like that could ever happen? Then what you see happening around the world, where people are suffering in underdeveloped countries that do not have access to the techniques and tools that we do.

I would just add one more thing. Farmers have been fortunate. You all have been extremely generous. We have been able to at least reduce the amount of hurt to some degree in terms of farmers in this country through direct help. I do not know whether you are going to be able to afford to do that in perpetuity, in the future. There are so many alternative needs in agriculture as well, in terms of research, in terms of our nutrition programs, both domestically and globally. It is going to be a big challenge for you to kind of put all these things together and come out with a fair solution.

You know, given what we have gone through, I do not think we have dodged a bullet, but we certainly have prevented total catastrophe that could have happened without kind of the holistic thinking, particularly in the private sector and particularly in the Congress. You guys have done a great job.

Senator CASEY. Well, we have got more to do, and Mr. Secretary, I want to thank you. I will send you another question about the global food security in writing, and Dr. Rosenzweig, I will make sure that you get a question in writing as well. I want to thank Dr. Higgs and Amy France for their testimony as well.

Thank you, Mr. Chairman.

Chairman ROBERTS. We appreciate that. Thank you very much. Senator Fischer. Senator Fischer, we can see you. Let's unmute.

Senator FISCHER. Okay. Am I on now?

Chairman ROBERTS. You are certainly on.

Senator FISCHER. Thank you, Mr. Chairman. I too would like to thank you, Mr. Chairman, for your wonderful service to this country. It has been a pleasure to have you as Chairman of the Agriculture Committee during my membership on this Committee. You have been a mentor to me. I am part of your posse that is out there, and it was wonderful to be able to welcome you to the State of Nebraska a couple of years ago. Sometimes Nebraskans and Kansans fight over things, like water, but usually we find ways to always work together and be able to serve our constituents. Thank you so much, Mr. Chairman.

This question is for everyone, but I would like to start with you, Secretary Glickman, if I could. The report that you mention in your testimony from the National Academies of Sciences, Engineering, and Medicine States “data will be at the center of the next revolution in food and agriculture.” Is there a gap between the increasingly data-driven nature of agriculture and the availability of decision support tools for agriculture producers that is based on modeling or visualization, integration of that data from the farm and the ranch?

You need to unmute, sir.

Mr. GLICKMAN. That is an excellent question. I think that the data to farmers from centralized sources about the use of fertilizer, pesticides, soil health is better than it has ever been. I am not sure that every farmer has been eligible for this, and smaller farmers sometimes feel like they have been excluded from this. I think you are correct. Data and data analysis is going to be critical for the future of production agriculture, in terms of inputs, in terms of science. That is one of the reasons I keep going back to this issue, is one of the challenges for you all, I think, and this Committee, is to make sure that we have a pool of talent, smart people, all around the country, in both land grants and non-land grant schools, that can help farmers cope with these challenges.

Senator FISCHER. How are we going to get USDA, get the focus there to get this information and these tools out of research and into usage? You know, and I am talking about tools. I am a cattle rancher, and I am talking about tools. I want to be able to not just answer questions and provide information that ag producers do for research, but then have it come back to us and make it practical. How important is that for USDA to take that step?

Mr. GLICKMAN. Well, I do think partnerships with private sector is one way to transfer those technologies into understandable ways that help the private sector, and that is one of the things the Foundation for Food and Agriculture is working on, is how to move the companies, whether they are seed companies, crop input companies, and also the data companies, the tech companies that have not necessarily traditionally been involved in agriculture, to make the exact link that you have been talking about.

I do not have the exact answer to your question, but I think you have gotten to the heart of one of the real issues, is how do we transfer that information into a workable plan for farmers and ranchers to actually use.

Dr. ROSENZWEIG. Senator Fischer, if I may, you know, we have been working with Open TEAM, the Open Technology Ecosystem for Agricultural Management, which is a FFAR-funded initiative. You know, part of the challenge is there are data silos within agriculture. We are collecting farm management data but that data cannot be used really to make decisions because we cannot connect those decision support tools with that data. It is not in the right format. It is not collected with that in mind.

What we are doing through Open TEAM is really creating this interoperable ecosystem of tools and technologies and creating these tools with farmers. I mean, that is part of the process of how we get it out of research and into farmers' hands is we co-create them with farmers on the ground. That is the work that is happening right now through Open TEAM, and there are some really cool advancements coming out of the work.

Senator FISCHER. Do you think it would be important, though, to be able to have USDA more involved, to have a specific office to make sure this gets out? Every day an ag producer does not have a lot of time to do the research and figure out where this all is. Usually it is through a county extension person or, as you said, with private industry who gives them a heads-up on things.

I really am interested in getting practical usage out of all the research that we see, and really, literally, seeing it on the ground—on the ground.

Dr. ROSENZWEIG. No, I agree, and one of the challenges we have to overcome there is data privacy and permissions. Farmers have to have control over their data and have the ability to share it with their county extension or an NRCS officer. They have to have control over that data, but ease of sharing with their agronomists or their coach, or whoever it might be that can help them with that. That is another kind of issue that we are tackling through Open TEAM is how do you maintain the ownership while still allowing them to transfer the data and open it up to those they want to see it.

Senator FISCHER. I know I am way over time here. I would really appreciate if you folks on the panel, if you have thoughts on that if you could write us about that. I would appreciate it, because it is something that I think is extremely important that we get all the great new research that is out there, the technology, and get it in the hands of people who are making a difference in feeding this world. Thank you.

Senator BOOZMAN. Senator Smith.

Senator SMITH. Well, thank you very much. It is great to be with all of you. I do not know, should I be calling you Chair-elect or Chair today?

Senator BOOZMAN. Whatever.

Senator SMITH. Well, I cannot see all of you but I think that this must mean that Chair Roberts has stepped away to go vote, and so I was just going to remind him about how much I appreciate him and how much I have learned from serving with him these last three years. I will do that personally in another way. I am just really glad to be a part of this panel.

I wanted to maybe just start with Secretary Glickman. I want to just highlight a point that you made a bit ago, and at the tail end

of somebody else's questions, which is the really important link between animal health and human health, and how we do not make that link as strongly as we should. Particularly as we are living through the very dark weeks of this COVID-19 pandemic that just seems so important.

I talk to folks in my home State, where there is a big emphasis, of course, on animal health and human health. The animal health people tell me that the bigger issue is trying to get the human health people to understand that they have a real vested interest in cooperating and collaborating with them. Actually Senator Young and I have a bill to bring forth a one-health approach, much more broadly, in the Federal Government. I wonder if you just want to comment on that a little bit, not necessary on the bill specifically, but I would welcome that.

Mr. GLICKMAN. I just concur totally with what you said, and it has to do with our government and how our private sector, and even how our university world is so stovepiped. We have seen this with COVID. There was an animal disease that transferred to humans and 260,000 Americans have died. People just need to be talking to each other a lot more. If your bill does that, that is terrific.

Senator SMITH. Yes. It reinforces the need to do that collaboration sooner rather than later, and so thank you. I just think it is such an important point.

Dr. Rosenzweig, I just want to welcome you to the panel, as my fellow Minnesotan. About 36 years ago I was just graduating from business school with my brand-new husband, Archie, and we moved to Minnesota so that I could take my first job out of graduate school at General Mills. I always feel as if I am a proud alum of General Mills, and I really appreciated your comments today. I am very encouraged and excited by the MBOLD coalition that General Mills and other corporate citizens in Minnesota are leading.

I want to just talk about this a little bit in the time that I have. You know, you do not need to talk to Minnesota farmers or food producers about the realities of climate change. They see it every year in the impacts of drought and heat and floods, and it is having a significant impact on their ability—their resilience, as you said.

I am wondering if you could just talk a little bit more about the MBOLD coalition, and I am especially interested, given that today we are talking about research, just talk a bit more about how that partnership with the University of Minnesota is working and what we might learn from that.

Dr. ROSENZWEIG. Sure. Thank you, Senator. Yes, MBOLD is a recently formed coalition of Minnesota's globally leading clusters of businesses, researchers, and food and agriculture producers, and we are working to accelerate solutions to some of the most pressing challenges that food and agriculture is facing today, particularly climate change and the growing demand for food. It is led by General Mills chairman and CEO, Jeff Harmening, along with other leaders in the food and ag industry in Minnesota.

Together we are working to address a couple of key areas—soil health and water stewardship, packaging sustainability, catalyzing innovation and entrepreneurship, and fighting food insecurity. Across all of these different areas we are piloting these solutions

in Minnesota, where we are all based, really with an eye toward scaling nationally and even globally.

Like you mentioned, the University of Minnesota is playing a critical role across a number of the different pilots that we have ongoing as part of MBOLD. You know, along with Cargill, we have launched a project in the Red River Valley of Minnesota and North Dakota really focused on helping farmers adopt soil health practices, and the University of Minnesota is going to be leading a lot of the work in that project, leading the soil health and soil carbon testing, and also a social evaluation that will help us understand the effectiveness of that program at promoting understanding about soil health and increasing adoption across the region.

I will also note that the University of Minnesota's Forever Green initiative is leading another project with MBOLD to create market opportunities for alternative crops, to help farmers in the State diversify beyond the typical corn-soybean system. The Nature Conservancy is also leading a pilot of ESMC in the State. Those are just a couple of the different initiatives we have going on through MBOLD.

Senator SMITH. Thank you. I am really proud of the innovation that Minnesota farmers and producers are pursuing, and they are showing something that I believe is so true about adapting and dealing with climate change, which is we can either lead or we can follow. If we lead, we create more opportunity, we create innovation, and especially with that focus on research we can really increase our competitive advantage rather than feeling as if it is damaging our competitive advantage. I appreciate that.

Thank you, Mr. Chair.

Senator BOOZMAN. Thank you. Senator Hoeven.

Senator HOEVEN. Thank you, Mr. Chairman. I too want to start out with some comments thanking our Chairman, Pat Roberts, for all his work on behalf of farmers and ranchers. Maybe if I go on long enough he will get back for some of it, but if not I certainly want it in the record.

I have truly enjoyed working with Chairman Roberts, and I think it is fitting that as he finishes up this term in the Senate, in this Congress, that he really goes out on such a high note, because he did a remarkable job leading, along with our Ranking Member, as well as the Chairman and Ranking Member in the House, the way forward in terms of building a remarkably good Farm Bill.

That just seems fitting and appropriate for somebody who has really dedicated his life to working on behalf of farmers and ranchers across our country, coming from Kansas and truly understanding the heartland and understanding agriculture, and that the work that our farmers and ranchers do benefit every single American, every single day, with the highest quality, lowest cost food supply. When we pass a Farm Bill every five years that is not just something that benefits farmers and ranchers. That is something that benefits every single American, every single day. That is remarkable in and of itself, but then when you look at this last Farm Bill that we were able to pass, with Chairman Roberts' leadership, I think we got something like 88 votes on the floor. Is that right, Ranking Member?

Senator STABENOW. Eighty-seven.

Senator HOEVEN. Eighty-seven. You know, that just shows the bipartisan work, the quality of the work that was done in finishing that Farm Bill. For our future leadership on this Committee, and as Senator Smith said so well, I truly enjoy being part of this Committee. Agriculture is No. 1 with me and always will be. What a marker there for us all as we go forward and try to finish future Farm Bills.

He certainly leaves having done incredible work on behalf of not just farmers and ranchers but certainly the people of Kansas and the people of this great nation. We thank him for that and we are truly appreciative.

I would like to ask a couple of questions here with my remaining time. One is to Secretary Glickman. I was at Chairman Roberts' unveiling of his portrait, and as I recall you spoke by video. I probably misheard, because I thought you did not say you were there for the hanging of his portrait. You said you were there for his hanging. I am sure I just misunderstood that. One, I thought you might want to touch on that for a minute. It was probably something with the, the video. Then I also wanted any thoughts you have on how we can do the very best job possible in terms of building ag research, which is so vital. Secretary Glickman.

Mr. GLICKMAN. Yes, Okay. There we go. I will leave the answer mysterious, whether it was his hanging or the hanging of his portrait. As you know he and I are very close personally, and we have spent a lot of time making fun of each other. I want to say—

Senator HOEVEN. Who has the better humor? I mean, if you really had to say, who is better at humor, you or Chairman Roberts? Remember, you are under oath.

Mr. GLICKMAN. I guess I would have to say him, because I am smart enough to know that if I said it was me he would probably never talk to me again. I will leave it that way.

I think the answer to your question is that this prioritization of agriculture research is really important because we will not get additional resources without that. You know, I think the Congress has really done a good job, but I am disturbed over the last many years to see kind of the real amount of spending not go up, and see it go up in other areas like the NIH or the Pentagon. I think part of that is that the general world, the general non-food and agriculture world does not realize the value of agriculture research on an everyday basis.

It is just continuing to tell the story of how important it is, is just something I would say.

Senator HOEVEN. Thank you. Then with the indulgence of the Chairman I would ask one more question for Dr. Steven Rosenzweig, and that is talk just a little bit about your work with your partnership with NDSU, and also the progress you are making on oat research.

Dr. ROSENZWEIG. Sure. I would be happy to. You know, General Mills has their own oat-breeding program, and we collaborate with public universities throughout the Dakotas and Canada really to advance new oat genetics. It is really a great partnership with public universities because there are no private breeding efforts really

happening in oats, which is a minor crop, and so that work is really important. That public-private partnership is critical.

You know, along with NDSU, I mentioned a little bit before about our project in the Red River Valley, working on sugar beets and wheat, which are critical crops from General Mills in the Red River Valley. We are looking forward to a partnership with NDSU in addressing soil health in sugar beet systems. Just some recent research out of NDSU suggests that you can get a cover crop established in those sugar beet systems and it does not hurt sugar beet yields, and it helps provide that cover for what is otherwise a pretty destructive crop to the soil, as you pull out a giant root to try to harvest it. That is really promising, and we look forward to working with North Dakota State on sugar beet research moving forward.

Senator HOEVEN. Thank you for that work. I appreciate it so much. I think it is so impactful and I am a strong proponent of NIFA and will continue to be. Again, thank you very much. We love the bison.

Senator STABENOW. As the Chairman is coming up, Mr. Chairman, I am going to go and vote right now. As I leave I also want to take just a moment to thank your staff. We have such a wonderful partnership and I want to thank James and all of the members of your staff who have done such an incredible job for you. James and Joe are the team, and we know we could not get things done without our very capable staff. We have, I think, the best professionals in agriculture, nutrition, and conservation on the Hill, so I appreciate all their work.

Chairman ROBERTS. Thank you very much. Senator Thune. Oh, he is on a Zoom, for goodness sakes. All right. Senator, I figure this is the last time I can call you Coop in public, so I am going to do that. Coop, you are up.

Senator THUNE. Okay. Can you hear me, Mr. Chairman?

Chairman ROBERTS. Of course. I can always hear you.

Senator THUNE. Okay. Well, thank you, and I have got to tell you, I am going to miss that. I am going to miss you and your staff and all the great work that you guys have done through the years for agriculture. You have been a tireless advocate, and I can tell you the farmers and ranchers in South Dakota are forever grateful, and across the country, for everything you have to create that stronger safety net. As you often say, greater certainty and predictability for agriculture. We are grateful for all you have done and for your service and you will create a big void in American agriculture. We know you will be out there speaking up wherever you go.

Thanks for holding this hearing, to you and the Ranking Member, Senator Stabenow. Dr. Rosenzweig, now that you have addressed North Dakota State let's deal with the really important business and I am going to ask you about South Dakota State, jackrabbit country. My understanding is that you partner with South Dakota State as well, and I am wondering if you can describe the value for private enterprises like General Mills of partnering with land grant universities like SDSU to advance research that helps to secure the U.S. food supply, and maybe more

specifically, talk about what General Mills has been able to accomplish through its partnership with SDSU.

Dr. ROSENZWEIG. Sure. Thank you, Senator. Yes, we gain significant value from our public-private partnerships, particularly at land grants that have top-notch research personnel and facilities. You know, we can just do so much more when we work together. As an example, South Dakota is the second-biggest oat producer in the country, and General Mills is one of the largest oat buyers in the North America.

In 2016, we partnered with SDSU to establish a state-of-the-art oat variety development lab on campus, where our oat-breeding team works in tandem with the top researchers and students at the university to improve the supply of quality oats in the U.S. and through that partnership we have been able to expand our oat research program, and that includes collaborating and funding SDSU oat expertise, plus all of the advancements in oat varieties and genetics are in the public domains, that we can grow the knowledge base of oats that has a reach beyond South Dakota to most of the Upper Midwest States and Canada.

You know, along with SDSU, we have been able to fight this fact that climate change and a lack of investment historically in oat research has been pushing oat production farther and farther north, into Canada and out of the U.S., which limits market options for farmers across the Midwest. Partnership with SDSU has enabled advancements in oat-breeding technology, genomics selection, and oat nutrition measurement that allow for new and additional oat markets for the growers of South Dakota. We just recently granted \$350,000 to South Dakota State to better support oat production in organic and regenerative systems, to improve oat performance as more and more farmers adopt these systems.

Senator THUNE. Thank you. Secretary Glickman, as you know, agriculture and the food supply face significant strain due to the pandemic, and I think we all saw first-hand in South Dakota when the Smithfield pork plant in Sioux Falls temporarily closed due to the COVID outbreak. You mentioned the importance of cross-agency collaboration to address food and agricultural issues, and I agree that this is something that is very much needed.

Based on your previous role as Secretary of Agriculture, what suggestions do you have for facilitating that kind of collaboration?

Mr. GLICKMAN. First of all, let me say that oats are a great cholesterol-reducing food. As somebody who has to watch my cholesterol, I am a big oats fan.

You know, look, we saw what COVID did to the entire food supply chain, from farmers and ranchers to processors to restaurants to the way people eat. I think that one of the things that we learned is that the issue of farm workers and workers in these plants in many cases—not in all cases, but in many cases—just were not given the attention on the public safety side of the picture. I think that many of the companies have learned from this and are doing a better job now with it.

While I was at USDA I would have to say that we focused a lot on food safety issues, but we did not focus very, very significantly on farm safety issues in plants. Theoretically, that is part of the Department of Labor's jurisdiction and OSHA, and there were al-

ways some conflicts between USDA and OSHA and Labor, in terms of the regulatory issues. Everything has to be done with good judgment. The number of people who work in these plants who got COVID and died was disproportionately greater, and similar to what you found in nursing homes, to some extent.

We have got to do a better job analyzing public health issues as it relates to workers in these processing plants, and I think most companies really want to do that, because it affects their productivity. I hope that we continue to work with them and find ways to both be efficient in the production of food and resilient in the production of food, but deal with this issue of health of the workers.

Senator THUNE. Thank you. Mr. Chairman, I do not have a clock, but I am sure my time has expired. I have got some other questions for other panelists, but I want to thank you again and we will miss you. I will miss you calling on Coop when it's my time to ask questions. Thank you, Mr. Chairman.

Chairman ROBERTS. Thank you. For the education of those who do not understand why I call the Senator Coop, I thought he looked like Gary Cooper in High Noon, and I realized, and he realized at one time, after about the third time around, that nobody in the entire hearing room knew who Gary Cooper or what High Noon was all about. Anyway, that is that.

Before I conclude the hearing, I would like to ask the Secretary, and I would like to ask Dr. Higgs, if either one of our other witnesses wish to respond. We have talked a lot about the current COVID-19 situation. We had swine flu. We had avian flu prior to that. There will be something else that we will have to contend with.

My question is, we have not, for the last, what, 10 or 15 years, really paid as much attention to something that happened some time back under the Nunn-Lugar Program, we were allowed in the secret cities in Russia. Of course, when Putin came in that stopped. I was able to go to a lab called Obolensk, about 60 miles away from Moscow, and discovered warehouses full of pathogens with the intent of attacking a country's food supply.

Now that is a whole different ball game. I know that we have NBAF out of K-State. I know we want to make it a national security program. I know we used to have exercises about that, and Dan, I probably bored you to death with those stories, especially with your post as Secretary of Agriculture.

I do not know of any exercises that we have conducted since that time, but I do know that those warehouses existed. I do not know what has happened under Putin, but I can imagine that situation could still exist, if not ongoing. Again, we do not have access to that. Think of Iran. Think of China. There is a lot of talk about China, you know, anyway.

Would you have any comments to make on that, Dan?

Mr. GLICKMAN. I would just say the U.S.—if you can hear me Okay—

Chairman ROBERTS. Yes.

Mr. GLICKMAN [continuing]. the U.S. cannot disengage from the world, and global collaboration in terms of not only the pandemics but these potential acts of terrorism require us to keep good rela-

tions with potential threats. They exist whether it is in the Middle East or whether it is in Russia or China or Iran or wherever. You know, you need a pandemic strategy at the White House level, not just at the department level, where people are kind of anticipating.

Prevention is always tough. Dealing with a problem once it is on top of you, we are smart enough to find solutions. I think your point is really a good one. How do we deal with prevention of these kinds of threats. It has just got to be a high national security priority.

Chairman ROBERTS. Dr. Higgs, part of the reason why you are there at the BRI but also at NBAF, which will be concluded in the next several months, we hope, and it should be a national security issue. That is how this was born, from the revelations that we had certain countries, primarily Russia at that particular time—well, it was the former Soviet Union—with intent to really take down a country's food supply.

As I said, that led to quite a few exercises. They have tailed off. It is not as if the dog is not barking. We all wonder about these zoonotic diseases that happen from time to time. If it is intentional, we have got a whole different problem to work with. Would you have any comment?

Dr. HIGGS. One of the issues with these biological agents, Senator, is that they are relatively cheap compared to other conventional weapons. So, we know, for example, that al Qaeda was considering various pathogens—hog cholera, foot and mouth disease, rice blast, and so forth—that they might consider to use against us.

Those threats have not gone away. They probably never will. Russia had an incredible biopreparat, secret bioweapons program with, huge numbers of people, perhaps 60,000, working on agents that could potentially be used against us. Your revelation and your experience of going to Obolensk was critical in us building the BRI and having our awareness raised.

At the moment, as we are speaking today, the United Kingdom, the Netherlands, Germany are slaughtering thousands of chickens because of H5N8 influenza. Russia has already killed a lot of birds because of that and detected it in wildlife.

That is something already on our horizon. It is a natural threat. The last time we had a serious outbreak of avian influenza here in the United States, in the space of less than a year, between 2014 and 2015 we lost 50 million birds, and it cost \$3.3 billion to the United States.

We just cannot afford to ignore what we know is out there, and it is very difficult to prepare for what we do not know, but that is what we have to do. It is as simple as that. We still conduct exercises, for example staff of the National Agricultural Biosecurity Center in Pat Roberts Hall regularly with the Kansas Department of Agriculture on FMD preparedness.

Mr. GLICKMAN. Pat, may I make one more comment, if I might?

Chairman ROBERTS. Certainly.

Mr. GLICKMAN. Okay. This is both a national security issue and it is also a regulatory and staffing issue. You know, we have made some changes in recent years in terms of APHIS, Animal Plant Health Inspection Service, in whose agency it is, where it reports to. It has been bifurcated. I think that we not only have to deal

with the intelligence side of this picture, to make sure we have all the data coming in from our talented people who are looking at these issues from an analytic and operational point of view, but we also have to have enough inspectors in the United States, with authority, to examine at our borders the food products that are coming into this country.

Chairman ROBERTS. As I indicated before we did have several exercises that dealt with this issue. The consequences were unimaginable. I know because I served as president—there was not anybody else in town so somebody had to do it. I think Ann Veneman was the Secretary, come to think of it, and she appeared. It was hoof-and-mouth disease. By the time Texas went to close its borders it was into Oklahoma and all the way up to North Dakota, and that was largely hoof-and-mouth disease. You could name any other possible attacks. As I indicated, the former Soviet Union had pathogens in warehouses.

I will leave it at that. I really want to thank the witnesses very much for your contribution. It was a good hearing. I will simply say that concludes our hearing today. Thank you to each of our witnesses for taking time to share your perspectives on agricultural research and securing the United States' food supply.

To my colleagues, I appreciate all of your efforts. Thank you for your comments. I wish you the best in the new Congress. We ask that any additional questions you may have for the record be submitted to the Committee Clerk by five business days from today, or by 5 p.m. next Wednesday, December 9th.

The Committee is adjourned.

[Whereupon, at 4:30 p.m., the Committee was adjourned.]

A P P E N D I X

DECEMBER 2, 2020



**NATIONAL SORGHUM PRODUCERS
AGRICULTURAL RESEARCH AND SECURING
THE UNITED STATES FOOD SUPPLY
TESTIMONY**

Presented to:

Senate Committee on Agriculture Nutrition & Forestry

December 2, 2020

**G50 Dirksen Senate Office Building
Washington, D.C.**

Presented by:

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Introduction

Chairman Roberts, Ranking Member Stabenow and Members of the committee, thank you for this opportunity to come before you and present the views of the National Sorghum Producers regarding Agricultural Research and Securing the United States Food Supply. These measures are critically important to farmers and ranchers and to the nourishment of every American, so we greatly appreciate the committee's focus here today.

My name is Amy France, and I farm near Marienthal, Kansas, alongside my husband, Clint. We have five children, one granddaughter and another on the way. I was raised off the farm by parents who were public educators and found my passion for agriculture later in life. The first decade of my career was spent in a small-town lending institution, and, today, my husband and I grow grain sorghum, corn, wheat, soybeans and black Angus cattle. I am honored to serve as only the second woman on the National Sorghum Producers board of directors as well as President of the Wichita County Farm Bureau and on the board of the Kansas Farm Bureau Foundation. I am humbled to be here today, and I hope my testimony as a farmer on behalf of NSP will be helpful to you and the committee.

Before I get into the heart of my testimony, Mr. Chairman, I want to thank you for all that you have done for farmers like me and my family. You fundamentally changed U.S. farm policy for the better. Your authorship of the Freedom to Farm Act acknowledged a trust in the ingenuity and business acumen of the American farmer to assess and meet the needs of the marketplace. Your efforts fostered a global agricultural marketplace where the U.S. farmer doesn't just compete but excels. As a representative of the National Sorghum Producers and a fellow western Kansan, I want to thank you for your legacy of leadership, and we are proud of the mark you have made and hope to honor this legacy for generations to come.

The U.S. sorghum industry encompasses approximately 6 million acres, yielding over 350 million bushels of grain. We have been successful in marketing our product internationally, and now, more than half of what we produce is exported. These exports help chip away at our national trade deficit and strengthen our rural economy. The rest of the crop is utilized domestically for human food consumption, ethanol production and livestock feed.

No matter your industry, we've all witnessed the challenges brought by COVID-19 and recent international trade disputes. These global events have brought considerable uncertainty to our markets. However, sorghum farmers have persevered, and we are proud of our success in identifying new markets and opportunities to sell and utilize our crop. But perhaps more concerning are the environmental challenges we've experienced in recent years, which if they continue to worsen, will threaten our very ability to grow a crop.

A Climate Resilient Solution

Fortunately, sorghum is a water smart and climate resilient crop with a strong environmental profile. Over 90 percent of U.S. sorghum acres are grown without supplemental irrigation. Its water-sipping and drought-resilient characteristics allow the plant to go dormant and wait for rain, qualities greatly appreciated in western Kansas and other areas of the Sorghum Belt. Increasingly, farmers who have traditionally irrigated from the Ogallala Aquifer are turning to sorghum to extend the life of this venerable, but threatened, water resource. In addition, sorghum responds well to no- and minimum-till practices. In Kansas, 87 percent of sorghum acres are cared for using these types of farming practices. I know the value of these vital stewardship methods firsthand, as our family has been an ardent practitioner of minimum-till for a generation.

However, low rainfall periods and weed management are not our only challenge. Weather conditions are becoming more extreme. In recent growing seasons in Kansas, we experienced excessive cold, flooding, record heat, unrestrained wind and untimely freezes, often in the same year. This new normal requires climate-resilient crops, and sorghum is well-positioned to be on the forefront of this movement. With its heat-tolerance and a robust root system that scavenges for nutrients, sequesters carbon and builds healthier soils, sorghum offers a foundation of traits from which to build.

Recognizing the power of these genetic traits, sorghum producers have craved innovations not just to respond to the challenges of the day but to prepare for the environmental and market challenges in the years ahead.

Expanding Sorghum Research

Our industry has evaluated and pursued numerous opportunities to expand research to improve and further understand our crop. That is why we applaud this Committee and Congress for the establishment of the Agriculture Advanced Research and Development Authority (AGARDA) in the last farm bill. Sorghum producers have seen how investments in not just cutting-edge, but bleeding-edge science, where academics and industry are incentivized to collaborate and develop market-based solutions can result in significant leaps forward.

In 2014, the Department of Energy launched the Advanced Research Projects Agency-Energy (ARPA-E) to facilitate a government role in taking on the necessary financial risk to develop transformational technologies in the energy sector. One of their programs was Transportation Energy Resources from Renewable Agriculture (TERRA), which selected sorghum as *the* model crop due to the fact that it is a grass crop like corn, wheat and rice but was more drought tolerant and has a wide range of genetic variability.

In plant breeding, creating gene mutations and sequencing DNA has been the easy part. It's visualizing and confirming what those mutations do to the crop, called phenotyping, that create

the bottleneck in advancing new traits in agriculture. TERRA utilized advanced sensing technologies and high performance computing to rapidly identify small changes in plants in the field. In 2016, building on the successes of TERRA, ARPA-E launched the Rhizosphere Observations Optimizing Terrestrial Sequestration (ROOTS) program to take what was being done above ground and deploy it below ground.

We have learned more about sorghum genetics and root development in the last six years than we did in the previous six decades combined. Furthermore, much of the information and approaches used for sorghum's benefit can be utilized by other crops, as well. Modest advances in production efficiency and sustainability are no longer enough but often require federal investments in high-potential, high-impact technologies that are too early for private-sector investment. Agriculture is just one small portion of the overall ARPA-E investment. Imagine what U.S. agriculture could accomplish with AGARDA if properly resourced and utilizing the ARPA-E philosophy.

Often, the last mile between discoveries from our research community and my seed bag is the most challenging. That is why, in 2016, sorghum farmers invested in a partnership with Kansas State University, to create the Collaborative Sorghum Investment Program (CSIP) housed at K-State. This program links outcomes of scientific discoveries to disciplined efforts for their development and dissemination, so solutions reach the farm. To date, the CSIP program has established technology transfers for traits like herbicide tolerance and genetic markers for sugarcane aphid, a devastating invasive pest of sorghum. These transfers are rapidly harnessing the advancement of seed technologies for sorghum and will provide market security in the years to come.

Advancement through Breeding Innovations

Hurdles remain in the implementation of what we've learned but instead of these challenges being technical in nature, they are often regulatory. New breeding innovations like gene editing (e.g., CRISPR) will allow sorghum breeders to quickly make direct edits to the genome of the crop, changes that otherwise take years to accomplish through conventional breeding. Furthermore, the precise nature of gene editing means there is lower risk than even traditional breeding practices, which have never been regulated.

Last Spring, USDA published their Sustainable, Ecological, Consistent, Uniform Responsible, Efficient (SECURE) Rule, updating its 30-year old biotechnology regulations. While not perfect, we believe this rule encourages the pursuit of innovations that will allow breeders to develop, and growers to quickly adopt, varieties that require fewer inputs like fertilizers and pesticides and make them more resilient to drought and other significant weather events.

EPA's Plant Incorporated Protectants regulations or PIPs rule, which are nearly 20-years old, must also be updated to reflect recent innovations and should work seamlessly with USDA's SECURE Rule. This past October, EPA took initial steps to modernize these rules, and while we appreciate their effort, the proposal falls significantly short of what is necessary. The Agency acknowledged the precision of gene editing and its inherent low-risk, when used to do what could otherwise have been accomplished through traditional breeding, but the proposal would create too many hurdles and stifle innovation for crops like sorghum and other smaller acreage crops. EPA's proposal regulates based on the process of trait development, rather than product, and therefore it is not risk-based. This is in contrast to USDA's approach and the recommendation of the National Academy of Sciences. The agriculture community is enthusiastic about new innovations like CRISPR and the opportunity to respond to the production and sustainability challenges facing the globe. However, we can only tackle these challenges through innovation coupled with risk-based regulation.

Conclusion

That is why we encourage this committee to consider these regulations closely and engage with EPA and USDA on their development and implementation. If the U.S. does not get this right and innovation is hampered, we will be left without the tools to tackle the environmental and food availability issues we face now and in the decades ahead.

Sorghum farmers have long known the value of sound science and the importance of our research community at our universities, at USDA-ARS and our industry partners. We have witnessed through ARPA-E the power of federal funding to garner groundbreaking results, particularly when that investment demands commitments to timelines, partnerships and market deployable solutions. We are hopeful the same can be said about AGARDA in the years ahead.

Finally, I want to again thank the Committee and Ranking Member Stabenow for the opportunity to share these perspectives with you and to Chairman Roberts, I especially want to thank you for your decades of service and unbridled support for Kansas farmers like me and my family.

Statement of Former Secretary Dan Glickman before Senate Agriculture Committee
December 2, 2020

It is an honor to appear before this Committee, which confirmed me to the post as Secretary of Agriculture over 25 years ago. It is also a pleasure to be here before my longtime friend and Kansas colleague, Senator Pat Roberts, who has done so much to advance the issues of agriculture research and highlight their importance to the country. I also want to pay special tribute to my friend Debbie Stabenow, who has equally worked to prioritize and support agriculture research. Both are wonderful examples of what bipartisan cooperation can mean to achieve a common goal of improving food and agriculture research, help sustain farm productivity, consumer trust in the food supply, fight domestic and global hunger, and promote a sustainable and environmentally friendly agriculture. Both legislators have been extremely supportive of the Foundation for Food & Agriculture Research (FFAR) which is becoming extremely critical in finding out-of-the box solutions and utilizing public-private sector partnerships to solve important challenges of the future. So many others on this Committee have also been bipartisan leaders in prioritizing agriculture and food research; that research apparatus is one of the most important functions of the U.S. Department of Agriculture.

It goes without saying that resources and help for food and agriculture research should continue to be a very high priority for this Committee, for the United States Department of Agriculture (USDA) for a myriad of other federal agencies, for the land-grant and non-land-grant university communities, and for the private sector. Even in a period of tight budgets, the benefits of increasing these resources should be understood to be critical for our nation's economic growth. In this statement, I wish to discuss the priorities I would hope this Committee and the new secretary and Administration will consider as you develop spending priorities over the next several years. What are these priorities?

In the short term, COVID has been nothing short of a disaster for the country and for agriculture and the food supply. While scientists are working to examine its origins, causes, and impacts on human and animal health, research into zoonotic diseases must be a much higher short-term priority. COVID, SARS, avian influenza, other strains of bird flu and even Ebola have wreaked havoc on our country and continue to be a source of destruction for the food system. It is clear that these diseases jump from animals to humans. We need to invest heavily into the causes and cures of these diseases. It is estimated that 70 percent of all human viruses come from animals. The cost of COVID and other diseases, many yet to be discovered, has been monumental for agriculture workers, businesses, the frightening increase in domestic hunger, and the entire food supply. This pandemic could, and likely will happen again, and the costs to our country and to the food and agriculture system will be profound. A concerted national effort, perhaps led by the agriculture research community, is desperately needed. The National Bio and Agro-defense Facility (NBAF), located at Kansas State University, can be a leading player in this area.

In the area of nutrition and health, diet-related diseases are the leading causes of poor health and early mortality and contribute to hundreds of billions of dollars of public and private spending to deal with preventable diseases like type 2 diabetes. The relationships between food, agriculture, health and medicine are often neglected in our health care systems. The federal spending for type 2 diabetes is over \$160 billion a year and growing fast. This is a major budget threat, as well as a threat to our military readiness and national security. New strategies and research funding are needed to deal with suboptimal nutrition, especially focusing on food and health, the content of our federal feeding programs, and the elimination of hunger both domestically and globally. The agriculture sector should be a key player in these research discussions and decisions. A better understanding of the science of nutrition is needed across the entire U.S. government research apparatus. I am pleased to see Congress and the private sector becoming much more active in the relationships between food, medicine and health.

Exactly 51 years ago today, December 2-4, 1969, President Nixon hosted the first White House Conference on Food, Nutrition and Health, a seminal event bringing leaders from the public private sector to discuss ideas on how to improve nutrition in America. As a result of that conference, Congress created many of the federal food and nutrition programs which have fed hundreds of millions of people and led to the reduction of poverty and elimination of famine in America. But we are still plagued with hunger and food insecurity in our country. Much of our nation's poverty is tied to hunger and poor diet. Given the continued existence of hunger, and the evolution of the science of nutrition and health, I believe that this Committee and the Congress should encourage the next Administration to hold another White House conference on Food, Nutrition and Health bringing together the nation's food and agriculture leaders, scientists and health and nutrition experts to redouble our efforts to better understand these issues and the impact on poverty, health and longevity.

In the area of climate change, bipartisan cooperation among various players in the agriculture community is really starting to happen, and this is a critically important development. Agriculture research to help farmers and ranchers - at home and abroad - cope and maintain predictable revenue streams in the age of changing climate, volatile weather, increasing droughts, floods and heat, is critical for the future of a healthy agricultural system. I am particularly concerned with declining water tables and their impact on crop production, pest and crop diseases worldwide particularly impacting wheat and rice, animal health, and the terrible damage done by the increasing number of forest fires throughout the U.S. and the world. The Committee's work on improving crop insurance and risk management has been extremely important, and will become more important, as climate change begins to hit agriculture even more directly. I should add that more and more farmers, ranchers and others participating in the agriculture industry are recognizing that climate change is real, not political, and working together is the only way to develop sensible, reasonable and impactful solutions.

To address all of these problems, and to increase agriculture productivity to sustainably feed a hungry world, calls for an interdisciplinary approach to the vexing issues of the future. USDA must collaborate with other agencies of the federal government, especially the National Institutes of Health (NIH), National Science Foundation (NSF), Department of Defense (DOD), and the White House in a true interagency process to solve the problems. Too often in the past, food and agriculture issues were often not deemed a priority outside of USDA. COVID has proven that this perspective must change. We need collaboration across the federal government, along with the university community, and the private sector to develop new technologies in many areas including: reduction of carbon in the atmosphere; soil health; water utilization; plant and animal health and diseases; food production to deal with a growing population globally; and many other areas. These issues will NEVER get fully resolved in one agency or department. We need strong leadership in this Committee, and across the board from the White House on down, to develop the comprehensive research strategies to solve these problems and challenges.

On a related matter, we must create better leverage and linkages across the federal government. As I mentioned before, cross-agency collaboration and visionary leadership must be a priority of the White House and the next secretary. The goal is to focus strategically on those "asteroids" or threats that food and agriculture will be coping with over the next decade. Sometimes these decisions have been understandably made with budgets in mind, and sometimes the protection of "turf" becomes a driving factor. The National Academy of Sciences Breakthroughs 2030 identifies innovative emerging scientific advances for making our food and agriculture systems more efficient, resilient and sustainable and provides a good analysis of those asteroids as well as highlighting the need for both basic and applied funding to achieve results. The report asks the following: What are the big questions in agriculture research that need to be answered in the next decade? What are the strategies needed to produce adequate food supplies sustainably to feed a hungry and healthy world, and how do we best achieve these enhanced new technologies in a safe and transparent manner with the necessary human capital and people power to get it done?

Finally, let me comment on the impact of two outside organizations with which I have been engaged. The Foundation for Food and Agriculture Research (FFAR) was authorized by Congress in 2014 with the specific “parentage” of Senator Roberts and Senator Stabenow and others on this Committee. FFAR has been an important out-of-the box public-private sector model to enhance food and agriculture research, very much like the National Institutes of Health (NIH) and the Centers for Disease Control (CDC). FFAR has benefited from \$385 million in congressionally authorized federal funds, and engaged over 400 outside funders, emphasizing many research areas, including farm profitability, environmental stewardship, human health, and helping develop a talent pool of younger scientists across the country. It has been leading the way in a new Agriculture Climate Partnership. Dr. Sally Rockey and her team have been extremely creative in advancing new technologies, working with USDA, the private sector, major foundations and the academic community. One example is a project at Kansas State University seeking higher yielding varieties of wheat and maize. Related projects are occurring at colleges and universities all over the United States. I also commend the work of the Chicago Council on Global Affairs, where I serve as a Distinguished Fellow, which has become an acknowledged world leader promoting research into ways to reduce global hunger. The work of the Chicago Council has been seminal in tying global and domestic hunger and research agendas together. There are still tens of millions of people in the developing world suffering from malnutrition and hunger, often facilitating violent ethnic and regional conflicts. The Feed the Future initiative was in large part developed through the work of the Chicago Council, in collaboration with US Agency for International Development (USAID), USDA and the private sector.

I might add that the Feed the Future initiative, coupled with sustained U.S. financial assistance to the World Food Programme has continued to be transformational in feeding a hungry world during these turbulent times. This has been a GREAT example of American leadership. It is my hope that this Committee will continue to provide the leadership, in collaboration with the Foreign Relations and Appropriations committees, and the White House, to maintain and even increase support for global humanitarian efforts and the necessary research to support those efforts. The problems we face in food and agriculture are global and not confined to one country. In this world we are all inextricably linked to each other, and all of us have much to gain from research programs on hunger and food security which have a foundation of global collaboration and sharing of data and information. It would be a mistake to go it alone on the issues I have spoken about, whether eliminating hunger or fighting climate change.

Mr. Chairman, Senator Stabenow and Members of the Committee, it has been a pleasure to be able to give you my thoughts on these critically important subjects. Again, I thank my friend Pat Roberts for his leadership in all issues related to food and agriculture, domestic and global.

**Hearing of the United States Senate
Committee on Agriculture, Nutrition, and Forestry**

December 2, 2020

Statement for the Record

**Stephen Higgs, PhD, FRES, FASTMH
Associate Vice President for Research
Director, Biosecurity Research Institute
Kansas State University**

Chairman Roberts, Ranking Member Stabenow, and distinguished members of the Committee, I am honored to appear before you today on behalf of Kansas State University (K-State) for this hearing entitled, "Agriculture Research and Securing the United States Food Supply." K-State President Richard Myers sends his regards; he understands the importance of this hearing and your deliberations. Securing America's food supply has seldom been more crucial.

There are many biological threats to United States agriculture, and as concluded by the bipartisan Blue Ribbon Study Panel on Biodefense (now the Bipartisan Commission on Biodefense), the U.S. lacks leadership, a strategic plan, and a dedicated budget to address these threats.¹ Since few elements dealt with agriculture, K-State raised the bio/agrodefense issue with Blue Ribbon Panel members. That led to a Panel hearing on the K-State campus on January 26, 2017. The outcome of that was a special focus report entitled, "Defense of Animal Agriculture."²

Early detection and accurate identification of a pathogen as soon as possible after an introduction is absolutely critical to enable the implementation of rapid and appropriate countermeasures. The reason for this is simple: with increasing time, the likelihood of pathogen dispersal from the site of introduction increases. Early detection enables countermeasures to be focused to contain and eradicate the pathogen in a relatively small area before dispersal.

Better still, with appropriate and timely intelligence and knowledge, we would have an idea what global pathogens are most concerning and how they might be introduced into the U.S. Surveillance is always imperfect, but focusing U.S. efforts in high risk areas could help prevent introduction of foreign pathogens or, at the very least, help control and eradicate them at the point of entry.

The success of detection, identification and control depends on a knowledge and understanding of the pathogen and these are only possible through research. Research provides data on where and when the pathogen is occurring and potential routes of introduction (pathway analysis). This

¹ *A National Blueprint for Biodefense: Leadership and Major Reform Needed to Optimize Efforts*; A Bipartisan Report of the Blue Ribbon Study Panel on Biodefense, October 2015

² *Special Focus: Defense of Animal Agriculture*; Bipartisan Report of the Blue Ribbon Study Panel on Biodefense, October 2017

knowledge can guide us to focus detection efforts and surveillance activities at locations of highest risk.

Research provides technologies and reagents for rapid and accurate detection and identification of specific pathogens. Research provides technologies and reagents to control specific pathogens. Research provides the understanding to enable strategic planning to optimize the implementation of these tools.

Since 2007, research at the Biosecurity Research Institute (BRI) at Pat Roberts Hall (PRH) has been developing and testing diagnostics, vaccines and the understanding to effectively protect US agriculture from foreign threats. The BRI/PRH is a unique facility working on threats to plants, animals and post-harvest food products. The research is complemented by essential training to sustain and build upon our current expertise in this area.

Based on President Myers' previous testimony before this body, I would like to start by restating his bottom line on December 17, 2017. As you know, his perspectives on matters of national security, including biosecurity, are unique for a university president due to his service as Chairman of the Joint Chiefs of Staff from October 01, 2001 to September 30, 2005.

PRESIDENT MYERS' BIO/AGRODEFENSE BOTTOM LINE IN 2017

"Well-conceived Presidential Directives have not gotten the job done. Key components of American critical infrastructure — agriculture and food — are vulnerable to terrorist attacks with bioweapons and undeliberate infectious disease outbreaks, and the U.S. is unprepared to confront these threats. Congress must enact enforceable statutes before it's too late."

Clearly, he was focused on infectious disease threats to U.S. crops and livestock in his testimony. However, the points that he made are no less relevant to the SARS-CoV-2 — COVID-19 — pandemic that we have been battling in 2020. The U.S. should have been better prepared.

Wrapping up his testimony, President Myers highlighted the vital importance of biothreat intelligence analysis and the deficiency of such expertise within the intelligence community (IC). After his 2017 testimony, a Marine intelligence analyst in the audience approached him to reaffirm his concerns about the lack of biological knowledge within the IC overall. Although she happened to be a biothreat subject matter expert (SME), she noted that there are far too few within the federal government. That IC SME shortage is especially problematic within the agriculture and food realm. Additional IC information will be provided below.

2020 PANDEMIC ILLUMINATES FOOD SUPPLY CHAIN VULNERABILITIES

The SARS-CoV-2 pandemic has elucidated glaring deficiencies in America's "field to fork" food supply chain. Long-ignored warnings came home to roost in 2020. One highly informative article about it focused on meatpacking companies specifically.³ It notes that these companies had been

³ Michael Grabell and Bernice Young, "Meatpacking Companies Dismissed Years of Warnings but Now Say Nobody Could Have Prepared for COVID-19," ProPublica, Aug. 20, 2020;

warned for years about the potential detrimental impact that a human pandemic could have on their abilities to operate. Interestingly, it suggested that many of these companies were, in fact, prepared a decade ago, but their preparation waned when Swine Flu, H1N1, proved to be much less problematic than predicted. After that, they saw no need to stockpile masks or other biosafety materials when they had not needed them for H1N1.

SARS-CoV-2 proved that thinking to be totally wrong and the companies — along with America and the world — paid the price. Processing plants closed, workers died, animals ready for market were culled, milk was dumped, etc. The outcomes were horrendous.

ADDITIONAL FOOD SUPPLY VULNERABILITIES

Clearly, a global pandemic even if the pathogen does not directly infect crops and livestock can negatively impact the food supply chain due to severe shortages of human resources. Nonetheless, far too little attention is paid to what impact infectious diseases of the food supply — food crop pathogens and food animal pathogens — could have nationally and globally. Hopefully, SARS-CoV-2 will serve as a wakeup call for the possibility of something similar happening to agriculture.

Food Plant Threats — Consider the United Nations (UN) Food and Agriculture Organization (FAO) assessment that “just 15 crop plants provide 90 percent of the world’s food energy intake, with three — wheat, maize and rice — making up two-thirds of this.”⁴ Ninety percent makes the protection of food crops rather significant. Moreover, if wheat, corn, or rice are targeted successfully by bioterrorists or if there is a natural disease outbreak that devastates the global supply of any one of the three, the world’s population will suffer massively. This is a matter that the Wheat State takes very seriously.

Although it did not materialize into a global disaster, the pathogen Wheat Blast — *Magnaporthe oryzae* — hitting Bangladesh in 2016 certainly wreaked havoc there. Wheat Blast can kill 100% of individual crops, and it likely got to Bangladesh in a shipment of grain from South America where it is endemic. The outcomes were devastating in areas of the country where it occurred, and even though infected fields were burned, there was a recurrence in 2017; the new outbreak spread to India too. The U.S. should learn from this in order to avoid a similar outcome. However, grain shipments from South America are likely still coming to the U.S. Research on wheat blast has been ongoing, safely and securely, at K-State’s BRI/PRH since 2009.

Food Animal Threats — With respect to livestock, the Porcine Epidemic Diarrhea virus (PEDV) foreign animal disease (FAD) outbreak in the U.S. in 2013 highlighted biosecurity problems here that must be addressed. It resulted in over 8 million pigs dying, and significant financial losses incurred by producers drove up the cost of pork markedly. It is suspected that PEDV came to the

⁴ See United Nations Food and Agriculture Organization: <http://www.fao.org/docrep/u8480e/u8480e07.htm>

U.S. in feed products from China, and the virus probably got here by accident. Regardless, the impacts were substantial and PEDV is now an enduring endemic problem to deal with in the U.S.

The greatest livestock threat to America today is probably African swine fever virus (ASFV) that ravaged China and much of Europe the past couple years. Prior to the outbreak in China, half the world's swine population was located there, and China's recovery efforts are still ongoing. Based on how PEDV likely got to the U.S., the same or similar pathways from China must be considered and monitored. If ASFV arrives in the U.S., our pork industry could be decimated. Research at the BRI/PRH has proven that ASFV can survive and remain infectious in animal feed products under conditions as experienced during long periods of transportation in shipping containers.

Additionally, highly pathogenic avian influenza (HPAI) continues to be a global threat annually and one that cannot be ignored. It is also a zoonotic disease concern — being transmitted from animals to people — so it is especially dangerous.

KANSAS INTELLIGENCE FUSION CENTER

With respect to the knowledge, understanding and research that is vital for awareness and preparedness to combat foreign diseases threats to U.S. agriculture, the Kansas Intelligence Fusion Center (KIFC) has a biothreat team that helps provide advance warning of infectious diseases potentially hitting the U.S. The KIFC appears to be the only fusion center of about 80 nationwide that has a biothreat team with SMEs capable of assessing the full range of biohazards to food crops, food animals, the food supply, and people. These have included BRI/PRH-affiliated SMEs from K-State, and multiple from the University of Kansas Medical Center and various state agencies. These SMEs allow the KIFC to assess global intelligence for the purpose of preventing bioterrorism attacks and preparing for natural infectious disease events emerging globally. Thus, the KIFC focuses "left of boom" (prior to an attack or outbreak) rather than "right of boom" (after the event) like other fusion centers.

This model should be emulated beyond Kansas, because it allows state-specific strategic planning with regard to "vulnerability assessments, mitigation strategies, and response planning and recovery" as called for in HSPD-9.⁵ On the ground — front line — expertise is essential for early warning when a new disease hits the U.S. Intelligence capabilities cannot just reside in Washington, DC where they are currently understaffed for addressing biothreats.

K-STATE'S ONGOING PROTECTION OF AMERICA'S FOOD SUPPLY

Protecting U.S. agriculture is a mission of America's land-grant universities that began in 1862 when President Lincoln signed the Morrill Act. These institutions participate in protecting agriculture and food in their states each and every day.

This Committee always leverages the expertise at the land-grant universities and, clearly, these institutions can and should play a leading role to develop the resources, technologies, plans and

⁵ Homeland Security Presidential Directive/HSPD-9 – *Defense of United States Agriculture and Food*; Jan. 30, 2004

human resources needed to address threats to agriculture. K-State stands ready to participate on any national teams and to lead when asked or when necessary. Protecting America's agriculture and food infrastructure has been our commitment since 1863.

Back in 1999 with encouragement from the Chairman of this Committee, K-State developed a 100-page "Homeland Defense Food Safety, Security, and Emergency Preparedness Program"⁶ — often referred to as "The Big Purple Book" — that detailed how to protect America's food crops, food animals, and food supply from biothreats. Later that year, K-State's President Jon Wefald testified before the U.S. Senate's Emerging Threats Subcommittee regarding the "Agricultural Biological Weapons Threat"⁷ facing America. That subcommittee was also chaired by Kansas Senator Pat Roberts.

Both the 100-page program and the testimony highlighted the need for a biocontainment facility capable of conducting research on biothreats to food crops, food animals, and the food supply. However, prior to September 11th and the anthrax attacks in 2001, little interest was shown for building it. Afterwards, state and federal funding was obtained and the BRI/PRH became a reality.

The BRI/PRH includes five BSL-3Ag rooms that can be configured for research with cattle, pigs, sheep, goats and poultry; up to 30 head of cattle can be accommodated at one time. Work has been done on numerous species to date, including white-tailed deer in 2017 to determine their susceptibility to Rift Valley fever virus (RVFV). In addition to BSL-3Ag labs, the BRI/PRH has dedicated BSL-3 space for conducting research on crop and food pathogens.

Wheat Blast research and development (R&D) has been ongoing since 2009 and food safety research began soon thereafter. The latter included studies for the Army whereby eight 1-ton grinds of hamburger were done in October 2011 to validate whether food pathogens could be detected and identified at the end of a commercial process. The breadth of food-related biocontainment R&D conducted under one roof makes the BRI/PRH unique-in-the-world.

The National Agricultural Biosecurity Center (NABC) - Established at K-State in 2003, and co-located with the BRI at PRH since 2018, has supported essential research on food-borne pathogens, including studies on threats to U.S. military, has developed pathogen-specific information resources and conducted pathway analysis on several pathogens. With Department of Homeland Security (DHS) support, NABC staff are now leading efforts on threat assessment, disease response strategic planning and training, to combat foreign threats to U.S. agriculture. Efforts to review and collate data related to foreign threats to U.S. agriculture and implementation of a communication system for strategic dissemination to improve preparedness are in progress.

⁶ *Homeland Defense Food Safety, Security, and Emergency Preparedness Program*, March 22, 1999. See: <http://www.k-state.edu/nbaf/documents/1999-Homeland-Defense-Program.pdf>

⁷ *Agricultural Biological Weapons Threat*, October 27, 1999. See: <http://www.k-state.edu/nbaf/documents/1999-US-Senate-Testimony.pdf>

National Bio and Agro-defense Facility Site Selection in 2009: Manhattan, KS — The nationwide site selection process for the National Bio and Agro-defense Facility (NBAF) from 2006 to 2009 resulted in Manhattan, Kansas be chosen. The 46.828 acres identified for the \$1.25 billion laboratory were on the K-State campus immediately adjacent to the BRI/PRH. The co-location was not by accident; the R&D capabilities within the BRI/PRH contributed greatly.

NBAF-related Research at K-State's BRI/PRH — K-State independently and as collaborators with federal agencies and other partners, initiated research on several NBAF-priority pathogens in the BRI/PRH; RVFV since 2013, Japanese encephalitis virus (JEV) since 2014, classical swine fever virus (CSFV) since 2015, and ASF since 2016. We were able to do this because the State of Kansas agreed to fund \$35 million for NBAF-related research in the BRI/PRH as part of our “best and final offer” for NBAF during the site selection competition. R&D continues on all four of these FADs, but the Kansas funding commitment ended in FY2019 when the last \$5 million was appropriated. The majority of the research is conducted by K-State faculty, staff and students, but collaborators from the USDA's Center for Grain and Animal Health Research (CGAHR) in Manhattan participate on some of the NBAF-related FAD projects. Moreover, CGAHR conducts other USDA BSL-3/3Ag biocontainment research in K-State's BRI/PRH as well. Going forward, federal support is needed for R&D on RVFV, JEV, CSFV, and ASFV to help mitigate these threats to the U.S. The number of research publications to date on NBAF diseases by BRI/PRH scientists are: RVF = 44; JE = 10; CSF = 18; and ASF = 46.

Until NBAF is fully operational in 2022/23, USDA has no biocontainment facilities where R&D can be conducted on zoonotic FADs. The Plum Island Animal Disease Center (PIADC) is an antiquated facility with limited capabilities for work with zoonotic threats. Consequently, training the NBAF R&D workforce is highly reliant on faculty and staff working at the BRI/PRH until the new facility becomes operational.

SARS-CoV-2 Research at K-State's BRI/PRH — When K-State wrote the “Homeland Defense Food Safety, Security, and Emergency Preparedness Program” in 1999, we committed that in a national emergency the biocontainment facility it was proposing would refocus quickly to confront the threat facing America. That commitment was honored in 2020 when SARS-CoV-2 hit the U.S.; the BRI/PRH stepped up immediately and began performing research on the new biothreat.

The Kansas State Veterinary Diagnostic Laboratory (KSVDL) in the College of Veterinary Medicine (CVM) set up a human and animal diagnostic test processing lab in the BRI/PRH. It met both Clinical Laboratory Improvement Amendments (CLIA) and Health Insurance Portability and Accountability Act (HIPAA) compliance conditions.

Multiple K-State investigators launched BRI/PRH research projects on SARS-CoV-2 to gain as much knowledge and understanding of this rapidly spreading threat as quickly as possible. Multiple animal species were assessed for infectivity and susceptibility including: cats, hamsters,

and pigs. Potential disease vectors were studied and mosquitoes were proven not to be capable of transmitting the virus.

Additional work has focused on the validation of disinfectants and various technologies to inactivate SARS-CoV-2.

Most recently, a \$1 million USDA SARS-CoV-2 grant was awarded to K-State researchers focused on safeguarding meat processing and food service. Work has just begun in the BRI/PRH. The importance is obvious based on the dire consequences SARS-CoV-2 has had on meat processing plants across the nation.

A summary of these and other SARS-CoV-2 R&D efforts at K-State can be found in *Seek 2020*.⁸

FEDERAL BIO/AGRODEFENSE EFFORTS

Homeland Security Presidential Directive/HSPD-9 — Delineating the federal role in bio/agro-defense post-09/11, President Bush issued HSPD-9, on January 30, 2004 to establish: “a national policy to defend the agriculture and food system against terrorist attacks, major disasters, and other emergencies.”⁹

This is still the federal basis for protecting America against biothreats to agriculture and food, whether naturally occurring or terrorist delivered. The components are all sound; the implementation by the federal government has been less than sound as documented below.

Federal Assessment of HSPD-9 Compliance — Establishing requirements for protecting the nation from global biothreats and actually implementing those requirements are completely different matters. Evaluations to date have not shown great results in meeting the obligations.

- ❑ ***“The Department of Homeland Security’s Role in Food Defense and Critical Infrastructure Protection,” DHS OIG-07-33, February 2007.***¹⁰
 - The DHS performance in food defense and critical infrastructure protection failed in not collaborating with USDA and HHS on developing integrated budget plans:
 - ✓ Noncompliant for 3-years with HSPD-9 mandates;
 - ✓ Failed to develop an implementation plan; but
 - ✓ Agreed to comply in FY2009; it’s unclear if they did.
 - The DHS performance in food defense and critical infrastructure protection failed in not conducting food sector vulnerability assessments:
 - ✓ Failed to develop standards or guidance; and
 - ✓ HSPD-7 critical infrastructure mandates were unmet.

⁸ <https://www.k-state.edu/seek/2020/a-pandemic-battle/index.html>

⁹ Homeland Security Presidential Directive/HSPD-9 – *Defense of United States Agriculture and Food*; Jan. 30, 2004

¹⁰ https://www.oig.dhs.gov/assets/Mgmt/OIG_07-33_Feb07.pdf

- The DHS performance in food defense and critical infrastructure protection failed in not showing consolidated DHS leadership in food and agriculture.

The early evaluation of HSPD-9 compliance by DHS documented a total failure. As will be shown below, the findings of a DHS OIG audit published in 2020 are no better.

❑ ***“Agroterrorism Prevention, Detection, and Response,” USDA OIG Audit Report 91701-0001-21, March 2017.***¹¹

- The USDA Office of Homeland Security and Emergency Coordination (OHSEC) failed to provide oversight of USDA’s agroterrorism preparedness:
 - ✓ No documented process in place;
 - ✓ No assessments of agriculture vulnerability; and
 - ✓ No effort made to assemble response plans.
- The USDA OHSEC lacked evidence of compliance with HSPD-9:
 - ✓ Agency responses were not evaluated or validated; and
 - ✓ Performance measures were never implemented.
- The USDA OHSEC demonstrated no quantifiable progress in protecting agriculture and food.

According to their own OIG, USDA failed to meet their responsibilities under HSPD-9. Rigorous congressional oversight is needed going forward and serious consideration should be given to placing the requirements of HSPD-9 into federal statute.

Securing our Agriculture and Food Act — Efforts by this committee and the Senate Homeland Security Committee led to the enactment of Securing our Agriculture and Food Act (SAFA) August 17, 2017. Its purpose: *“to amend the Homeland Security Act of 2002 to make the Assistant Secretary of Homeland Security for Health Affairs (now Countering Weapons of Mass Destruction) responsible for coordinating the efforts of the Department of Homeland Security related to food, agriculture, and veterinary defense against terrorism, and for other purposes.”*¹²

The recognition of non-compliance with HSPD-9 undoubtedly contributed to the enactment of SAFA in 2017. When executive action had failed to get federal agency compliance with HSPD-9 an obvious next step was congressional action.

Federal Assessment of SAFA Compliance — After 3-years for the implementation of the SAFA requirements, the DHS OIG undertook an analysis of the success or failure. DHS failed.

¹¹ <https://www.hsdl.org/?view&did=801888>

¹² Securing our Agriculture and Food Act: <https://www.govinfo.gov/app/details/COMPS-13642>

❑ ***“DHS is Not Coordinating the Department’s Efforts to Defend the Nation’s Food, Agriculture, and Veterinary Systems against Terrorism,” DHS OIG-20-53, July 16, 2020.***¹³

- The DHS Countering Weapons of Mass Destruction (CWMD) Office has not carried out a program to oversee or manage DHS HSPD-9 responsibilities:
 - ✓ No documentation of HSPD-9 activities;
 - ✓ No HSPD-9 implementation plan; and
 - ✓ No mechanism to track HSPD-9 activities.
- The CWMD Office has failed to lead DHS SAFA policy requirements:
 - ✓ Has not developed policies or led initiatives; and
 - ✓ Has not coordinated with Federal partners.
- The CWMD Office has made no quantifiable process protecting food and agriculture.

Remarkably, 16-years after HSPD-9 was put forth to protect American agriculture and food, essentially no progress has been made. SAFA was intended to add statutory requirement to the original executive order, and to date (3-years later), it still hasn’t accomplished that goal. *Congressional oversight is imperative.*

PATH FORWARD: WHAT’S NEEDED

Funding of the Farm Bill’s Agriculture Advanced Research and Development Authority — The Agriculture Advanced Research and Development Authority (AgARDA) Pilot (Sec. 1473H) in the most recent Farm Bill put forth by this Committee clearly foresaw the threats to agriculture and the need for novel R&D approaches going forward. Particularly insightful from a bio/agrodefense perspective were the sections on qualified products or projects for: (1) *“plant disease or plant pest countermeasures to intentional or unintentional biological threats (including naturally occurring threats);”* and (2) *“veterinary countermeasures to intentional or unintentional biological threats (including naturally occurring threats).”* R&D in these two areas is critical to protecting America’s food supply and to U.S. homeland security. Of critical importance is that funding is strategic and goal-oriented to get the information, knowledge, understanding, technologies and trained people that we need. Furthermore, the funding must be sustained in order to maintain and build upon our resources and capabilities so that we can respond quickly to new threats. Allowing these to decline because of short-term or intermittent funding and then having to recreate the capabilities is a poor strategic plan to combat threats that can emerge quickly and with little if any warning.

- ❑ ***Plant disease or plant pest countermeasures:*** Food crops are likely the most overlooked area when it comes food vulnerability and bio/agrodefense. The UN FAO assessment was

¹³ <https://www.oig.dhs.gov/sites/default/files/assets/2020-07/OIG-20-53-Jul20.pdf>

mentioned earlier that “just 15 crop plants provide 90 percent of the world's food energy intake, with three — wheat, maize and rice — making up two-thirds of this.”¹⁴ Plant pathogens are disseminating around the planet at such a pace that geographic distinctions are no longer relevant. The pathogens of all major food, feed, fiber and fuel crops are being introduced into new production areas daily facilitated by trade and travel. Plant pathogens are emerging or re-emerging due to climate change and land-use change; trade and travel ensure their rapid dissemination around the planet. The impacts have been and will continue to be substantial to the economy, food security, and ultimately to national security.

- **Wheat** — Wheat Blast disease, *Magnaporthe oryzae* Triticum, has been mentioned already, but it is a continuing threat that could destroy a crop vital to feeding the world. From its original location in Brazil, it has now spread to two continents, Asia (Bangladesh and India) and Africa (Mozambique). Wheat productivity has dropped 90% in some locations and poor farmers are falling deeper into poverty. Trade restrictions are required or the pathogen will continue to spread.

Other imminent threats to wheat are: Stem and Yellow Rust diseases, *Puccinia graminis* f.sp. tritici and *Puccinia striiformis* f.sp. tritici; and Scab or Head Blight disease, *Fusarium graminearum* and other *Fusarium* species. Mycotoxins produced by *Fusarium* are threats to human health and livestock health.

- **Maize/Corn** — Late Wilt disease, *Acremonium maydis* (syn. *Harpophora maydis*), was first reported in Egypt in 1960. This pathogen is now reported to be present in India, Israel, Hungary, Portugal, Spain and perhaps Kenya. If it gets to the U.S., the outcomes could be disastrous economically.

A corn-related issue that CDC considers a significant public health concern involves the development of fungicide-resistant populations of *Aspergillus maydis* that have arisen globally over the last 5-10 years. *A. maydis* is a plant and human pathogen most noted for production of aflatoxins that cause chronic and acute lethal toxicities in humans and livestock. The widespread use of fungicides for plant disease control has led to the development of resistance in *A. flavus* as well as the more common human pathogen *A. fumigatus*.

- **Rice** — Bacterial Blight disease, *Xanthomonas oryzae* pv. *oryzae*, is a significant threat to rice production in all regions where rice is a primary staple crop (Africa and Asia). Annual losses in India to Bacterial Blight exceed \$3 billion USD.
- **Ryegrass** — Obviously, ryegrass is not a human food crop, but it serves as a food crop for livestock people eat. *Raythayibacter toxicus* causes ryegrass toxicity, killing significant numbers of sheep, cattle, and horses in Australia. The initial outbreak was in 1956 in South Australia, but it has since been reported New South Wales, Western Australia, and

¹⁴ See United Nations Food and Agriculture Organization: <http://www.fao.org/3/u8480e/u8480e07.htm>

South Africa as well. How it got to South Africa is unknown, but ryegrass, a primary host of *R. toxicus*, is exported from Australia annually, thus increasing the potential for spread to other countries including the U.S. Nematodes serve as the vector delivering the bacterium to the plant host and there is a concern that delivery to wheat is not out of the realm of possibility. Regardless, the arrival of *R. toxicus* in the U.S. could be disastrous.

As a result, *R. toxicus* is now a BRI/PRH priority pathogen. Using genetic and genomic analytical tools, research is being initiated to better understand the emergence of new *R. toxicus* genotypes (e.g., the recently-emerged RT-I population in South Australia) as well as to determine the geographic origin of the recent outbreak strain in the Bunbury dairy region of Western Australia. Understanding these issues may allow the development of countermeasures to help prevent entry into U.S. livestock production areas.

- ❑ **Veterinary countermeasures:** While not as overlooked as food crops, food animals also tend to get little attention when biothreats to national security are considered. That will change when NBAF becomes operational, but full operations won't begin until 2023; America remains highly vulnerable until then. Moreover, NBAF is still projected to work on only seven or eight FAD threats when it becomes fully operational and there are many more non-zoonotic and zoonotic infectious diseases circulating worldwide. And that does not account for emerging diseases yet undiscovered. Thus, increased federal funding is desperately needed.
 - **Non-zoonotic disease R&D** — The federal government should be funding R&D at the nation's land-grant universities to develop FAD and non-FAD countermeasures, but that is being done on an exceedingly limited scale. The vast majority of the BRI/PRH research on ASF and CSF to date has been done with State of Kansas funding, and with animal industry not-for-profits contributing recently, particularly with ASF R&D. To date, there have been 46 ASF publications emanating from the work and 18 CSF publications. Kansas and producers are concerned with biothreats; the federal government should be as well.
 - **Zoonotic disease R&D** — Essentially almost every potential pandemic threat facing the world is a zoonotic disease that can be transmitted from animals to humans. This has been the global consensus for years. With that agreement as to where the greatest threat exists, it's mindboggling that there is not a major focus on confronting these diseases in the animal host where they reside. In some cases, the primary host is unknown, but in many cases they are known. Regardless, stopping the disease in the animal host prior to a human pandemic makes great sense.

The U.S. should have learned from West Nile, chikungunya, and Zika viruses in the past. Although that did not happen, the lessons are still valid nonetheless.

In recent decades, many federal agencies have collaborated to co-fund projects that cross agency-specific mission areas. Perhaps this is an area where the USDA and the Department of Health and Human Services (HHS) should partner. HHS funds research

employing small animal models, but they aren't going to fund research employing livestock. USDA may solve portions of that problem in NBAF when it comes online adjacent to the BRI/PRH in Manhattan. However, livestock are not the host for many of the potential pandemic threats.

Enhanced Funding Government-wide on Biothreats to Agriculture and Food — USDA is an obvious lead agency funding these studies, but other agencies — DOD, DHS, HHS, NSF, EPA — should be involved as well. Agriculture — crops, livestock — and food cross all sectors and, thus, all funding agencies should have a role.

- ❑ **Pandemic and All-Hazards Preparedness and Advancing Innovation Act¹⁵** — Although this is under the purview of HHS, significant efforts were put forth in 2019 to expand the coverage by adding “Zoonotic Disease, Food, and Agriculture.” The Senate led that effort and it must be continued going forward.
- ❑ **Other Legislation** — The Senate Committee on Agriculture, Nutrition, and Forestry should pursue every opportunity possible to insert “Zoonotic Disease, Food, and Agriculture.” language into bills championed by other committees wherever and whenever appropriate.

CONCLUSION

K-State BRI/PRH Contributions

K-State and the BRI/PRH have been proud to contribute to America's bio/agrodefense efforts over the years and we look forward to continuing these efforts for many years to come. The BRI/PRH contributions have included:

- (1) The evaluation of technologies to detect and identify highly pathogenic organisms that threaten deployed servicemen via addition to their food supply;
- (2) Development of wheat varieties resistant to the Wheat Blast pathogen;
- (3) Technology to distinguish between foreign pathogens infectious to swine;
- (4) An oral vaccine to protect swine from CSFV, a.k.a., hog cholera;
- (5) Vaccines for avian influenza, a pathogen that resulted in the loss of over 50 million poultry in a one-year period following the introduction into the U.S.;
- (6) Rapid diagnostics to detect ASFV — a pathogen that could devastate U.S. pork production — that BRI/PRH research has demonstrated can survive in animal feed products that may be imported from ASFV endemic areas.
- (7) Research on JEV has demonstrated susceptibility of North American mosquitoes and of both domestic and feral-like swine.

¹⁵ <https://www.congress.gov/116/bills/s/1379/BILLS-116s1379enr.pdf>

- (8) Collaborative research on RVFV with USDA scientists have evaluated diagnostics and studied the disease in sheep, cattle, and white-tailed deer.
- (9) Pathway analysis by researchers and staff of the National Agricultural Biosecurity Center (NABC) at the BRI/PRH have identified routes by which foreign pathogens, including ASFV and Wheat Blast, might be introduced into the U.S.
- (10) In March, soon after the introduction of SARS-CoV-2 into the U.S., research at BRI/PRH was quickly refocused to study this new pathogen. To date:
 - a. Research has proven for the first time that the virus neither infects nor is transmitted by mosquitoes, and cannot infect swine.
 - b. Research has evaluated cats as hosts and hamsters as small animal models.
 - c. Vaccine candidates will be evaluated in the coming months.
- (11) Complementing the research, the BRI/PRH has developed courses and training programs related to foreign threats to agriculture, several configured for online delivery.

All of these activities that add to our knowledge and understanding of global threats to agriculture are critical in order to anticipate and prepare for introductions and then to respond and eliminate the pathogens in the event of introduction to prevent spread and reduce impacts.

Vital U.S. Bio/Agrodefense Needs Going Forward

- (1) Funding of the AgARDA pilot program in the Farm Bill:
 - a. Plant disease or plant pest countermeasures;
 - i. Food crops are by far the most overlooked area when it comes food vulnerability and bio/agrodefense.
 - ii. The U.N. FAO assessment is that “just 15 crop plants provide 90 percent of the world’s food energy intake, with three — wheat, maize and rice — making up two-thirds of this.”¹⁶
 - iii. For America, a pathogen taking out wheat or corn would be disastrous.
 - b. Veterinary countermeasures;
 - i. The federal government should be funding R&D at the nation’s land-grant universities to develop FAD and non-FAD countermeasures, but that is being done on an exceedingly limited scale.
 - ii. Essentially every potential pandemic threat facing the world is a zoonotic disease that can be transmitted from animals to humans. This has been the global consensus for years, yet very little federal funding has been available to confront these diseases in the animal host. That must be addressed.

¹⁶ See United Nations Food and Agriculture Organization: <http://www.fao.org/docrep/u8480e/u8480e07.htm>

- (2) Enhanced bio/agrodefense IC capacity as stressed by President Myers, Dec. 17, 2017;
 - a. The American Association for the Advancement of Science put out an alert last week highlighting the “areas where the next pandemic could emerge;¹⁷ IC monitoring of these areas should be ongoing.
 - b. Increased IC biothreat expertise at the federal level.
 - c. More cleared USDA personnel centrally and within each state and territory.
 - d. Increased number of state-level fusion centers with agriculture and food SMEs.
- (3) Bio/agrodefense legislation and enhance congressional oversight;
 - a. Executive actions like HSPD-9 are important to mobilize executive agencies into action. Long term, federal statutes and congressional oversight are needed to protect the nation adequately.
 - b. In 2017, SAFA was a great first step focused on DHS, but the DHS OIG confirmed earlier this year that DHS is not complying with SAFA. Thus, greater congressional oversight is needed.
 - c. Additionally, U.S. bio/agrodefense should be based in federal statute. This Senate Committee should lead that effort to ensure U.S. agriculture and food are, in fact, protected from natural and intentional biothreats from around the world.

Thank you for your attention to these urgent matters.

¹⁷ [Areas where the next pandemic could emerge are revealed | EurekAlert! Science News](#)



**Testimony of Steven Rosenzweig, PhD, Senior Agricultural Scientist, General Mills
Submitted to the United States Senate Committee on Agriculture, Nutrition and Forestry
Hearing on “Agricultural Research and Securing the United States Food Supply”
December 2, 2020**

Chairman Roberts, Ranking Member Stabenow and Distinguished Members of the Committee, thank you for the invitation to speak about the importance of agricultural research in securing our nation’s food supply. As one of the world’s largest food companies, General Mills celebrates this committee’s bipartisan legacy of supporting public food and agriculture research. Your accomplishments in the last Farm Bill’s research title were remarkable and should be applauded. Chairman Roberts, I’d like to especially thank you for your distinguished leadership on agriculture, nutrition and national security in Congress over the last 40 years.

I am Steven Rosenzweig, a Senior Agricultural Scientist at General Mills. While I was a PhD student studying soil science, I never imagined myself working for a global food company, let alone testifying to this committee on its behalf. The fact that positions like mine exist reflects the importance of agricultural research to every level of the food system from farmers to consumers.

General Mills is a major packaged-food manufacturer engaged for over 150 years in the development and production of food products including ready-to-eat cereals, yogurts, soups, snack bars, refrigerated dough, pet foods and numerous other products. Despite the unprecedented challenges posed by the COVID-19 pandemic this year, we continue making food the world loves and needs. This perseverance is a testament to the resilience of the farmers, suppliers, our front-line employees, and everyone else required to bring food from the farm to the table. But there are challenges facing our agricultural systems that threaten our ability to continue making food for another 150 years.

Threats to Agricultural Resilience

Agricultural production is increasingly vulnerable to disruption, which affects the price, quality, and availability of food for people in the US and around the world. Climate change threatens agricultural production both through sudden shocks like catastrophic weather, and gradually escalating pressures like shifting temperature and precipitation patterns. These risks are compounded by the continued degradation of natural resources. Over a quarter of American cropland is losing soil to erosion at rates above the tolerable threshold set by the National Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA), with an average of 1.7 billion tons of [soil lost](#) from American croplands each year. Agriculture is the primary driver of biodiversity loss, and we are losing biodiversity across North America, notably [birds](#) and [pollinators](#), at unprecedented rates, constituting [billions of dollars](#) annually in lost crop production and billions more in economic losses [beyond the food system](#). Agriculture uses 80% of the water in the US, and it is being used faster than it can be replenished for critical water sources like the Ogallala aquifer beneath the Great Plains. Climate change will further widen the gap between water demand and supply. Furthermore, farmers are under mounting economic pressures, evidenced by increasing levels of debt, [bankruptcy](#), and [suicide](#) despite historic levels of government support.

Consumers care about where their food comes from. American agriculture has seen historic gains in productivity, but productivity and efficiency do not increase resilience, especially if these gains undermine the integrity of our agricultural and natural ecosystems. The challenge for American



agriculture today is to be productive while rebuilding our natural resources, leveraging the natural resilience of healthy ecosystems to fortify farmers and ranchers in the face of climate change. Restoring the health and function of our agricultural ecosystems and restoring farmers' and ranchers' economic vitality is the critical work to be done now to ensure resilient food systems into the future as consumer demands for sustainably sourced food grows

At General Mills, we are committed to treating the world with care, not just today but for generations to come. The health of our business depends on the health of the planet and the wellbeing of farmers who are the foundation of entire food systems. That is why we are on a mission to ensure thriving farmers and communities, and regenerate planetary health. It is with this mission and the recognition of the scale and urgency of the issues at hand that we have sought to lead the food industry in research and action for the regeneration of our agricultural systems. But, we can't do it alone. We need your continued support and leadership.

Regenerative Agriculture

As a growing number of farmers and ranchers are demonstrating, focusing their innovation on restoring the soil and biodiversity of the farm ecosystem creates positive, cascading impacts on farm businesses, farm communities, and ultimately entire food systems. Regenerative agriculture is a farmer-led movement containing a diversity of ideas and beliefs, but at its core it is a holistic approach to farming and ranching that integrates multiple principles of agricultural management, similar to the principles of soil health codified by the NRCS, for improving ecosystem health and resilience: 1) Understand the unique context of the farm or ranch, 2) Minimize chronic disturbances to the soil and biological community, 3) Maximize diversity of plants and animals, 4) Keep the soil covered, 5) Keep a living root in the ground as long as possible throughout the year, and 6) Integrate livestock on cropland. When implemented together, these principles work to restore and enhance key ecosystem processes like water infiltration, nutrient cycling, and naturally regulated pest cycles. Regenerative farmers leverage these natural processes to reduce reliance on external inputs, increase profitability, and provide a range of ecosystem services like mitigating climate change, supporting biodiversity, and providing cleaner water. An [analysis](#) we conducted along with Ecotone Analytics suggests that for every \$1 invested in regenerative agriculture, an additional \$5 in social, environmental, and economic value is generated for farmers and landowners, taxpayers, local community members, municipal water users, and society as a whole. This growing movement among farmers and ranchers focuses innovation on integrating the regenerative principles to create a win-win for agriculture and the environment. At General Mills, we believe in the regenerative capacity of agricultural innovation, which is why we've committed to advancing regenerative agriculture on one million acres by 2030.

General Mills employs an outcome-based approach to regenerative agriculture. As opposed to a practice-based checklist or certification of specific farming activities, we consider a farm or ranch regenerative if it improves soil health, biodiversity, water, and farm economic resilience. Our focus on a holistic suite of outcomes reflects the multitude of benefits that regenerative agriculture can provide. Regenerative agriculture can address issues of both environmental and economic resilience. For example, analyzing data from the USDA Agricultural Research Service and other long-term cropping system experiments across North America, researchers found that crop rotation diversification alone increased yields over time and under all growing conditions, including [mitigating yield losses](#) by up to 90% in drought years. In a [national survey](#) of cover crop users, farmers on average report yield increases up to 5% with cover crops, and money saved on fertilizers and herbicides. And lastly, a survey conducted



by South Dakota State University found that relative to conventional farmers, farmers who use soil health practices are [more optimistic about the future](#) of their operation, more satisfied farming, less stressed, and even indicate that they have more fun.

We also consider regenerative agriculture to be the greatest opportunity for meeting our climate commitment. In 2015, General Mills became the first company across any sector to publish a goal approved by the Science Based Targets initiative to reduce absolute greenhouse gas (GHG) emissions across our full value chain. There are now over 1000 companies with such a commitment. For General Mills and many other food companies, the areas of greatest environmental impact in our value chain occur outside of our direct operations. Agriculture makes up over half of the GHG emissions in our value chain, meaning we must help farmers address agricultural emissions in order to meet our commitment to reduce our GHG footprint by [30% by 2030](#). Regenerative agriculture can pull carbon dioxide out of the atmosphere and sequester it in soil as organic matter, where it nourishes a network of life. Increasing soil organic matter also rebuilds the natural reservoir of nutrients in the soil, helping farmers reduce their reliance on GHG-intensive fertilizers. Regenerative agriculture empowers farmers and ranchers to play an important role in the fight against climate change, and thus it can and should be a part of an economy-wide strategy for addressing climate change.

The food and agricultural industries have a critical stake in the health of our agricultural ecosystems, and thus have a role to play in advancing the farmer-led regenerative agriculture movement. At General Mills, we have begun our journey to meaningfully engage this movement and invest in its potential to regenerate ecosystems and livelihoods. We have also made industry-leading investments in research to advance the science of regenerative agriculture and improve our understanding of its potential impact to the environment and economy. While we continue to invest our company's resources, we encourage this committee to continue to invest federal resources into public-private research partnerships in the food and agriculture sector to accelerate research efforts to help farmers and ranchers find the best solutions to meet the challenge.

Strategies to Accelerate Adoption of Regenerative Agriculture

Over the last two years we have worked to pilot a variety of strategies for accelerating adoption of regenerative agriculture in key sourcing regions. These pilots build on several years of [award-winning](#) partnership and investment to drive progress toward our commitment to sustainably source our top 10 priority ingredients by 2020, defined for US grains and dairy as driving towards continuous improvement against industry-defined efficiency metrics. While these efficiency gains have been an important step, we now look to build on this work to enable farmers to go beyond sustainability to regenerate their agricultural ecosystems and businesses. Across every pilot there is a variety of farmer experience levels and production types – including both organic and conventional farmers, grain and mixed grain/livestock farms, and small and large operations. Our pilot strategies include a mix of different resources and incentives for farmers, including education, coaching, cost-share, payments for ecosystem services, establishing markets for alternative crops including perennials, and more. We are leveraging applied social science research to identify the most effective and scalable strategies for promoting sustained adoption of regenerative agriculture.

In 2019, we formed a partnership with the Kansas Department of Health and Environment (KDHE) and the Cheney Lake Watershed to advance regenerative agriculture in the production region surrounding the [Cheney Reservoir in central Kansas](#), the primary source of drinking water for 500,000 residents in



the Wichita area. This pilot strategy includes free educational workshops hosted by the [Soil Health Academy](#), and one-on-one coaching from [Understanding Ag](#), to help farmers develop and implement their own regenerative management plans over three years. Through field days, discussion groups, and social media groups, farmers are leveraging a peer learning network to accelerate learnings about successful practices. This pilot model seeks to supplement existing technical assistance resources from NRCS and other local conservation organizations to help build farmers' understanding of their ecosystem and its connection to the financial viability of their operation. This enables an understanding of why, regardless of any cost-share or external incentive, regeneration of their ecosystem is essential. We are working to expand this program into north-central Oklahoma, where there is currently only one conservation service provider for every 208 farmers. We are partnering with the Oklahoma Conservation Commission to hire a full-time soil health specialist who will collaborate with NRCS and Conservation District staff to lead regenerative agricultural education and technical assistance in the region.

We are also piloting a similar one-on-one coaching model with 45 farmers across a key oat growing region in [North Dakota and Canada](#), and with four large dairies and two dairy co-ops in [Michigan](#). The western lower peninsula of Michigan is a key dairy sourcing region to support the Yoplait yogurt brand, and we are working to understand what changes large dairies can make to integrate the regenerative agriculture principles and realize greater profitability. The dairy industry has been particularly hard hit in recent years, but we believe regenerative agriculture can build the resilience of dairy farmers to weather these pressures. Along with partnering with the co-ops and farmers to provide individualized coaching support from Understanding Ag, we have developed partnerships with the Institute of Water Research at Michigan State University to study the impacts of regenerative dairy practices on water quality, with Cornell University to model a holistic suite of outcomes across the dairies, and provided \$100,000 in funding to University of Wisconsin's Dairy Brain program to advance next generation data analytics for holistic dairy management. Building on this pilot in Michigan, we are commencing a partnership with the National Fish and Wildlife Foundation to integrate regenerative agriculture into the Sustain our Great Lakes program, a competitive grants program focused on benefitting fish, wildlife, habitat, and water quality in the Great Lakes basin. This new partnership will direct \$750,000 annually to expand technical assistance capabilities and increase enrollment in Farm Bill practices in complement to advancing regenerative agricultural principles across the Great Lakes region, with over half of the funds directed to the western lower peninsula of Michigan.

In partnership with Cargill and the recently formed MBOLD coalition, Minnesota's globally leading cluster of businesses, researchers, and food and agriculture producers, General Mills is supporting the Wilkin, Traverse, and Richland County Soil and Water Conservation Districts to promote soil health practices in the Red River Valley of Minnesota and North Dakota. With a planned \$1 million cash contribution from General Mills, this project will fund technical assistance and cost-share for several dozen farmers for five years, with the goal of establishing a network of soil health demonstration farms in one of the most intensively tilled regions of the country. Project funds will also enable the University of Minnesota and other research partners to study the soil health, water quality, economic, and social impacts of the changes in management.

In addition to these efforts we are working to support state-level coalitions of public and private organizations to enable the spread of the regenerative agricultural movement through enhanced coordination and alignment. In 2019 we helped support the creation of the Minnesota Soil Health



Coalition, and this year along with KDHE, No-till on the Plains, and the Kansas Grazing Lands Coalition we helped form the Kansas Soil Health Alliance.

By piloting and sharing learnings from these approaches and a range of other strategies, we hope to help the food and agriculture industries identify partnerships and investments that are impactful and scalable solutions for accelerating adoption of regenerative agriculture.

Advancing Agricultural Research and Ecosystem Service Markets

Chairman Roberts and Ranking Member Stabenow championed the creation of Foundation for Food & Agriculture Research (FFAR) in the 2014 Farm Bill. Consistent with their vision, FFAR builds public-private partnerships to fund pioneering research addressing urgent challenges in food and agriculture. FFAR is attractive because it boosts private-sector investment with public support and accelerates research efforts to help us realize our sustainability goals. Several of FFAR's flagship programs have been launched in partnership with General Mills.

One example of this work is the Ecosystem Services Market Research Consortium (ESMRC), the research arm of the Ecosystem Services Market Consortium (ESMC), of which General Mills is a founding member. General Mills, together with KDHE and ESMC, is conducting one of the first pilots of this market alongside our regenerative agriculture pilot in Kansas, wherein farmers will be paid for GHG reductions and water quality improvements. Together with ESMRC and research partners at Colorado State University, Yale University, Applied Ecological Services, and the Soil Health Institute, we are conducting the research necessary to create a scaled, efficient, cost-effective ecosystem service marketplace that benefits farmers and ranchers. We believe that farmers and ranchers who are working to restore soil, biodiversity, water, and other natural resources should be paid for providing these services to society. Compensating farmers for their stewardship through an ecosystem services market improves both environmental outcomes and farmer profitability, and such a market may also provide a critical incentive for more farmers to adopt regenerative agriculture. As a member of ESMRC's working group on Racial Justice, we are working to ensure ESMC can serve as a tool of economic empowerment for all farmers, particularly for those that are Black, Indigenous, and people of color who have been historically underserved by federal programs and opportunities for economic advancement.

In addition to providing added value for farmers, ecosystem service markets provide companies a process to trace and verify impact on the environment and local communities. Currently, there is little standardization or guidance for how food companies should account and report GHG reductions in their agricultural value chains, but ESMC has provided a platform to help the industry begin to align. To strengthen the ESMC and further the scalability and standardization of ecosystem service markets, General Mills supports bipartisan legislation introduced by Senators Stabenow, Whitehouse, Braun and Graham. The Growing Climate Solutions Act would establish a *Greenhouse Gas Technical Assistance Provider and Third-Party Verifier Certification Program* through which USDA would provide endorsement of third-party verifiers and technical service providers that help private landowners generate carbon credits through a variety of agriculture and forestry related practices. As the demand for carbon markets grows it is imperative that we have qualified technical advisors helping farmers develop and implement the most beneficial practices for their land.

Given General Mills' outcome-based definition of regenerative agriculture, we seek to quantify the environmental and economic impact as farmers implement these systems. Most agricultural research to



date has focused on understanding the impacts of isolated conservation practices, assessing the difference between, say, till vs. no-till, or cover crops vs. no cover crops. But regenerative farmers are often implementing multiple practices at once, with additive or even synergistic effects for greater impact. Additionally, most research today focuses on assessing only a narrow set of performance metrics. For example, while there are many studies that examine the effects of conservation practices on yield, soil health, profitability, or biodiversity, it is rare to find studies that assess all or some of these different outcomes together. We need more long-term, systems-level agricultural research that focuses on a holistic suite of outcomes to help us better understand the range of impacts that occur when multiple regenerative principles are implemented together. To contribute to this understanding, we are partnering with ecological research firms, nonprofits, government agencies, and universities to track the changes in soil health and carbon sequestration, insect and bird biodiversity, water quality, and economic impacts as farmers in our pilots implement regenerative systems. We are also investing in the development of satellite imagery, sensors, and modelling to track adoption of regenerative agriculture and monitor a holistic suite of outcomes at a landscape scale.

General Mills has made many other notable contributions to advance agricultural research including:

- Support of the development of open source technology through OpenTEAM, which is a FFAR initiative to develop a farmer-driven, interoperable network of tools that provide farmers around the world with the best possible knowledge to improve soil health.
- Provision of matching funds to FFAR's \$9.4 million grant to the Soil Health Institute, The Nature Conservancy, and the Soil Health Partnership to improve soil health and support thriving farms. This is currently the largest soil health research program in the US.
- Contribution of over \$2.5 million to the University of Minnesota, The Land Institute, and value chain partners to support the development and commercialization of the deep-rooted perennial grain Kernza.
- Expansion of the Soil Health Partnership into wheat production systems in the Great Plains states through a \$735,000 grant to the [National Wheat Foundation](#).
- Partnerships with USDA ARS and public Universities like North Dakota State University, South Dakota State University, and the University of Minnesota to improve disease resistance in oat lines, enabling reduced fungicide use and organic oat production.
- Partnership with the Savory Institute to launch the Land to Market network and associated Ecological Outcome Verification, which is the first outcomes-based consumer facing label that promotes regenerative ranchers who monitor ecological outcomes.
- As one of the largest oat buyers in North America, we worked with USDA ARS to develop the 'Oats Grand Challenge,' an ARS internal program which enables \$5 million in new funding to minor crops.
- Supporting organic research through partnerships with the Organic Trade Association, the Organic Center and the Organic Farming Research Foundation.

Conclusion

Thank you, Chairman Roberts, Ranking Member Stabenow, and Members of the Committee for your strong legacy of support for public agriculture research and for establishing FFAR's public private partnership model. Despite the many challenges facing our food and agricultural systems today, there many reasons to be optimistic about the future. Farmers and ranchers, with the support of researchers and conservation professionals, are increasingly focusing their innovation on regenerating the



agricultural ecosystem, reversing the degradation of natural resources, and generating positive impacts for the environment and farm business. And more than ever, the private sector is looking for ways to contribute to the advancement of these regenerative agricultural systems. With emerging opportunities like ecosystem service markets and public-private partnerships for research and innovation through the FFAR model, the food and agriculture industries have immense opportunities to invest in securing the resilience of the American food supply, but with farmers struggling, we are far from the finish line. We encourage this committee to continue to invest federal resources into public-private research partnerships in the food and agriculture sector to accelerate research efforts to help farmers and ranchers meet the challenge. If research in regenerative practices from companies like General Mills is matched by increased public investment by our government, utilizing organizations like FFAR, the potential for positive change is limitless. Thank you for the opportunity to testify on these important issues. We look forward to continuing our partnership.

QUESTIONS AND ANSWERS

DECEMBER 2, 2020

Senate Committee on Agriculture, Nutrition & Forestry
Agricultural Research and Securing the United States Food Supply
December 2, 2020
Questions for the Record
Mrs. Amy France

Chairman Pat Roberts

- 1) **Your testimony indicated that sorghum continues to be an important crop for producers facing environmental conditions such as drought and water scarcity. How can continued research efforts help sorghum producers overcome environmental challenges such as extreme weather, floods, and drought?**

Sorghum growers make the best planting and production practice decisions they can based on what we know, but there is so much we still do not know. Investments in the genetics of sorghum and related plants regularly provide details to mitigating risk. Research has informed growers regarding planting times for specific varieties to maximize yield, while limiting inputs, to the discovery of new traits that allow the crop to better resist drought and pests. These traits could be in the form of improved root architecture, crops better suited for symbiotic relationships with beneficial microorganisms or disease resistance proteins.

However, we are just beginning to unlock the utility of the genetics of sorghum and related plants. At times we have seen individual plant populations withstand weather extremes and pest pressures where others have failed but we frequently don't know why. Often the answers lie in the plants' DNA and expressed phenotypes just waiting for their discovery. Investments in sorghum research will inform every aspect of our production to further improve on its sustainability qualities and marketability.

- 2) **Advancements in research often yields benefits well beyond its initial focus. Can you describe how research on sorghum drought tolerance has impacted sorghum crop insurance?**

Crop insurance has emerged as America's premier crop risk management tool. One key feature is improvement in crop performance actually improves the performance of the risk management tools, as well, making them more effective for farmers and less costly for taxpayers. For example, drought tolerance reduces the number of crop failures, lowering the amount of crop insurance payouts. Thus, improving drought tolerance in sorghum via expanded research programs indirectly---but significantly---improves crop insurance for all involved.

Senator Debbie Stabenow

- 1) **In order to best advance research tools necessary for farmer knowledge around adaptation and mitigation of climate change, what are the top three actions the USDA's**

Chief Scientist/Under Secretary for Research, Education, and Economics can take in conjunction with the Land Grant University System?

1. There is much that can be accomplished through plant genetics and crop cultural practices. However, we see additional opportunities in evaluating inputs such as biostimulants, symbiotic microorganisms (e.g., mycorrhizal fungi) and nutrient stabilizing products that can help achieve sustainability objectives, yet we see less research emphasis here. This is in part due to the complexities of studying the interactions of these inputs with the crop, as the work is more like community ecology than typical crop research. We believe USDA-ARS and our land grant institutions are well positioned to take on the multidisciplinary research necessary to uncover these answers.
2. The continuum from laboratory to field must be adequately resourced at each step to ensure that not only there is robust basic and applied research, but that the results of this research are translated in useful, implementable ways to farmers and landowners. While many mitigations may eventually enhance productivity, few are not without initial cost. We believe that the Under Secretary and Chief Scientist have existing, broad authority to enable research investment in these areas -- what they are lacking most is funding. Land-grant universities were established to meet the challenges of the time and since then, they've continued to help farmers, ranchers, landowners and consumers to meet and understand new challenges. The Land-grant system has been working and is best positioned to continue to address these issues now.
3. USDA, in partnership with land grant universities, should strengthen and expand our plant germplasm collections for referencing and discovery of new traits to address climate challenges. We can discover valuable traits from cultivated varieties or wild relatives that are not available to evaluate.

2) Please articulate the measures taken by the National Sorghum Producers with regard to crop diversification's role in protecting the food supply and assuring food security.

The fastest-growing market for U.S. sorghum is the market for human food, and NSP and its sister organization, the Sorghum Checkoff, have been working to promote this market for the past decade. Our organizations are paving also the way for U.S. sorghum farmers to meet the challenges of a changing planet by increasing agronomic resources to assist farmers in providing a safe, nutritious and affordable food supply that also promotes the public good by facilitating diversification of crop rotations and promoting other climate smart cultural practices like rotational grazing and grazing of crop residues. Not only do these practices shrink farmers' environmental footprint, they increase crop productivity and lower the risk of food security-reducing crop failures, as well. Sorghum farmers have been ardent practitioners of diversification for generations, and the resources our organizations are providing are enabling them to do even more to help solve the world's increasingly complex challenges.

3) How can diversification of grain production impact soil health, framers, and consumers across the U.S.? What are some key challenges and benefits from transition of

traditionally grown corn and soybeans to a more diversified rotation including crops such as sorghum and oats? Where are some opportunities to scale the adoption of these systems?

Sorghum farmers have ardently practiced crop rotation for almost a century, and as a result, soils on the western Plains are some of the healthiest in the U.S. Not only do these healthy soils impact crop productivity and farmers' ability to provide nutritious crops, they positively impact air and water quality, as well. Most importantly, crop rotation helps break the disease and pest cycles that can decimate crops and trigger food security concerns almost overnight.

While these benefits are well-known and numerous, the challenges are equally numerous. While very positive for farmers and the sorghum industry overall, crop insurance sometimes provides a barrier to transitioning crop production systems, so more coverage in the transitional period would be a positive step. These stopgap coverage measures would help farmers in marginal corn production areas to make a desperately needed transition. While drought tolerant corn genetics have improved rapidly and substantially, there are still millions of acres in the U.S. where sorghum would be a wise agronomic choice, and transitional coverage and other agronomic resources would facilitate this transition.

Senator Michael Bennet

1) As climate change continues to drive hotter and dryer conditions throughout the West we must make sure farmers and ranchers have the tools they need to adapt.

a. How could more investment in high-risk, early-stage agricultural research and development benefit farmers and ranchers in drier states, like Kansas and Colorado?

The high-risk versus high-reward calculations are different for every industry. For some, the potential financial upsides are so great that the risk from private industry is justifiable. However, for agriculture the risk thresholds are typically much lower due to the perceived ceiling in industry's financial benefit. For these reasons it is appropriate for the federal government to play a significant role in accepting some of the financial risk particularly when the benefits might go beyond financial.

A great example of such a situation is in the challenges facing farmers in the central United States where water availability, including in Colorado and Kansas, are depleting. We've witnessed a significant drop in water levels of the Ogallala Aquifer. Unfortunately, water conservation solutions based on what we know now are not sufficient. We must quickly adapt our practices and the very crops we grow quickly to head off a potential catastrophe for our food systems.

The research necessary requires significant investment and coordination which we have witnessed through ARPA-E. We have no doubt USDA, if properly resourced and instructed to partner with industry and land grant universities can meet these

challenges. Drought tolerance and improved water efficiency traits are out there in the sorghum gene pool but the specific genes and the phenotypes they exhibit are unknown. We need to commit now to the discovery and deployment of these traits in our crop producing varieties. But to do it requires teams of people who have deep expertise in plant biology, genetics, bioinformatics and production agriculture, all of which requires resources often beyond what is available for most crops including sorghum. That is why federal investment in breakthrough innovations in agriculture is necessary.

b. What lessons have you learned from working with ARPA-E? What should we consider when establishing a similar program at USDA to drive innovation in agricultural research and technology development?

Three particular aspects that have greatly influenced the success of the program are the emphasis on multidisciplinary teams; the latitude the program has to pursue bold innovation rather than being constrained by efforts that are smaller in scope and better pursued through more traditional research programs; and the policy of retaining a talented leader limited to a five year term. Empowerment of this leader to move quickly and hold scientists accountable is also essential to the program's success.

As a result of these features, ARPA-E has played a convener and coordinating role of the best and brightest from industry, government and academic institutions, and this has prevented the siloing of information and fostered collaboration. We suggest Congress avoid being overly prescriptive and allow government, academic and industry scientists to establish and review priority project areas as has been the case throughout ARPA-E's hugely successful history.

Senate Committee on Agriculture, Nutrition & Forestry
Agricultural Research and Securing the United States Food Supply
December 2, 2020
Questions for the Record
Secretary Dan Glickman

Chairman Pat Roberts

- 1) What role do you see for domestic and international agricultural research efforts in supporting the goal of producing enough food for the growing population?

We can only feed a hungry and growing world with increased funding, resources and commitment to food and agriculture research. This research will benefit crop and animal agriculture in both the US and the developing world, particularly as we face threats from climate change, heat and drought, weather volatility, pest and animal diseases, zoonotic threats, and challenges to global health and nutrition. This research will be largely be focused at USDA and its facilities, together with collaboration with other Government agencies(DOD, NSF, NIH), FFAR, academia and the private sector. We also need to fully find our domestic feeding programs.”

Senator Debbie Stabenow

- 1) In order to best advance research tools necessary for farmer knowledge around adaptation and mitigation of climate change, what are the top three actions the USDA’s Chief Scientist/Under Secretary for Research, Education, and Economics can take in conjunction with the Land Grant University System?

There must be an upgrade within USDA on its climate change strategies to make it is organization capable of dealing with the challenges. The real question is whether there is anyone or any part of USDA really in charge of new climate commitments. Is the Secretary’s office, the Office of Chief Economist, the Under Secretary for Research (and chief scientist), NRCS, etc? The responsibility needs to be the Secretary’s, properly delegated to the correct part of the team. And then a high performance team put together working internally, and with the White House and other agencies of Government.

- 2) Regarding staffing and capacity at USDA’s ERS and NIFA, what can the incoming Secretary do to rebuild those agencies? How can the next Secretary of Agriculture address food insecurity in the pandemic in order to ensure its full alleviation?

I think was a mistake to move NIFA and ERS out of Washington. It hurt morale throughout the entire USDA research team, and it seemed to serve no strategic purpose except possibly to save on rent. What research objectives were strategically benefitted from these moves? Very few if any in my judgment. And it creates enormous challenges to retain and hire talented professional at the agencies. At a time of the pandemic, it makes little

sense and seemed like a purely tactical decision, not consistent with our long term strategic needs in federal food and agriculture research.....instead of dealing with the pandemic, we need more dollars allocated to zoonotic research (as viruses continue to spread from animal to humans), fully funding SNAP and other federal feeding programs, and amplifying research funding into the relationships between diet, nutrition and health especially relating to disease prevention.

Senator Michael Bennet

- 1) This year Colorado saw three of the top five largest fires in the state's history. As we look to future fire seasons, prolonged drought and the poor condition of our forests will continue to fuel catastrophic wildfires. Improving forest health to help prevent destructive wildfires is a priority to farmers and ranchers in Colorado.
 - a. Drawing on your time as Secretary of Agriculture, how can we direct USDA research efforts to help reduce wildfire risk and build resilient national forests?

To help reduce wildfire risk and build resilient forests, I would seek the help of professional forest managers and scientists at the State, Federal and private sector levels to identify current gaps in research, especially the role climate change is playing on the impacts of repeated droughts and hot weather on forest health. We also need better coordination between USDA Forest Service, BLM and the Department of Interior, the Pentagon and FEMA, as well as state foresters, in managing fires and mitigating the risks. Also, collaboration with foreign Governments should be a priority. Flexible and sufficient funding is also required.

Senator Robert P. Casey, Jr.

- 1) You note in your testimony how the COVID-19 pandemic has exacerbated global hunger and revealed vulnerabilities in the global food supply chain. You also note how Feed the Future has furthered U.S. leadership in eradicating global hunger.
 - a. How can we better integrate and leverage investments in agricultural research between domestic and foreign assistance programs to address evolving challenges to eliminating global hunger?

Good question. Good Collaboration between the research and operating arms of USDA, USAID, State Department, the NGO world, and the private sector is desperately needed for proper implementation of the Feed the Future initiative, PEPFAR, MCC, Dole-McGovern school meals, and girls and related women's initiatives. Congress needs to stay active in funding and providing oversight here. We also need strong funding in the US humanitarian initiatives, including appropriations for the World Food Program, where the US continues to demonstrate a bipartisan commitment to fight global hunger

- b. As we adapt to a post-COVID world that also faces the continuing challenge of climate change, how should we look to research to help us update and reform Feed the Future and other foreign assistance programs to address tomorrow's global food security challenges?

In all these programs, Congress must continue to exercise a healthy amount of bipartisan oversight to insure there is adequate funding and appropriate implementation by the Executive Branch. Most of the initiatives to feed hungry people, at home and abroad, and to deal with climate change, have come from the Congress, and Congress must continue to be the leader and keep "watch" on the Executive branch to make sure it does its job with commitment and professionalism.

Senate Committee on Agriculture, Nutrition & Forestry
Agricultural Research and Securing the United States Food Supply
December 2, 2020
Questions for the Record
Dr. Stephen Higgs

Chairman Pat Roberts

- 1) What role does agricultural research, and in particular institutions like the Biosecurity Research Institute (BRI) and the National Bio and Agro-Defense Facility (NBAF), have in ensuring we are prepared to respond to potential threats to food, agriculture, and public health?

RESPONSE

Just because research may be labelled as agricultural, does not mean that the discoveries and tools that are developed are limited to use within the agricultural arena. The BRI is unique in that we conduct research, education and training on pathogens of plants, food-borne pathogens and pathogens that infect animals including in some cases people. This means that we have researchers, their team members, companies and agencies with whom they interact, all under one roof. This type of environment can foster cross-discipline collaborations. A problem can therefore be discussed by people with very different perspectives and that can mean novel and innovative approaches and solutions.

In many ways, our role is to know what we do not know, identify and prioritize what we need to know and then figure out what research needs to be performed in order for those knowledge gaps to be filled. The development of accurate diagnostics is in part dependent upon an understanding of the target organism(s) – the more complete the understanding, the more accurate and durable the diagnostic test. BRI scientists not only develop diagnostics for some of the most high consequence pathogens threatening plant, animal, and human health, they also conduct the research necessary to provide the foundational knowledge upon which those diagnostic tests depend. Accurate and reliable diagnostic tests are essential to effective health care. In the midst of a crisis you do not really have the luxury of time to procrastinate. Unfortunately, research in high containment labs like the BRI and NBAF next door is very expensive and the normal process of funding announcements, grant applications, grant reviews and then awards can take months.

The BRI has enabled research on about 20 different pathogens, in many different hosts including, mice, hamsters, chickens, cats, pigs, sheep, cattle, white tailed deer and even wheat. The ability to work in a safe and secure environment with zoonotic pathogens means that our research can obviously have benefits to human health.

As the threats associated with SARS-CoV-2 virus became apparent, researchers, BRI staff and University administrators realized that this was not just an opportunity but a responsibility to begin work on this virus. Because we work with so many pathogens at the BRI using a wide

variety of approaches, we were well positioned to be nimble and responsive to the emerging global threat. There was the normal paperwork and reviews of protocols to be done, but K-State's leadership and committees pulled out all of the stops and met online as needed to enable the research, including our emergency response and recovery team in the National Agricultural Biosecurity Center. We obtained the virus as soon as it became available, and early in January had been proactive in getting personal protective equipment. PPE availability remains an issue but suppliers were very helpful once they realized that it was for COVID work. At a time when much of the University was shut down, my staff were keeping the BRI running and on-task.

With respect to NBAF, although it is approximately 7 times larger than the BRI, it has a much narrower focus with respect to the pathogens and animals with which it will work. Several years ago, it was stated that although they will work on zoonotic pathogens, they would not work on human vaccines and there will be no poultry work there. This is just my opinion, but I suspect that even had NBAF been fully staffed and fully operational, that SARS-CoV-2 would not fit their pathogen criteria as a priority, and bureaucracy might have been a hindrance to their refocusing in a timely fashion to work on the virus.

With respect to zoonotic disease research priorities, something that COVID-19 has shown us is that we never seem to be prepared, even if the warning signs are on the horizon and the pathogens are heading our way. Although most emerging threats to human health are zoonotic, and jump from animals to people, it is rare that we do not know something about these threats even if it is about a closely related pathogen. Our priorities should be the same, be vigilant, have the tools and people that you need, have a plan and, like a boy scout, always be prepared. In essence, knowledge is power and research provides that knowledge. We need a system of sustained funding, not a system that has to be reinvigorated or worse still reinvented each time a new threat emerges. The lag time to come up to speed results in greater negative impacts. Funding with a pattern of famine to feast to famine is not a good strategy.

That said, you cannot assume that you can simply extrapolate what you know about one pathogen to a close relative. You have to accept the data as they are generated and be prepared to adapt your approaches and plans quickly to deal with new pathogens.

- 2) How does Kansas State work with the U.S. government and industry stakeholders both formally and informally to share the unique facilities, research, results, and expertise that is developed at institutions like the BRI?

RESPONSE

We have great relationships with the Department of Homeland Security, the US Department of Agriculture, the Kansas Department of Agriculture and several industry partners. The relationships with DHS and USDA have certainly expanded because of NBAF, in both the research and training arena. Funding is always an issue. The BRI costs about \$5M a year to operate and have a bond payment. Furthermore, we have been operating since 2007 and as you can imagine, for the sake of safety and security we cannot defer maintenance work.

Our funding model depends on recouping the operational costs by research fees charged to research awards to principal investigators. Even though what we charge does not in any way cover our full costs, they do appear to be high and are a deterrent to grant funders, government and industry partners. The \$35M State of Kansas NBAF transition fund that we received has been absolutely critical and has enabled us to do studies that otherwise we could not have done. This includes some of the COVID-19 research. Funding from the Kansas Department of Commerce supports our global food systems initiatives across campus, supports part of the staff and facilities needs at the BRI, and enables us to support an innovation ecosystem to attract corporate partners, large and small, to the neighborhood around NBAF. A recent investment in COVID response from the KSDOC is helping K-State build out a pilot-scale production test lab in containment for vaccines and other countermeasures developed in our laboratories. We also have an economic development plan to engage strategic corporate partners that aligns with the Kansas Board of Regents' strategic plan for economic prosperity.

In terms of sharing our resources, data and expertise, we do everything possible to publicize and share. What we do is too important for personal egos, personal self-serving agendas and politics to get in the way of moving the field forward.

- 3) As one of our first Land-grant Universities, Kansas State is home to some of the nation's newest research facilities, including NBAF. It is also home to other more traditional research facilities. From this unique perspective, what observations can you share with the Committee about the current state of our agriculture research infrastructure throughout the United States?

RESPONSE

The Experiment System in Kansas involves multiple research institutions including experimental field stations, research extension centers, etc., strategically placed across states allows timely, and efficient access for the land grant university stakeholders.

Stakeholder/industry input when embarking on research is critical. If industry is not going to use the cutting-edge tools that you develop because of costs or complexity then you are wasting time and frequently taxpayer money. It is our responsibility to hear what they say and give them what they need. It is also important not to duplicate efforts, so planning and coordination between facilities is very important. Because of our focus on African swine fever for example, we have been partially funded by the National pork board. Our strengths have attracted interests in corporate partnerships with major animal health and food companies.

As reiterated by Fletcher and colleagues in 2020 (<https://doi.org/10.1007/s42161-020-00509-2>) land-grant Universities facilitate progress through "...*an integrated push-pull of science and technology driven by creativity and innovation; balance is required to achieve the greatest good*". There is a substantial underinvestment in the national agricultural research enterprise that precludes realization of the greatest good from rapidly evolving biosciences and technologies, including precision agriculture and data sciences. The current investment portfolio is heavy on the technology component, but light on the human resource and infrastructure components. To

keep pace with the massive investments made by other countries (e.g., China) and maintain a global leadership in agricultural research, increased and more strategic investments in agricultural research will be required.

We are currently conducting research driven by 21st century technologies housed in 20th century infrastructure with 20th century facilities. The energy required to support those technologies is greater than the capacity of the buildings that house our sciences. Advances in many of the biological sciences are dependent upon plant and animal cell lines and organisms stored in ultralow freezers without back-up and fail-over energy systems. The consequence is that an interruption in the power-grid can result in lost critical genetics and the ten years investment that it took to develop them.

The most recent Farm Bill authorized investments in land-grant university research infrastructure and strategic facilities. There has yet to be an appropriation to fund this part of the Bill. Funding at a level that will impact this infrastructure short-fall needs to be appropriated and continued into and beyond the next Farm Bill.

Something that cannot be ignored is that after completion of facilities such as the BRI, we must budget for continued maintenance and if necessary, upgrading to integrate new technologies and materials as they become available. The operation of high containment facilities is very expensive and adequate funding to keep these facilities safe and secure and to enable essential research, education and training, must be part of our infrastructure to protect U.S. agriculture from known and unknown threats.

- 4) Your written testimony mentioned emerging and re-emerging plant pathogens. How has COVID-19 and environmental challenges highlighted gaps in our understanding of these diseases and our agro-defense vulnerabilities?

RESPONSE

As I mention elsewhere, like many other emerging and re-emerging pathogens, although SARS-CoV-2 was basically a new virus, as a result of the emergence of related viruses, namely SARS and MERS, we had a considerable knowledge and understanding that we should have learned from. Nonetheless, we seemed to be remarkably unprepared to deal with the many challenges that we have faced this year. Some of these challenges were unprecedented, for example, the impact that human illnesses and responses to reduce these had on the operation on commercial meat processing and packaging facilities, and subsequent scarcity of some food items. Our federal agencies seemed to act with authority but uncertainty and issued recommendations that were not necessarily data-driven. What may be considered as a major gap in our understanding was the consequences of the responses to the pandemic, including severe disruptions to commerce, travel, the health care system and indeed, our daily lives.

From the university perspective, the COVID-19 pandemic also interrupted research programs for many of the plant pathogens that threaten food security and environmental health. The impacts ranged from reduced availability of PPE and scientific supplies (reagents), to reduced productivity from required distancing guidelines (staggered access to laboratories), to delayed

graduate degree research programs. Among the interrupted research programs, including the wheat blast project at BRI, were those investigating the identification and deployment of host plant resistance genes to mitigate the impacts from plant diseases that reduce production of vital food crops (e.g., wheat) in developed (Brazil) and developing (Bangladesh) nations.

On the topic of environmental challenges, as I mentioned in my response to Senator Stabenow, I do not know of any conclusive demonstration that the emergence or re-emergence of any of the pathogens and pests has been driven by changes in climate. Models may predict that increasing temperatures may increase the incidence and geographic distribution of diseases caused by some of these pathogens, but it has not happened yet. Global trade and travel has most certainly been a major contributor and will ensure their rapid spread around the planet – SARS-CoV-2 is the best current example for human health, African Swine fever virus for animal health, and wheat blast for plant health. This is happening daily in plant and animal agricultural systems. Some of these pathogens cause rapid and huge impacts while others chip away at the systems they attack. Collectively, they challenge our abilities to meet the increasing demands for a safe and adequate food supply as well as underpin the economies of many nations. We need increased research support to identify emergence hotspots and for the development of more effective and strategic surveillance systems. The U.S. is substantially behind the curve for surveillance and for research on emergence of new pathogens.

Senator Debbie Stabenow

- 1) In order to best advance research tools necessary for farmer knowledge around adaptation and mitigation of climate change, what are the top three actions the USDA's Chief Scientist/Under Secretary for Research, Education, and Economics can take in conjunction with the Land-grant University System?

RESPONSE

Although, climate change may not have directly influenced the emergence and re-emergence of pest and pathogens that threaten our agriculture, it may certainly influence productivity and yields of for example major cereals and crops. Understanding how such changes will impact these requires research as does the development of mitigation strategies. These may for example, include the development of drought-resistant plants or specific pathogen-resistant varieties of plants and animals. We need to better understand what the threats are, where they are and how they might get to the U.S. This means active surveillance coupled with feasible mitigation strategies. These all of course require sustained funding and a suitably trained workforce. It has been well documented that the U.S. lacks leadership, funding and a strategic plan to combat threats to agriculture. USDA and Government leaders must therefore work with Land-grant Universities and producers to understand what we need, what we lack and how to fill these gaps. We need to be prepared for the next threat that we face, and this needs strategic forward planning and funding. An understanding of pathogen and arthropod vector current distribution and of the environmental parameters that influence these is critical in order for us to accurately anticipate and prepare for potential changes due to climate change.

- 2) The COVID-19 pandemic has exposed the vulnerabilities to food security as pressures interrupt every facet of the supply chain. What lessons have been learned that can prepare USDA for the next pandemic? Specifically, what REE-focused investments can Congress make to ensure USDA and universities have the resources to prepare, respond, and recover from future pandemics?

RESPONSE

The main lesson learned is that we never seem to learn from the past and always seem to be unprepared. We have much of the knowledge and understanding that we need, we have recommendations from learned groups and committees, but we do not have the long-term commitment. As I mention in my written testimony, we have guidance and mandates from HSPD-9, the Securing our Agriculture and Food Act and more recently the Farm Bill's Agriculture Advanced Research and Development Authority (AgARDA). What we must do is to provide funding and give appropriate authorities the responsibility to implement these and to be accountable to make them succeed.

The authorization of AgARDA was the perfect first step in getting to the focused investments you asked about. However, without the second step, appropriations for AgARDA, the need for

new innovation to confront newly emerging threats will not happen in a timely manner. The following is from my written testimony about AgARDA:

Particularly insightful from a bio/agrodefense perspective were the sections on qualified products or projects for: (1) *“plant disease or plant pest countermeasures to intentional or unintentional biological threats (including naturally occurring threats);”* and (2) *“veterinary countermeasures to intentional or unintentional biological threats (including naturally occurring threats).”* R&D in these two areas is critical to protecting America’s food supply and to U.S. homeland security. Of critical importance is that funding is strategic and goal-oriented to get the information, knowledge, understanding, technologies and trained people that we need. Furthermore, the funding must be sustained in order to maintain and build upon our resources and capabilities so that we can respond quickly to new threats. Allowing these to decline because of short-term or intermittent funding and then having to recreate the capabilities is a poor strategic plan to combat threats that can emerge quickly and with little if any warning.

Lots of additional specifics for protecting food crops and food animals were included in my testimony, but SUSTAINABLE funding for bio/agrodefense is the key. America’s land-grant universities are positioned to help protect America from emerging global biothreats, but that can’t be done without resources.

Senator Amy Klobuchar

- 1) As the coronavirus pandemic has reminded us, disease outbreaks happen and we need to be prepared for them. That's why I worked with Senator Cornyn to include provisions in the 2018 Farm Bill creating a National Animal Vaccine and Veterinary Countermeasures Bank and National Animal Disease Preparedness and Response Program. Our workers, businesses, and farmers have been hit particularly hard by the pandemic and building on preparedness efforts is critically needed.
 - a. What lessons have land-grant university research systems and nonprofits learned throughout the coronavirus pandemic that can inform our efforts to better prepare for future disease threats?

RESPONSE

A lesson learned is that we never seemed to be prepared, however, as a Land-grant University; we at K-State had the commitment and ability to be nimble and apply our expertise and resources to this new threat. The support of the University administration and institutional committees including biosafety (IBC) and the animal care and use (IACUC) enabled us to keep the BRI fully operational so that we had the required safe and secure containment environment, and at the same time to identify what we needed to know about SARS-CoV-2 and to design experiments to fill the knowledge gaps. As I have mentioned elsewhere, the federal systems for funding, for example from NIH and CDC are too slow and cumbersome to support urgent and unanticipated research needs. Fortunately, resourceful investigators and the availability of funds that could be redirected at this disease enabled us to initiate some of this critical work – flexibility from Federal agencies and private sources was the key.

In the case of SARS-CoV-2 we were fortunate that this was not designated as a Select Agent. Had the virus been given this status, the federally required procedures would have had a very significant impact on the ability to initiate research. Over the years, non-funded federal mandates have placed considerable burdens on research facilities and staff that can adversely affect research. These include the ability to obtain and share material and to develop collaborative research.

Sadly, based on previous experience we will likely be equally unprepared for the next biological threat. Dedicated and sustained funding is needed to support programs such as AgARDA that can quickly sponsor relevant research, education and training efforts in a timely manner. Short term funding for example for 1-3 year projects is important, but their needs to be continuity and coordination of support so that we can produce practical tools with reagents that can either be stockpiled or scaled up to meet the needs.

Senator Michael Bennet

- 1) Kansas State University and Colorado State University are both members of the Coalition for Epi Response Engagement and Science (CERES), which leverages land-grant universities to protect our agricultural industry and secure our food supply against global health threats. As part of these efforts, Colorado State University is partnering with the International Livestock Research Institute in Kenya to work on an African Swine Fever vaccine, deploying the same approach used in the development of Solavax, a vaccine candidate for COVID-19.
- a. As land-grants continue their work to fight global health threats, what lessons have we learned from COVID-19 that could apply to the agricultural sector?

RESPONSE

Please see answers above that show that a lack of preparedness is the main lesson and then issues related to the ability to quickly refocus on the new threat with supportive funding. Despite being a primarily human pathogen that does not infect agricultural animals and plants, our experiences with SARS-CoV-2 could easily be extrapolated to a pathogen that does infect livestock or plants. We also witnessed how a human pandemic could also impact the food and material supply chains as many food processing facilities were shuttered due to outbreaks on site, leaving animals stuck at various points in the supply chain with few alternatives to process them. Only through interventions by university extension offices like ours at K-State were we able to identify alternatives to slaughter and waste of food animals. Although SARS-CoV-2 has infected and killed many people, an agricultural pathogen could have even greater consequences. A new pathogen that killed wheat, maize or rice could lead to famine on a global scale and collaborative research is necessary to prepare us for this.

- b. How can Congress support these efforts to best encourage innovation in disease research and response?

RESPONSE

Kansas State University is one of the founding members of CERES with Colorado State because global disease outbreaks that impact agriculture also impact people, and the reverse is true as well as we have witnessed with COVID-19. We recognized the threats existed and prepared to respond, but the disease itself emerged in ways that we hadn't anticipated. Nevertheless, the CERES universities, among many other land-grant universities, pivoted relatively quickly to respond to the pandemic through focused disease mitigation research, diagnostic and analytical laboratories that retooled for human testing, and ultimately development in production scale-up of vaccines and countermeasures. Resources that support coalitions of land-grant universities that leverage unique talent and facilities to ultimately predict and respond to "One Health" challenges need to be a priority going forward. Whether it is a zoonotic virus like SARS-CoV-2 that impacts humans, a vector-borne disease that impacts humans or food-animals, plant-based viruses that results in famine, or antimicrobial resistance that impacts our abilities to counteract diseases in humans or food-animals, collaborative, high-performing coalitions like CERES will be critical to the national and global response – meaningful and long-term investments in them will ultimately determine whether we are able to respond quickly enough to prevent thousands or

hundreds-of-thousands of human deaths. More coalitions like CERES, networked across the US, are needed for us to be prepared.

- 2) Recently we've seen investments in facilities like BioMARC, which is a nonprofit biological Contract Development and Manufacturing Organization based at Colorado State University, to help increase and improve pandemic preparedness. These investments are an important part of the strategy to preventing pandemics like we're seeing this year.
 - a. From a One Health framework perspective, how can we ensure that these investments are meeting the public health needs?

RESPONSE

For starters, it is critical to broaden the perspective of what constitutes *One Health*. Until plant health is incorporated more deliberately into the One Health concept, the stated One Health goals cannot be achieved. The recent global emergence of fungicide-resistant fungal pathogens in humans linked to plant-based agriculture is one example of the connections.

Coalitions like CERES should comprise members with public health programs – the Colorado School of Public Health and the MPH program at Kansas State comprise focus areas in infectious and zoonotic diseases. The National Institute of Anti Microbial Research and Education, NIAMRRE, comprises university (mainly land-grant) and industry partners with strengths in human and animal health, since the complex microbiome influences all life at the most fundamental levels. Public and environmental health impact disease mitigation and management before pandemics result. Investing in collaborative coalitions that comprise a diverse set of universities and university strengths, private-sector and government sector members, and commodity group leaders is the path forward for us to prepare for and respond to future disease outbreaks.

Senate Committee on Agriculture, Nutrition & Forestry
Agricultural Research and Securing the United States Food Supply
December 2, 2020
Questions for the Record
Dr. Steven Rosenzweig

Chairman Pat Roberts

- 1) Your written testimony highlights General Mills' efforts to improve agricultural ecosystems, while ensuring farmers' and ranchers' economic vitality. Can you describe how General Mills partners with producers throughout the value chain to encourage participation in these efforts focused on environmental sustainability, while at the same time making it economically sustainable for the producers?**

We are piloting different ways of partnering with producers, but across every program it is critical to support improved environmental and economic outcomes. General Mills has explicitly defined regenerative agriculture as an approach that improves not only soil, water, and biodiversity outcomes, but also farmer economic resilience.

Everything we do is completely voluntary – farmers are signing up for our programs because they see regenerative agriculture as the right approach for their business. By combining the six regenerative agriculture principles together in a systems-approach, farmers are finding that they can maintain or increase productivity while reducing reliance on expensive external inputs, leading to improved profitability while also building long-term resilience through a healthier farm ecosystem. In central Kansas last fall, we hit max capacity with 150 farmers attending the regenerative ag workshops we held. Farmers are hungry for this information. Many of them realize that there is greater economic risk in *not* making the shift to regenerative agriculture given the increased prevalence of extreme weather which demands adaptation and resilience.

In addition to educational opportunities, one of the strategies we are piloting to accelerate adoption of regenerative agriculture is one-on-one coaching, where we connect them to an experienced farmer, rancher, or agronomist who works directly with the farmers to help them develop and implement their own regenerative management plan over several years. One of the biggest barriers to scaling regenerative agriculture is the lack of talented, trusted conservation professionals working with farmers. There are two million individual farm businesses in the US, each needing technical assistance from a qualified conservation professional helping them implement practices that are adapted for their unique context and operation. There simply aren't enough qualified personnel. For example, in one of our key sourcing regions in north-central Oklahoma, there is only one conservation professional for every 208 farmers. We need to greatly expand the capacity of conservation professionals to accelerate education and technical assistance to advance regenerative agriculture.

Another major barrier to regenerative agriculture is perceived economic value. There is added risk and cost to implementing new practices. Improvements in soil and biodiversity that ultimately lead to economic gain can take several years, which is why we are investing locally with NRCS and Conservation Districts to expand cost-share opportunities for soil health practices. But there needs to be greater prioritization for soil health-building practices within the Farm Bill conservation programs.

We are also piloting ecosystem service market payments to farmers and conducting research to understand if this is an effective mechanism for advancing adoption of regenerative agriculture. These payments represent a major opportunity for promoting both financial and environmental outcomes by rewarding farmers for producing environmental benefits.

2) Producers face ever-changing challenges such as weather, pests, and disease. At the same time, consumer needs are developing and changing. As one of the largest food companies in the world, how do you approach agricultural research to ensure you are providing research and development that meets these constantly changing needs throughout the supply chain?

The vast majority of research we support is on-farm research alongside our pilots, so we're collecting data in places where General Mills has a large sourcing footprint, and that makes the data highly relevant to our products and the brands connected to them. Consumers are increasingly demanding products with a positive environmental and social impact, but it's hard to predict what aspect of regenerative agriculture is going to resonate with any one consumer. That's why we're focusing on place-based impact, and a holistic set of outcomes. The Cheney Watershed in Kansas, for example, produces wheat that ends up in Pillsbury dough, and we are conducting intensive data collection on a range of impacts – including water quality, farm profitability, wildlife, soil health, and climate mitigation – so we can connect consumers to the range of benefits produced by regenerative farmers there. There are many issues that regenerative ag can address, and we can enable this work to resonate with consumers if we tell the story in a compelling way.

We are also looking to empower farmers to ask and answer their own research questions. Through OpenTEAM, which is a Foundation for Food and Agriculture Research-funded initiative, we're piloting tools that enable farmers to track data on their own farms and make sense of it to help them reach their goals. Additionally, in Canada, we are working with an independent agronomy firm made up of farmers that work with other farmers in their area. We provide cost-share and research funds, as well as some technical guidance and access to a network of expertise, and the agronomists work with the farmers to try new practices and collect data to answer their questions. This highly flexible research approach ensures that we are collecting data to answer the most relevant and pressing questions from farmers.

Senator Debbie Stabenow

1) In order to best advance research tools necessary for farmer knowledge around adaptation and mitigation of climate change, what are the top three actions the USDA's Chief Scientist/Under Secretary for Research, Education, and Economics can take in conjunction with the Land Grant University System?

I collaborated with Drs. Andrea Basche (University of Nebraska-Lincoln), Gabrielle Roesch-McNally (American Farmland Trust), and Rachel Schattman (University of Maine) to develop these responses.

1) Direct more research funding toward ecologically based, systems-level agricultural research to enable universities and USDA to play a bigger role in generating and disseminating knowledge on the implementation and impacts of regenerative agriculture.

There has been enough research to know that regenerative agriculture can play a critical role in climate mitigation and adaptation, and we need to get to work supporting farmers and ranchers in the transition to regenerative agricultural systems. However, much of the knowledge that has been generated about successful regenerative agricultural approaches has come from leading-edge producers, and this critical knowledge is slow to be replicated and disseminated to the rest of the agricultural community through the USDA and the Land Grant University System. Only a small fraction of the Research, Education, and Economics budget has been [directed](#) toward researching ecologically-based approaches like regenerative agriculture. Additionally, as I mentioned in my written testimony, traditional research has been limited to studying the effects of isolated conservation practices, so we lack a full understanding of the potential impacts of multiple practices being implemented together in a system, as regenerative agriculture seeks to do. The USDA's Chief Scientist can direct more research funding toward ecologically based, systems-level agricultural research to enable universities and USDA to play a bigger role in generating and disseminating knowledge on the implementation and impacts of regenerative agriculture.

2) Increase investment in the social sciences to uncover effective mechanisms for accelerating adoption of regenerative agriculture.

Regenerative agriculture can play an important role in the fight against climate change and in adaptation to more extreme weather, but adoption is low – key practices like cover crops have been adopted on less than 5% of suitable cropland acreage. This low adoption rate persists despite a wealth of information on the benefits of these systems. Investments in social science research such as sociology and behavioral economics, ideally coupled with agricultural research to ensure the work is integrated and not siloed, would push beyond the USDA's traditional economics focus to uncover effective mechanisms for accelerating adoption of regenerative agriculture. In addition to identifying barriers for the farmers themselves, social sciences enable insights about ways to involve other critical agri-food system actors (e.g., non-operator landowners, lenders, farm advisors) in the transition to regenerative agricultural systems, and consider the perspectives of beginning and racially diverse farmers who face disproportionate challenges in adaptation to climate change.

3) Invest in research that expands the climate mitigation potential of agriculture and improves monitoring capabilities.

Reducing agricultural greenhouse gases and sequestering carbon in soils and perennial vegetation will be critical to ensuring a stable climate and resilient food system. Regenerative producers are currently integrating practices and technologies that are widely available today to achieve these climate benefits, but we can expand the capacity for climate mitigation by accelerating development of frontier technologies like perennial grain crops or dairy feed additives that can reduce a substantial amount of greenhouse gases or sequester large amounts of carbon. Additionally, we need to better understand pathways for farmers to reduce dependence on greenhouse gas-intensive fertilizers. Regenerative farmers and ranchers are finding that they can maintain production with little fertilizer and without mining their soils, but our understanding of these mechanisms is poor.

As agriculture's climate mitigation potential advances, so must our ability to monitor its climate impacts. Cost-effectively monitoring soil carbon sequestration and greenhouse gas reduction at scale remains a large challenge and is the primary barrier to successful ecosystem services markets for agriculture. But enhanced development and integration of tools like low-cost sensors, improved soil sampling approaches, remote sensing, and modeling would greatly expand our ability to account for agricultural mitigation of climate change. These efforts are essential to building public trust and continuing to grow private investment in agriculture's climate mitigation potential.

2) Please articulate the measures taken by General Mills with regard to crop diversification's role in protecting the food supply and assuring food security.

As your question suggests and I described in my written testimony, crop diversification is critical to a resilient food system, and it is one of the principles of regenerative agriculture. As a food company with a wide range of brands across many categories including ready-to-eat cereals, yogurts, soups, snack bars, refrigerated dough, and numerous other products, we contribute to the diversification of the agricultural system by the nature of our business. In Michigan alone, General Mills buys dairy, soft wheat, sugar beets, dry beans, and several other products. But we are also looking to enable crop diversification more proactively through a host of different activities, including:

- Through Annie's, we've been working to design products through the lens of a crop rotation. Our regenerative ag mac and cheese products use organic wheat and peas from the same farmer's rotation, supporting diversity in his system by providing a market for more than one ingredient—and in this case providing a market for a nitrogen fixing crop that helps improve soil health. Despite their relatively small size, these products based on multi-year agreements with producers have an outsized impact as a proof of concept for how we can take more cues from farmers and ecosystems in how we design our food.

- We have contributed over \$2.5 million to the University of Minnesota, The Land Institute, and value chain partners to support the development and commercialization of the deep-rooted perennial grain Kernza, which not only opens new market opportunities but enables farmers to sequester large amounts of carbon in soil and perennial vegetation.
- Working with Michigan dairies to diversify dairy feed production systems beyond the traditional alfalfa-corn silage rotation. This includes supporting the production of cover crops that can both protect water quality and be used as supplemental feed and incorporating new forage mixes into the rotation like oat-pea blends and sorghum-sudangrass crops.
- Invest in oat genetics and agronomy research to improve oat quality and economic competitiveness in the Midwest.

3) How can diversification of grain production impact soil health, farmers, and consumers across the U.S.? What are some key challenges and benefits from transition of traditionally grown corn and soybeans to a more diversified rotation including crops such as sorghum and oats? Where are some opportunities to scale the adoption of these systems?

Agricultural systems in the US have been dramatically simplified and homogenized over the 20th and 21st centuries, with negative impacts for a broad range of outcomes including biodiversity, natural pest control, water quality, greenhouse gas emissions, and farm economic resilience. Agricultural diversification enables farmers to maximize [multiple ecosystem services](#) while [increasing crop yields and yield stability](#). Specifically, reports from the [Union of Concerned Scientists](#) and the [Sustainable Food Lab](#) document the positive environmental and economic benefits that are accompanied by integration of small grains and other crops into the corn-soybean system. These reports also highlight the major barriers farmers face such as market and financial barriers and crop insurance constraints, with specific policy recommendations like promoting the Whole Farm Revenue Protection Program and expanding support for diversified crop rotations within the Conservation Stewardship Program (CSP) and the Environmental Quality Incentives Program (EQIP). Additionally, we must reframe the success of agriculture in terms of human nutrition and net profitability, and away from a sole prioritization of production and yield. This can be done throughout USDA programs to prevent the ongoing overproduction of a small number of commodity grains and the plummeting of crop prices and enable a shift to more diversified systems.

These reports also highlight the opportunities to develop small grain markets for both food and animal feed as a promising solution for scaling the integration of oats into the corn-soybean rotation. While feeding small grains as part of livestock rations may provide the [greatest opportunity](#) for scaling, General Mills also sources soft wheat across the Midwest for cereals and baking mixes, and has been working to address challenges to scaling food-grade oats throughout the Midwest. Over the last several decades, climate change and a lack of investment in oat research has pushed oat production farther and farther north, into Canada and out of the US, further contributing to the simplification of cropping systems in the Midwest.

As one of the largest oat buyers in North America, we worked with USDA ARS to develop the ‘Oats Grand Challenge,’ an ARS internal program which enables \$5 million in new funding to minor crops. We also partner to advance US-adapted oat genetics and agronomy through partnerships with public universities like Michigan State University, North Dakota State University, South Dakota State University, and the University of Minnesota. Greater investment to develop food-grade oats is needed to ensure food companies can source high-quality oats out of the Midwest.

4) Would you please provide an update as to where General Mills is in their goal to 1 million acres of regenerative agriculture by 2030? If there are roadblocks to this program's success, what are they and what lessons have you learned during this process?

General Mills announced the goal in 2019, and since that time we have worked to pilot a variety of strategies for accelerating adoption of regenerative agriculture in key sourcing regions – please see my written testimony for details on some of the strategies we are piloting. We began by crafting a definition of regenerative agriculture: A holistic, principles-based approach to farming and ranching that seeks to strengthen ecosystems and community resilience. Regenerative agriculture is based on 6 ecologically based principles for agricultural management, and improves the following outcomes: soil health, biodiversity, water, and farmer economic resilience. While we recognize that there does not need to be one universal definition of regenerative agriculture, we have sought to align the industry in a paradigm shift toward management principles that regenerate the health of agricultural ecosystems, as opposed to a singular focus on maximizing yields or efficiencies, and an outcome-based approach, as opposed to practice-based checklists or certification of specific farming activities. While there is still more work to be done, the wave of recent announcements from other major food companies toward a focus on regenerative agriculture is a hopeful sign that paradigms within the industry are shifting.

As we progress on our regenerative journey, we are committed to a learning mindset and recognize that our approaches to advancing regenerative agriculture will continue to evolve as new opportunities and challenges emerge. However, we have already encountered a number of constraints to the scaling of regenerative agriculture:

- The first barrier is understanding and mindset. The USDA-NRCS has helped popularize the soil health & regenerative agriculture movements through a campaign of rainfall simulators and soil health demonstrations, because when a farmer sees those demonstrations it triggers a shift in mindset. It is critical to create a link in the farmer’s mind between their management practices, the health of their soil and farm ecosystem, and the economic viability of their business. Without that understanding, there is little motivation to change, which is why we have heavily invested in education and farmer and agronomist training.
- The second barrier, related to the first, is perceived economic value. There is added risk and cost to implementing new practices. Improvements in soil and biodiversity that ultimately lead to economic gain can take several years, which is why we are investing

locally with NRCS and Conservation Districts to expand cost-share opportunities for soil health practices. There needs to be greater prioritization for soil health-building practices within the Farm Bill conservation programs. We are also piloting ecosystem service market payments to farmers and conducting research to understand if this is an effective mechanism for advancing adoption of regenerative agriculture.

- The third barrier is the lack of talented, trusted conservation professionals working with farmers. There are two million individual farm businesses in the US, each needing technical assistance from a qualified conservation professional helping them implement practices that are adapted for their unique context. There simply aren't enough qualified personnel. For example, in one of our key sourcing regions in north-central Oklahoma, there is only one conservation professional for every 208 farmers. That's why we are partnering with the Oklahoma Conservation Commission to hire a full-time soil health specialist who will collaborate with NRCS and Conservation District staff to lead regenerative agricultural education and technical assistance in the region. We need to greatly expand the capacity of conservation professionals to accelerate education and technical assistance to advance regenerative agriculture.

Senator Amy Klobuchar

- 1) **One of the emerging challenges for agriculture is the balance between productivity and sustainability. That's why Senator Thune and I worked on a provision in the 2018 Farm Bill based on our Agriculture Data Act to improve the use of conservation data so that farmers are able to make better choices about conservation practices that benefit both their yields and the environment.**
 - a. **Can you elaborate on how General Mills' research projects can help link farm productivity with environmental resiliency? How can long-term research projects help us better understand the effects of implementing multiple conservation practices at one time?**

Data emerging from long-term agricultural systems research, national farmer surveys, and new analyses derived from satellite imagery, show us that soil health-building practices and systems simultaneously benefit farm productivity and resilience and environmental benefits. Given General Mills' outcome-based definition of regenerative agriculture, we seek to quantify the environmental and economic impact as farmers implement these systems. However, as I mentioned in my written testimony, traditional research has been limited to studying the effects of isolated conservation practices, so we lack a full understanding of the potential impacts of multiple practices being implemented together in a system, as regenerative agriculture seeks to do. While implementing a single conservation practice can be beneficial, there are often trade-offs such as yield reduction that can hinder adoption and long-term effectiveness. Adopting a systems-approach that [stacks](#) multiple regenerative agriculture principles can buffer against negative outcomes and achieve greater and more rapid soil health improvement. Long-term, systems-level research can play a critical role in advancing our understanding of systems that improve productivity, [resiliency](#), and environmental impact. I

was based for a year at the USDA-ARS research site in Brookings, South Dakota. Their long-term cropping systems experiment integrated cover crops several years ago, and now we can see these additive benefits of having multiple soil health practices like no-till, diverse crop rotations, and cover crops all in combination. We need more of this long-term, systems-level research that focuses on a holistic suite of outcomes to help us better understand the range of impacts that occur when multiple regenerative principles are implemented together. However, systems-level research is difficult to conduct and replicated research trials may not always represent the most innovative and cutting-edge systems that are being implemented by farmers. Therefore, traditional research approaches must evolve to be more collaborative, integrating USDA and university replicated research trials with research conducted on working farms. This is the focus of the research we are doing in the context of our regenerative ag pilots – on-farm research to track soil, water, biodiversity, and economic outcomes as farmers implement multiple regenerative principles adapted to their unique context.

Senator Michael Bennet

1) Given your past work on dryland agriculture at Colorado State University:

a. How can we support producers interested in adopting regenerative agriculture practices in drier western states?

I collaborated with Dr. Meagan Schipanski from Colorado State University to develop these responses.

- Diversification of cropping systems is essential for dryland farmers seeking to implement regenerative agriculture. Moving beyond the traditional system of wheat-fallow to systems that implement the regenerative principles provides [opportunities](#) for carbon sequestration, greater grain production, reduced herbicide use, and improved profitability. These diversified systems could be encouraged by reimagining federal farm programs to shift funds away from subsidizing insurance or other programs that are based on single crops rather than the management system as a whole. This could include expanding and continuing to improve whole farm crop insurance and strengthening conservation programs. It will be essential to bring ag lenders and insurers to the table as crop insurance and best management practice requirements often incentivize decisions that impact short-term decisions at the expense of longer-term sustainability. Additionally, reframe the success of agriculture in terms of human nutrition and net profitability, and away from a sole prioritization of production and yield. This can be done throughout USDA programs to prevent the ongoing overproduction of a small number of commodity grains and the plummeting of crop prices and enable a shift to more diversified systems.
- Develop business venture funding programs that support rural investment in infrastructure (storage, processing, marketing) to support the expansion of markets for more diverse crops.

- Research shows that farmers who fall outside of typical farmer demographics are more likely to try new systems. Barriers for young, beginning, female, and racially diverse farmers to enter or expand agricultural production must be overcome to enable all farmers to participate in regenerative agriculture.
- Evaluate the potential to integrate more perennials into dryland cropping systems, including pastures and dual use perennial crops. This could include an evaluation of the potential for certain grazing practices to be allowed within the CRP program as part of a farm's overall regenerative management plan.
- Facilitate the expansion of ecosystem service markets that can reward farmers for producing environmental benefits through regenerative agriculture.

b. What are the existing research and technology development gaps in these areas?

Regenerative agriculture systems are just that—systems. They do not lend themselves well to traditional, replicated field experiments. Instead, innovative, collaborative approaches are needed that integrate university research resources with producers to generate a comprehensive data and management expertise that links regenerative management systems to measurable environmental, economic, and social outcome metrics.

One possible approach is to develop a hub and spoke type network where hub regenerative agriculture research sites managed by land grant institutions are linked to a network of working farms implementing a diversity of regenerative agriculture approaches. Eastern Colorado is lacking in a dryland cropping systems research station and could be a prime location for Keystone Regenerative Ag Hub. Specifically, the USDA-ARS research station in Akron, which only has 1 remaining scientist due to the lack of hiring and support in recent years, could be re-envisioned as a Regenerative Ag Hub as a partnership between Colorado State University, USDA-ARS, and a producer advisory board.

Research and technology gaps that could be addressed through this partnership include the integration of new soil moisture, livestock health, and other low-cost emerging sensors into an open source farm/ranch management decision support tool. Combined with periodic field data collection, these high-resolution temporal and spatial datasets would provide an improved understanding of how regenerative principles can best be adapted to water limited environments as well as quantifying the climate mitigation potential of different systems.

Senator Robert P. Casey, Jr.

- 1) **Especially as farmers continue to face challenging economic conditions, we know that for many, including many Pennsylvania farmers, organic production not only provides environmental benefits but also helps support farmers' bottom lines through a price premium.**
 - a. **Based on your ongoing research and partnerships that General Mills is a part of, could you identify the major production and financial barriers that you think**

farmers who may be interested in transitioning to organic production currently face?

General Mills is one of the largest branded manufacturers of organic products in the US. Organic farmers are critical to the success of our business and they face unique challenges and constraints. The biggest hurdle in transitioning to organic is the risk and financial challenges involved in the 3-year transition, during which time producers don't typically receive a premium for the differential management practices they're using. One way we've addressed this is by providing a long-term purchase guarantee with Gunsmoke Farms LLC so the farm could rely on the certainty of our offtake agreement once the certification was complete. However, transition financing remains a major challenge for the industry.

Organic farmers also have constraints regarding the availability of affordable fertilizers and the need to control weeds without synthetic herbicides, and they must overcome these barriers despite a lack of organic expertise among agronomists and crop consultants. We have supported organic research through partnerships with the Organic Trade Association, the Organic Center and the Organic Farming Research Foundation. Additionally, through our regenerative agriculture pilot programs, we provide one-on-one coaching to both organic and conventional farmers, and we seek to connect organic farmers together so they can learn from each other about the most effective practices for their regional context. However, we need more organic research and support for initiatives like the [Organic Agronomy Training Service](#) to overcome the unique informational and technical challenges that organic farmers face.

One additional challenge is the lack of crop varieties developed specifically for organic and regenerative conditions. Most plant breeding is conducted in conditions with high rates of synthetic fertilizer, herbicide, and tillage. We need more varieties that are adapted to organic conditions, with stronger abilities to compete with weeds and thrive under low fertility conditions. To contribute to this effort, we recently granted \$350,000 to South Dakota State University to better support small grain production in organic and regenerative systems to improve performance as more farmers adopt these systems.