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Before the

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

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

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

Background

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

Today, MSU AgBioResearch operates 13 such outlying research facilities located in strategic growing and climatic regions throughout the state, in addition to numerous laboratories and other research facilities on campus. Key findings from research assist the food and agriculture industry, which contributes more than $100 billion of annual economic impact to Michigan alone. With more than 300

commodities produced on a commercial basis, Michigan is the second most diverse agriculture state in the nation (behind only California). The MSU College of Agriculture and Natural Resources, MSU AgBioResearch and MSU Extension work hand-in-hand with the commodity organizations to address the issues facing growers and producers throughout the state – solutions on everything from disease management to food processing. These research results are vital to providing healthy, nutritional food at affordable prices and with fewer environmental impacts.

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

- In the late 1800s, botany professor **W. J. Beal** was one of the pioneers in the development of hybrid corn, which doubled the yield for farmers. In 2014, Michigan farmers harvested the largest corn crop on record with total production exceeding 355 million bushels.
- In 1915, **F. A. Spragg** released the first navy bean variety, Robust. During the 20th century, 40 varieties of beans in eight commercial classes were developed at MSU and released. And in the first decade of the 21st century, 10 new bean varieties were introduced under the direction of MSU researcher **James Kelly**, who continues as one of the world's top bean breeders. MSU has helped Michigan become one of the leading dry edible bean producers.
- In 1929, dairy industry pioneer **G. Malcolm Trout** linked the processes of pasteurization and homogenization, finding that homogenized milk needed to be pasteurized first in order to have an appealing taste. He also developed new processes to make cheeses, yogurt and other products. Today, dairy is a leading segment of Michigan agriculture, contributing $14.7 billion to the state's economy.
- Horticulturist **Jim Hancock** has developed several blueberry varieties, some of which are the most widely planted blueberries in the world. For the past 70 years, Michigan has been the No. 1 state for blueberry production – largely in part to Hancock's influence.
- In 1965, MSU partnered with the U.S. Department of Energy (DOE) to form the **MSU-DOE Plant Research Laboratory**. Researchers continue to look at ways to improve energy crop production and unravel the intricate mechanisms by which plants – the root of all biofuels – capture, convert and deposit energy. This effort continues today with the goal of meeting the cellulosic biofuel blending mark of 16 billion gallons by 2020 – as mandated by Congress in 2007.

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

Recent Highlights

When **avian influenza** was detected in parts of the U.S. earlier this year, MSU AgBioResearch and Extension scientists immediately responded in an effort to assist farmers and educate the public. Educators worked in conjunction with both the Michigan Department of Agriculture and Rural Development and the Michigan Department of Natural Resources to ensure that appropriate steps were being taken to address this serious biosecurity threat. A website strictly devoted to avian influenza was developed, which included frequently asked questions and information, including a YouTube video for

backyard farmers. In the end, Michigan's poultry population remained largely unaffected by avian influenza. This is just one example of how MSU works with state and federal agencies, including the Centers for Disease Control and Prevention, to provide timely, fact-based information to minimize public concern and maximize human and animal health safety.

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

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

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

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

MSU's Multidisciplinary Appeal

Not only does MSU have a rich agricultural history, it is a university steeped in multidisciplinary efforts. Faculty members are encouraged to collaborate beyond college and department lines, reach across

disciplines and work together to achieve results with lasting impacts. There are many examples, a few of which are described below:

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

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

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

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

Entomologist Rufus Isaacs is another fine example of an MSU researcher who is leading work that transcends barriers – this time of the geographical sort. He is leading a multi-state, multi-institutional project that impacts crops from apples to pickling cucumbers. As honey bee populations decline, Dr.

Isaacs is looking at alternative pollinators to help maintain the vitality of U.S. crops that are pollinated every spring and valued at more than $14 billion annually. Major funding from Dr. Isaacs program comes from USDA, MSU Project GREEEN and industry organizations.

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

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

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

Facing Challenges

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

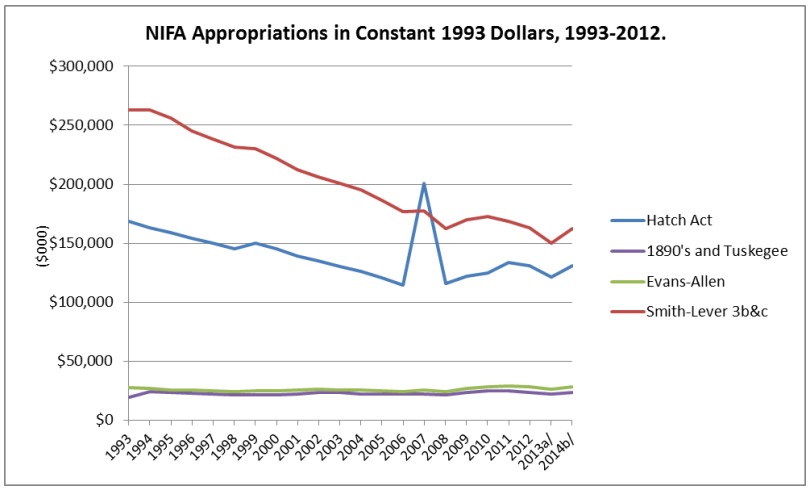

Figure 1 (Data provided by NIFA, constant 1993 dollars)

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

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

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

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

National Endeavors

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

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

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

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

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

Moving Forward

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

- Ensuring the safety of food products – and maintaining the confidence of consumers – continues to be a top priority at MSU. We continue strong collaborative efforts like this one that combine our leading programs in packaging and food processing to agricultural economics and toxicology. CRIS will work to achieve the following goals:
  Expand the opportunity to conduct basic and applied research on the safety and toxicology of ingredients in food, packaging, cosmetics and household care products.
- Develop and validate testing methods and strategies for evaluating the safety of ingredients in food, packaging, cosmetics and household care products.
- Establish a graduate training program that prepares scientists for a career in assessing the safety and toxicology of ingredients in food, packaging, cosmetics and household care products that includes training in risk assessment and U.S. and international regulatory policies.
- Inform the public, health professionals, regulators and the scientific community on research matters reflecting the state-of-the-science pertaining to the safety and toxicology of ingredients in food, packaging, cosmetics and household care products.

Maintaining the Momentum

Like other agricultural universities, we look forward to continuing to generate and disseminate new knowledge and educate young people to work in the ever-important areas of food production. As the world population is expected to reach 9 billion within the next few decades, our work is more important than ever.

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

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

Thank you for this opportunity and your support.

Douglas D. Buhler is Director of MSU AgBioResearch and Senior Associate Dean for Research of the College of Agriculture and Natural Resources at Michigan State University.

As director and senior associate dean, Buhler is responsible for all research investments in the CANR and serves as the administrative leader of MSU AgBioResearch, a group of more than 300 researchers on campus from seven colleges. MSU AgBioResearch engages in innovative, leading-edge research that combines scientific expertise with practical experience to generate economic prosperity, sustain natural resources and enhances the quality of life in Michigan, the nation and the world. It encompasses the work of more than 300 scientists in seven MSU colleges—Agriculture and Natural Resources, Communication Arts and Sciences, Engineering, Natural Science, Philosophy, Social Science and Veterinary Medicine—and has a network of 13 research centers across the state and a total annual budget of over $100M per year.

Buhler is a native of Wisconsin and received his B.S. degree from the University of Wisconsin-Platteville and M.S. and Ph.D. degrees from the University of Nebraska. He was on the faculty at the University of Wisconsin-Madison from 1984 to 1989 and research scientist for the United States Department of Agriculture-Agricultural Research Service from 1989 to 2000. He then joined Michigan State University as Professor and Chair of the Department of Crop and Soil Sciences, a position he held from 2000 to 2005. From October 2003 to March 2005 he we also served as State Leader for Agricultural Programs for

Michigan State University Extension. From 2005 to 2010 he was Associate Director of the MSU AgBioResearch and Associate Dean for Research for the College of Agriculture and Natural Resources. Buhler served as interim Dean of the College of Agriculture and Natural Resources from 2011 to 2013.

Buhler's professional activities have generated over 330 publications including 130 refereed journal and review articles. Buhler has been an author or editor of three books and presented 90 invited seminars, symposia, and workshops. He is a Fellow of the American Society of Agronomy, Crop Science Society of America, Weed Science Society of America, and North Central Weed Science Society and Distinguished Alumni of the University of Wisconsin-Platteville. Buhler serves on numerous boards and advisory panels including the Foundation for Food and Agriculture Research, Center for Food Integrity, Michigan Grape and Wine Industry Commission, and Michigan Crop Improvement Association.