"A Research Agenda for the Food and Agriculture Challenges Ahead"

Texas A&M University College of Agriculture and Life Sciences Centennial Lecture Series

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Good morning. It's great to be here in College Station and I'm honored to be a part of the University's College of Agriculture and Life Sciences' Centennial Lecture Series.

I'm told the ag college was actually established in 1911, so I'm glad to see the celebration going strong into 2012 – even centuries are bigger in Texas.

At USDA we're also "thinking big" about our food and agriculture research, education, and extension system. As some of you might know, 2012 is the 150th anniversary of the establishment of the Department of Agriculture, as well as President Lincoln's signing of the Morrill Act, which created the Land-Grant University system.

Anniversaries are great opportunities to reflect on the past, and see where past successes can help solve challenges we face today, and challenges on the horizon. We're thinking big these days, because not only do we have a long history to look back on, but because "big" succinctly describes the challenges we face.

We're also thinking big, because USDA isn't alone in facing these challenges, but is a part of a national and global network of food and agricultural producers, consumers, researchers, educators, and policymakers working on the food and ag challenges of the 21st century. Food and agriculture are universal – everyone has a stake. We're thinking big, so we can work together. We're going to need to work together.

Finally, we're thinking big because while times are changing and the challenges we face are changing, our tools are changing as well. With science and technology, today we can do things unheard of just 20 years ago. Just think about the range of instrumentation that's available to us on this wonderful campus. We can go from the subatomic level, up to satellite imaging. We can go from understandings of systems biology to developing new synthetic life forms. Technology has opened many doors for innovative solutions to the challenges we

face, and we're pushing forward and thinking big to put these innovations into practice, while keeping an eye on what the next 20 years might bring.

We're thinking big like Dr. Ruth Benerito. After World War II, Americans were quickly adopting synthetics in favor of cotton clothing, which wrinkled easily. As Research Leader for USDA's Southern Regional Research Center (SRRC) in New Orleans, Benerito saved the cotton industry by pioneering a method of producing a wrinkle-, stain- and flame-resistant cotton fabric, resulting in fabric with a better shape and appearance, known as "wash and wear" or "durable press."

Today we consider Dr. Benerito a pioneer in bioproducts, finding innovative uses for our renewable biological resources. The value and promise of bioproduct innovations are immeasurable in a rapidly shrinking world, and we're working with our partners to encourage bioproduct growth of all kinds through aggressive research and development.

Today more than 3,000 companies produce more than 20,000 bioproducts made from grasses, grains, oilseeds, and agricultural waste rather than petroleum. They range from cleaning supplies and personal care products to food packaging and

turf for football stadiums. The companies that manufacture these goods employ about 100,000 Americans – many in rural communities.

Just last week President Obama announced up to $35 million over three years to support research and development in advanced biofuels, bioenergy and high-value biobased products. The Biomass Research and Development Initiative (BRDI) provides funding for consortia partners that focus on the integration of biomass feedstock development, biofuels/biobased products production, and life-cycle analysis to promote the growing bioeconomy. This program has improved the positioning of advanced manufacturing technologies, specifically in rural areas, making near-term commercialization more viable.

Even many petroleum companies are starting to look at bioproducts, and their knowledge about fuels and chemicals and feedstocks will prove beneficial as this technology develops.

With the right focus and commitment, we can lay the foundation for an economy built to last, creating jobs, driving innovation, giving access to all types of fuels and gradually reducing our dependence on oil, and supporting incomes for

farmers and ranchers. Now more than ever, Americans are ready to tap into the incredible potential of a biobased economy.

We're also thinking big like Dr. Edward Knipling. A native Texan, Dr. Knipling first became interested in studying entomology as a student right here at Texas A&M. He would later go on, with Dr. Raymond Bushland, to pioneer a method for combating the screwworm fly before they invaded open wounds – a process that would eventually lead to their eradication from the continent. We call the screwworm a pest, but pestilence might be more to the point – these are incredibly destructive insects that feed on living tissue. Exposing mass-bred screwworms of different life stages to radiation, Drs. Knipling and Bushland discovered a process for sterilization without affecting mating behavior or causing other serious damage. Released into the field, these infertile flies could mate with wild screwworm flies, but no progeny resulted, thus driving down this pest's population.

The technique was used to systematically eliminate the screwworm from the entire U.S. by 1966. Forty years ago, the U.S. and Mexico signed an agreement to eradicate the screwworm from Mexico, which was achieved in 1991.

The benefits to livestock are well over one billion dollars per year, and the benefits over more than 50 years, including economic and environmental factors, and avoidance of animal and human suffering, are too large to even estimate. For this pioneering work on what is known as the "sterile insect technique," Drs. Bushland and Knipling were eventually awarded the World Food Prize.

The genius of Dr. Knipling's process was addressing insect control before reaching damaging levels, and on an area-wide rather than local scale. In this case, he thought big both literally and figuratively.

Today, at USDA we're continuing this work. The proud achievements of ridding the continent of the deadly screwworm fly and eliminating bovine babesiosis by eradicating the invasive cattle tick were a prelude to the application of the most cutting edge science to agriculture.

Today we are selecting the next generation of livestock by their genes, inventing environmentally-safe RNAi insecticides that only kill the pest, and taking

advantage of our new knowledge of genomics to make the sterile insect technique cheaper and more widely available.

The results of the development of commercial genotyping tools continue to have a major impact on livestock research and the dairy artificial insemination (AI) industry as well as in beef, sheep and pork. The Bovine SNP50 assay is clearly the de facto standard for cattle genomics research and genetic prediction use around the globe. Since its inception in 2007, sales for the Bovine SNP50 alone have surpassed 700,000 in dairy and beef cattle. Commercial AI companies use these technologies to evaluate young dairy sires at birth, increasing the accuracy of each animal's genetic evaluation, virtually eliminating the need for progeny testing. This step alone decreases the cost of young sire evaluation from $60,000 to $70,000 to less than $1000, saving the industry millions of dollars annually and years of data collection and evaluation.

These achievements often are unrecognized in the general public. We're modest folk, so we don't mind that. Giving people the peace of mind that comes with a safe and secure food and agriculture system is recognition enough. When I think about the way that we in the agricultural sciences do take this very modest

approach, I'm reminded of one my favorite quotes from George Washington Carver, where he said, "it's simply service that measures success." And I think that really sums up the ethic that many of us in the agricultural sciences have.

But sometimes even hyperbole doesn't do justice to the achievements of food and ag science. Much has already been said about the achievements of the third big thinker I want to mention, and I think everyone here is familiar with the achievements of longtime TAMU faculty member Dr. Norman Borlaug –Father of the Green Revolution.

Dr. Borlaug won the Nobel Peace Prize in 1970 for his success in developing high-yielding wheat varieties and reversing severe food shortages that daunted India and Pakistan in the 1960's. Credited with saving millions of lives, his work virtually eliminated recurring famines in South Asia and helped global food production outpace population growth. Later in life, he was very important in drawing global attention to the emerging wheat stem rusts, and through his advocacy the Gates Foundation became very interested in this very severe problem for wheat production globally, and has funded research to develop

wheat stem rust resistant varieties that have now been introduced into a number of countries.

Dr. Borlaug took thinking big to a whole new level. Today with even more advanced breeding technology, we are working to sustainably intensify agricultural production to feed a growing planet. With global population expected to pass 9 billion by mid-century, we are working to increase global ag production by 70% or perhaps double it to meet our food, fuel and fiber needs. And we're doing this in the face of enormous challenges such as land degradation, zoonotic disease outbreaks, water scarcity, and climate change. It's all the harder when you also factor in the limited arable land that's available to bring into production, and also for the need to produce food and at the same time meet the needs that are being demanded of agriculture for bioproducts.

This challenge looms over all others, and can only be met with the full strength of our global agricultural resources. The legacies of these three scientists and pioneers who revolutionized agriculture and made the world a better place gives me hope. Adaptation and innovation are the names of the game in agriculture, and as we've done it before, I know we can do it again – and everyone here will

have a role to play. I do believe that this question of how we can sustainably intensify agricultural production is the existential challenge for our next generation – those who are the students here, today, at Texas A&M.

I'd like to introduce a fourth character here, and that character is the extension agent. In 1862, in his last message to Congress, Abe Lincoln referred to the Ag Department as "The People's Department." That ideal has guided our work over the past 150 years, and extension has played a major part. The accomplishments of these pioneering scientists would have been much more limited without the tireless work of our nation's extension service, transferring innovation from the laboratory to the farm and community.

Extension is evolving, and today we're remaking extension for the 21st century. Communication is different today than it was even ten years ago, and the possibilities for sharing information have grown immensely. It's hard to imagine what the future holds in this realm. We can imagine that through sharing of quality, reliable information and ideas, we may redefine the way that science, including agricultural science, is conducted, planned, designed, implemented and used in the future.

At USDA we are promoting closer links between researchers and extension experts by funding integrated programs that support cooperation. We are also, through eXtension, looking to use all available tools such as IT and the web to deliver information to users. eXtension posts high quality information on many, many important agricultural topics so that any web user has access.

In recent years extension has penetrated into new realms such as emergency preparedness and response - helping to keep the public informed during an emergency, and then helping during recovery by offering good information on available assistance. We're also interested in how the extension approach may be useful in managing and reducing conflict, in delivering medical services, and in meeting the needs of cities and suburbs.

As with extension, IT is already radically changing the way we do research and will continue to do so. IT will play a role in facilitating the conduct of the "e-research" and in the interpretation and dissemination of its results. In many respects, it already is true – team science and virtuality is already with us. But it will be even

more so as we move ahead. One of the key success factors in moving ahead is the sharing of data.

One good example of this is germplasm collections. Genebanks support agricultural productivity and global food security goals by ensuring access to plant genetic resources in the face of daunting challenges such as crop diseases and pests, an expanding human population, environmental deterioration, and changing climates. Genebanks also safeguard the genetic resources and biodiversity that help provide farmers with access to new, more productive varieties of crops and animals.

Communications advances allow for much easier and broader sharing of germplasm and germplasm data on a global scale. This in turn facilitates the breeding of crops and livestock, more quickly, resistant to emergent threats, or contributing desirable characteristics.

With its partners, USDA recently launched the Germplasm Resources Information Network-Global, also known as GRIN-Global. GRIN-Global is a powerful but easy-to-use, Internet-based information management system for the world's plant

genebanks. GRIN-Global provides a powerful information tool to safeguard and utilize invaluable crop diversity. It also expands and streamlines access to USDA's Germplasm Resources Information Network, a database of more than 540,000 different samples of plants available from the National Plant Germplasm System. GRIN-Global has now been translated into six languages. The CGIAR centers are now moving to put their information about their germplasm collections into this system, and we're encouraging gene banks globally to also adopt it. This is going to be a wonderful way for plant breeders and genomics researchers to easily access the germplasm collections of the world to identify germplasm important for their research purposes.

This is but one example of how data can be shared to advance research and development. We're entering an era where we can crowdsource agroecologic innovation, where genomic data is available to all who can benefit from it and further our collective research goals. In a globalized world, with globalized challenges, we can only benefit from cooperation and collaboration.

This is one of the benefits of a food and agricultural research system that includes the public and private sectors; governmental, university, and non-profit research

institutions. These institutions all have different strengths, all necessary for meeting the challenges we face, and sharing data and resources helps each do better what it does best.

The emergence of these technologies is timely, for these issues cannot wait. The urgency of these challenges is reflected in the agendas of the upcoming meetings of the G8 & G20 countries later this year, where global food issues will be discussed at the highest levels of government. These global discussions are going to be asking "how are we setting our priorities in agricultural science?"; "how are we funding agricultural research and development?"; "how are we going to monitor progress towards achieving that 70-100% increase in agricultural productivity?"; and "how are we going to be able to share our science as we're moving forward, so that we can achieve our goals in a way that is going to maximize the resources that we're going to be able to bring to bear?"

Ensuring food security is on everyone's minds, as is making sure our intensified ag production will be sustainable and preserve our natural resources for generations to come.

To support the sustainability of the intensification of ag production, USDA's National Agricultural Library is working with academic, government, and private sector partners to develop the LCA Digital Commons, a database of life cycle assessment (LCA) data sets and tools. LCA is a science-based process to gauge the environmental and energy impacts of products and services, and serves as the basis for environmental declarations which are increasingly important in trade and commerce.

The LCA Digital Commons will make U.S. data widely available, which is vitally important for U.S. commodities and industries. U.S. soybeans exported to Europe for biodiesel production, for example, are required to meet carbon reduction thresholds. U.S. soybeans failed to make the required benchmark when European data was used; with U.S. data, the benchmark was more than adequately exceeded.

All of these technologies are making possible an innovative agroecological approach to the shared global goal of sustainable intensification of ag production. As a recent report by USAID and the Association of Public and Land-Grant Universities makes clear, if we're going to "feed the future," and do so without

damaging the environment, we need to think big, we need to think collaboratively, we need to be strategic, and most of all, we need to be smart.

Researchers around the world are working as I speak to solve these challenges, but these challenges will continue beyond the lifespan of much of that research.

The best investment we can make, then, is in the most valuable commodity we can cultivate – the next generation of food, ag and natural resource scientists. Only with a rigorous commitment to STEM education will we be able to prepare the students of today to become the world-class innovators of tomorrow. We need to instill early on an interest in food and agriculture by showing its connections to all aspects of society. We need to cast as wide a net as possible, drawing the best talent from across our diverse population. And we need to spread the word about the value of food and ag science and the exciting careers that await.

Technology gives us a great advantage in spreading that word, but nothing is better than hearing it from a friend or mentor. So as you leave here, I hope you take with you an awareness of the weight of the challenges that lie ahead, but

also inspiration from the great works that have been done, and confidence in the great works still to come. If we think big, we will get there. Thank you.