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Before the House Agriculture Committee
Subcommittee on Rural Development, Research, Biotechnology, and Foreign Agriculture

July 28, 2011

Chairman Johnson, Ranking Member Costa, and Members of the Subcommittee, I am Edward Knipling, Administrator of the Agricultural Research Service. Thank you for the invitation here today to discuss the work of the ARS and the agricultural science that we pursue on behalf of all Americans. I am delighted to share our work with you and to have a discussion regarding our programs.

The Agricultural Research Service is the Department of Agriculture's primary intramural scientific research agency. We constitute USDA's federal laboratory network and as such the majority of ARS' funding remains "in-house" to employ government scientists and technicians. Our research is broad-based covering all science facets of agricultural and food production and utilization and is particularly concerned with problem-solving and pre-commercial research of long duration.

The Agricultural Research Service was officially founded in 1953 but has precursor agencies that date back as far as 1884 to the Bureaus of Animal and Plant Industry. The importance of agricultural research performed by the government goes back even farther, to the first work done to stem hog cholera outbreaks in 1868. Prior to the formal creation of the agency, Congress recognized the need for concentrated centers of agricultural research focusing on issues of regional importance and, for example, in 1938, appropriated funding to create agricultural research laboratories in Peoria, Illinois; Wyndmoor, Pennsylvania; Albany, California; and New Orleans, Louisiana; to work particularly on utilization of agricultural commodities. These locations still exist to this day as major centers of ARS work and concentrations of our science. We are proud of this long history of government commitment to solving agricultural problems that affect every single American in one way or another.

Today, ARS is a multi-faceted agency that is spread across the country at over 100 locations. We also have 4 research locations in foreign countries. We employ over 8,500 people, 2,500 of whom are PhD scientists. In Fiscal Year (FY) 2011, the agency has a budget of over $1.13 billion. The agency's funding is allocated to two budget lines; the Salaries and Expense account and Buildings and Facilities. In FY 2011, the appropriation rescinded $230 million in balances from prior appropriations, and there was no funding received under the Building and Facilities line.

The stated mission of ARS (www.ars.usda.gov) is to conduct research to develop and transfer solutions to agricultural problems of high national priority and provide information access and dissemination to:

- Ensure high-quality, safe food, and other agricultural products;
- Assess the nutritional needs of Americans;
- Sustain a competitive agricultural economy;
- Enhance the natural resource base and the environment, and;
- Provide economic opportunities for rural citizens, communities, and society as a whole.

As an organization with national reach, ARS has a broad spectrum of users and stakeholders who drive the research priorities of the agency. When the agency was officially formed in 1953 it was with the intent to create a clearing house for research issues within USDA and to serve the other agencies of the Department that need science information and technology to carry out their programs. This remains an important purpose of the agency. Examples of customer agencies within USDA include the Animal and Plant Health Inspection Service, the Food Safety and Inspection Service, the Natural Resources Conservation Service, and the Food and Nutrition Service. Additionally, the agency is dedicated to serving producers of both commodity and specialty crops, as well as private sector entities that depend on public research. Each year, the agency dedicates itself to an extensive process of listening to these stakeholders as we determine their needs and problems and use this information in setting priorities.

As mentioned, most of ARS' research takes place inside of the agency and is conducted by our federally employed scientists. However, research partnerships of all types are very important to ARS and a hallmark of the agency is the collaborative nature of our work. Of particular importance is our close partnership with the land-grant colleges and universities, as well as other universities. Of our 105 locations, 60 are located on the campus of a land grant institution and an additional seven are located on other institutions of higher learning.

Our sister agency, the National Institute of Food and Agriculture (NIFA), serves to complement ARS by providing grants and other forms of extramural funding, largely to the land grant institutions, which enhances the research partnerships at the laboratory, field, and scientific levels. Further, ARS scientists are often Co-Principal Investigators with our university partners on grants funded by NIFA and the National Science Foundation which serve as a source of extramural funding for ARS.

Over the last 150 years the United States has built a system for agricultural research that has led to more innovation than any other in the world. This is a unique system emphasizing necessary foundational research for the public good that cannot and will not be done by private or commercial enterprises. ARS and NIFA, as well as the other research agencies, broadly coordinate our research programs through joint planning, stakeholder conferences, peer review of projects, complementary allocation of funding and program reviews.

As part of the Research, Education, and Economics (REE) Mission Area, ARS, like its fellow REE agencies, currently is directing special research attention to five broad national priorities that the Administration has deemed of particular importance:

- Climate change/adaptation;
- Food safety;
- Children's nutrition and health;
- Global food security;
- Bioenergy.

To give you a better understanding of the Agricultural Research Service and our work on these major priorities, I would like to describe highlights and examples of significant accomplishments of our work done under four major program areas: Natural Resources and Sustainable Agricultural Systems; Crop Production and Protection; Animal Production and Protection; and Nutrition, Food Safety and Quality.

Natural Resources and Sustainable Agricultural Systems

Sustainable agricultural systems produce the agricultural crops and livestock needed by society; protect the natural resource foundation essential for production, processing, and other uses; and provide economic and social value to producers, processors, consumers, and communities. Our research creates profitable agricultural systems that capitalize on the Nation's vast renewable natural resources to preserve the fertility and productivity of soils, provide abundant and high quality water supply and clean air, maintain healthy agricultural and rangeland ecosystems, and offer renewable energy and fuel alternatives that form the basis of the U.S. economy and the well being of rural America.

Today, farmers have a wide array of conservation techniques to choose from, and the U.S. government supports many of them through cooperative programs. One problem associated with these efforts is determining what works and what doesn't. The Conservation Effects Assessment Project (CEAP) of the Natural Resources Conservation Service answers this question, by determining the effectiveness of USDA conservation programs on the environment. ARS plays a significant role in this project by analyzing the impact of agricultural practices in numerous watersheds across the country. The ARS watershed research focuses on the effects of practices such as no till farming, terracing, riparian buffers, cover crops, and chemical, fertilizer, and manure application on soil erosion and water quality in agricultural watersheds. Measurements at some watersheds have been going on for decades, allowing tracking of changes in these areas over time and with varying conservation scenarios.

These data have been used to construct models for the accurate prediction of the consequences of conservation technologies, allowing one to track conservation progress and select conservation interventions for the future that work best given the characteristics of the region. Examples of ARS contributions include an ARS study that found that cattle manure deposited directly into streams contributed 12% of the phosphorus in water from the studied watershed. Improved fencing to limit cattle access to streams solves this problem. Scientists from ARS

developed a weather advisory system to help farmers decide when to apply manure so that nutrient runoff associated with rain events could be avoided.

This research and the resulting models have led to improved deployment of conservation practices that have significantly reduced soil erosion and improved water quality. Two recent reports regarding the Chesapeake Bay region and the Upper Mississippi river basin indicate significant reduction in soil loss and nitrogen, phosphorus and pesticide runoff. In the Chesapeake Bay region, soil losses were reduced by 55%, nitrogen loss was reduced by 31% and phosphorus loss was reduced by 41% due to conservation interventions deployed there. In the Upper Mississippi river basin, soil loss was reduced by 69%, nitrogen loss by 18%, phosphorus loss by 49%, and 51% reduction in pesticide loss. This type of long term, large scale agriculturally-based conservation research needed to realize these and future improvements illustrates a primary strength of ARS in this research area.

Crop Production and Protection

Crop Production and Protection research programs deliver science-based information, genetic resources, and technologies for increased crop productivity and quality, protection from plant diseases and pests, and economically and environmentally sustainable methods of crop production that meet consumers' demands for a ready supply of high quality, safe, affordable and nutritious food, the public's desire to protect the environment, and the global community's needs for food security.

The ARS response to a new strain of wheat stem rust (Uganda 99 or ug99) illustrates another of the unique capabilities of ARS, its disease experts and genetics resources enabled it to respond quickly to this urgent agriculture issue. In the early 1900s, wheat stem rust caused extensive losses of wheat worldwide, until rust resistant varieties could be developed. These were extremely successful at reducing the incidence of wheat stem rust for decades. In 1999, a new strain of wheat stem rust was discovered in Uganda that had overcome the resistance of currently available strains, and ARS disease experts were the first to identify it as a new mutant strain called ug99. Since its discovery, this rust has spread across Africa, Asia and parts of the Middle East.

Monitoring programs in the major wheat producing areas of the U.S. were strengthened by ARS and others to detect Ug99 or related wheat stem rust entry into the country. ARS scientists are also determining the mechanisms by which the Ug99 strain was able to overcome the disease resistance of commercial varieties. Worldwide surveys of wheat, barley and related grasses were undertaken to discover resistance to Ug99, and several resistant plants have been discovered. Research is currently underway to transfer disease resistance from varieties where it was discovered to all commercial forms of wheat grown in the U.S. and worldwide. ARS scientists are also developing and studying the use of appropriate fungicides to help combat wheat stem rust. Finally, ARS scientists are participating in an international consortium that monitors the movement of Ug99 from country to country, and supporting efforts to provide Ug99 resistant wheat to areas of the world that have been stricken with this disease. These interventions are

intended to prevent the entrance of this disease into the US, and mitigate or prevent the negative consequences of the disease should it manage to become established here.

Much of the infrastructure needed for U.S. monitoring for wheat stem rust was already in place, maintained by ARS. This includes scientific expertise in the diseases of cereal grains. Because of this, ARS was able to rapidly mount an effective research response to this problem.

Animal Production and Protection

The mission of the ARS Animal Production and Protection research programs is to provide the scientific information and tools to help support the U.S. food animal industries to continue to compete successfully in worldwide trade, provide the supply of nutritional animal products required by the nation, and contribute toward global food security. ARS accomplishes this mission by maximizing production efficiency and animal health through scientific innovation and the discovery and development of new technologies focused on national priorities. Strategic public-private partnerships have been established to achieve our mission, including support of government action and regulatory agencies responsible for trade, bio-defense, and global food security.

The recent success of dairy cattle genomics illustrates a unique strength of ARS, the ability to commit to a research topic long enough to generate real solutions to complex agricultural problems. In the early 1990s, ARS began investing resources in cattle genomics. ARS cattle genomics research contributed significantly to early cattle genome mapping and ARS leadership organized a successful collaborative effort to sequence the bovine genome, which was published in 2009 in Science.

Building from these accomplishments, ARS scientists in collaboration with scientists at George Mason University, University of Missouri, University of Maryland, University of Alberta and Illumina Inc., developed the tool needed to enable dense genotyping on individual cattle at a cost that allowed the analysis of enough cattle for successful genomic prediction of quantitative traits. Combining national production records for dairy cattle available and the ability to do dense genotyping provided the opportunity to realize the huge potential of genomic analysis for Dairy cattle selection. Subsequent analyses by ARS demonstrated that use of genomic prediction in dairy cattle substantially improved the accuracy of selection of young dairy bulls compared to that derived from trait measurements in the parents, and effectively shortened the generation interval. Scientists from ARS have further developed genotyping tools, strategies and computer analyses to further reduce the cost of genotyping without significantly reducing accuracy.

These innovations have been extensively adopted by the US dairy industry. It is estimated that this technology will double the rate of genetic progress. To put this in perspective, according to the National Agricultural Statistics Service, milk production per cow has increased at the rate of 1.6% per year over the last decade. If this rate were doubled, the dairy herd in this country could be reduced by 30% in the next decade without reducing the milk supply, significantly reducing

both the cost of producing milk and the demand on feed and natural resources used. This success has been possible only through sustained ARS commitment and leadership in cattle genetics and genomics.

Nutrition, Food Safety and Quality

The Nutrition, Food Safety and Quality research and information area exists to lead and coordinate ARS research and information dissemination to define the role of food and its components in optimizing health for all Americans. Our scientists focus on developing tests and processes that keep the food supply safe; reducing and controlling pathogens and toxins in agricultural products; and improving the economic viability and competitiveness of American agriculture by enhancing the quality and utilization of agricultural products for the benefit of producers and consumers.

Unique national resources that are part of this program include the National Nutrient Databank and the "USDA What We Eat in America/NHANES" national food consumption survey. Partnerships with other federal agencies and non-profit and industry groups allow ARS to leverage funds and build upon common research goals. Information dissemination programs operated by ARS' National Agricultural Library address general and specific human nutrition issues and audiences and include general web portals such as www.nutrition.gov for the American consumer as well as the targeted web sites for professionals such as the Food and Nutrition Information Center.

The ARS response to *E. coli* contamination of a variety of foods illustrates several distinguishing characteristics of ARS, which includes the ability to rapidly respond to public health problems; the development of real solutions to those problems; and the ability to provide a long-term commitment of resources to a research topic. In 1993, hundreds were sickened after eating undercooked Jack-in-the-box hamburgers. The culprit was rapidly identified as *Escherichia coli* O157:H7. *E. coli* is a common bacterium that is resident in the large intestine of man and animals and is typically harmless. However, O157:H7 *E. coli* produces toxins, which cause severe illness and death. ARS scientists rapidly (within a year) developed tests for bacterial contamination of meat that were used by the meat processing industry to monitor and control contamination, followed by further tests to specifically detect E. coli O157:H7.

According to the CDC, E Coli disease has been reduced by 40% over the last decade. However, outbreaks continue both in the US and other countries in meat and other foods such as fresh produce. Some outbreaks have been linked to E. coli O157:H7, but others are due to non-O157 E. coli (STEC) strains described as O26, O45, O103, O111, O121 and O145, also known as the "Big Six". ARS scientists at the request of the USDA-Food Safety and Inspection Service (FSIS) recently developed and validated tests that can specifically detect and differentiate the disease causing non-O157 strains for use in regulatory monitoring of the food supply.

For 17 years, ARS' food safety research program has rapidly and uniquely responded to the challenges of pathogenic *E. coli* contamination of foods, and has successfully provided technological solutions that have been rapidly adopted by its various stakeholders. These technologies have been and will continue to be used to monitor, eliminate the entrance, and/or reduce the level of disease causing E. coli into the food supply.

International Research

ARS operates four laboratories abroad that are dedicated to the biological control of invasive species and pests. These labs are located in Montpelier, France; Brisbane, Australia; Buenos Aires, Argentina; and Beijing, China. The laboratories exist primarily to allow ARS scientists to evaluate harmful, non-native species that have invaded the United States and to discover beneficial species in their native environments that can be used to control the invasive species.

In addition to these laboratories, the agency's Office of International Research Programs serves to promote and enhance the research of ARS through mutually beneficial international research agreements. We currently have cooperative agreements with researchers in dozens of countries across the globe. These agreements cover the entire spectrum of research and allow our scientists access to information and conditions for their research that would otherwise be unattainable.

Technology Transfer

ARS's Office of Technology Transfer (OTT) is assigned the responsibility to facilitate and accelerate the delivery of ARS research results for the public benefit to private sector entities that further develop, commercialize, and market publicly developed and owned technology and information Further responsibilities of the office include protecting intellectual property (IP), and developing strategic partnerships with outside organizations, ARS-OTT is centralized for patent, license, and cooperative agreement policies and approvals, but maintains field offices to provide one-on-one customer service to ARS researchers and private sector partners throughout the U.S.

In addition to OTT activities, technology transfer is accomplished through many other mechanisms, such as:

- developing written information for customers and stakeholders, including scientific publications, publications in trade journals, and reports to stakeholders;
- releasing plant germplasm to the public;
- transferring research materials to scientists outside of ARS;
- delivering specific research results to regulatory agencies to support their actions;
- participating in meetings with industry organizations and universities, workshops and field days; and
- distributing information to the public via the ARS Information Staff, the National Agricultural Library, and other sources.

Buildings and Facilities

As the nation's science based Federal intramural agricultural research agency, ARS uniquely owns and manages a large infrastructure of modern research laboratories and other real property assets that support and sustain the long term USDA science capacity. Collectively, this network of over 100 locations spread across the country essentially constitutes the national laboratory for agriculture. The agency places the management of its physical assets as a high priority proactively monitors and reviews the status of those facilities. Currently ARS is developing a capital management strategy to take us into the future.

ARS is now completing a number of repair, maintenance, and modernization projects that were funded with $176 million made available by the American Recovery and Reinvestment Act of 2009. This program created jobs and corrected facility deficiencies which allow ARS research to be effectively and efficiently conducted at suitable facilities. Critical deferred maintenance is work associated with critical systems such as HVAC, electric, roofing, exterior closure and plumbing and involves maintenance to systems and components beyond simple patch and repair tasks. Completion of this work will, in many cases, result in improved energy efficiency, reduction in current operation and maintenance costs, and arrested further deterioration of ARS facilities.

At the end of FY 2010, ARS obligated approximately $171 million. The balance of approximately $5 million was used as a reserve for change orders typically expected in construction of this type. As of July 2011, ARS has obligated a total of $174million.

ARS also owns or leases over 400,000 acres of land across the country, on which are more than 3,000 operational buildings with a total gross square footage of over 13.5 million. The agency estimates the replacement value of all of its real property assets to be $3.64 billion.

Mr. Chairman, as you can see ARS is a very active and involved agency that is dedicated to solving the world's agricultural problems and to delivering the science needed to feed and clothe a growing world population. ARS has been focused on these issues for over half a century and we are very excited about the next 50 years as well. I appreciate this committee's long-standing support of ARS and I would like to again thank you for the opportunity to testify before you today. I look forward to answering any questions that you may have.