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RESEARCH, EDUCATION, AND ECONOMICS

Statement of Dr. Catherine E. Woteki, Chief Scientist and Under Secretary
Before the Subcommittee on Agriculture, Rural Development,
Food and Drug Administration, and Related Agencies

Mr. Chairman, Ranking Member Farr, and members of the Subcommittee, my name is Catherine E. Woteki, and I am the Under Secretary for Research, Education and Economics and Chief Scientist at USDA. I am pleased to appear before you to discuss the President's 2013 budgets for the Research, Education, and Economics (REE) mission area agencies of the United States Department of Agriculture (USDA). I am accompanied by the Administrators of the four agencies: Dr. Edward Knipling, Administrator of the Agricultural Research Service (ARS); Dr. Mary Bohman, Administrator of the Economic Research Service (ERS); Dr. Cynthia Clark, Administrator of the National Agricultural Statistics Service (NASS); and Dr. Chavonda Jacobs-Young, Acting Director of the National Institute of Food and Agriculture (NIFA). Also present is Michael Young, the Department's Budget Director. Each Administrator has submitted written testimony for the record, which provides a complete description of their proposed budgets.

This is the USDA's 150th anniversary year. I've been reflecting a lot lately on how much USDA's origins lie in its scientific mission "to acquire and to diffuse among the people of the United States useful information on subjects connected with agriculture in the most general and comprehensive sense of that word, and to procure, propagate, and distribute among the people new and valuable seeds and plants." The Act creating the Department also called for acquiring and preserving information by practical and scientific experiments, the collection of statistics and

the creation of the National Agricultural Library. The same year that USDA was founded, the Morrill Act was signed into law, creating the Land Grant system that today continues to serve as one of our signature accomplishments. The system consists of not only the universities designated in 1862, but also land-grant universities designated in 1890 (historically black colleges and universities) and in 1994 (tribal colleges). More than 20 million students, many of whom are the first in their families to graduate from college, have successfully graduated from these schools and helped to build your States and America as we know it. Today we take great pride in our heritage and in all we've achieved in partnership with these great education and research institutions.

The agencies in the REE mission area have a history of doing the research that supports every other area of USDA and some other departments, and that keeps our country fed, at one of the lowest food costs in the world. Pioneering work in genetics and genomics has made remarkable strides for farmers and producers. Cutting edge science has increased production – and farmers' bottom lines – in the dairy industry, in cattle and small ruminant breeding, and in row crops and fruit. And all Americans benefit.

Our scientists work collaboratively with researchers throughout government, the private sector and universities to address some of the Nation's and the world's biggest challenges. In one recent example, ARS, NIFA and the Animal and Plant Health Inspection Service (APHIS) joined forces to coordinate and advance research into citrus greening, which threatens the citrus industry. During the past five years, researchers at ARS have transformed their Germplasm Resources Information Network (GRIN) database into GRIN-Global, which will enable

scientists around the world to access stored seeds and other germplasm as they implement the next "green revolution" for global food security.

The analysis and statistical work done by ERS and NASS guide policy makers, regulators, consumers, businesses and the global marketplace with high-quality, dependable and timely economic research. The scientific questions we pursue at USDA span the range of the most pressing issues facing the planet today – from food security to food safety to helping farmers produce and remain profitable in the face of emerging diseases of crops and livestock -- and more variable weather patterns -- to informing our commodity markets. We do our work at a truly crucial point in time for our country and the world – and in the past two years we have done it even under dramatic reductions in research and education.

We face the prospect of needing to double our agricultural production globally – on about the same amount of arable land we have in production today – in the next 38 years. By 2050, the United Nations projects that the global population will surpass 9 billion people, 2 billion more than today. To meet these needs, we will have to pursue a strategy of sustainable intensification for agriculture, to not only feed ourselves, but also to keep our exports strong, and sustain our natural resources. The only way to achieve those goals is to invest in science, because that is where the answers to all of these fundamental questions – and our survival – can be found. While budget constraints in recent years have been challenging, I am happy to report that this year's budget upholds the long recognition that research is an important strategic investment for the Department, as the Secretary pointed out in his recent testimony. Clearly, agricultural research continues to be an important strategic investment for national security, for our farm

economy and rural America, and for the Nation as a whole as we work toward an economy that is built to last.

The importance of these investments in agricultural research can be illustrated in this simple ratio of 20:1. That is, each dollar spent on agricultural research returns about $20 worth of benefits to the economy. It is this understanding and a sign of how important research is to the President and the Department that REE benefits from modest proposed increases even with an overall net decrease to the Department's budget. Look deeper and you will realize there are numerous shifts that reallocate funds to higher priority from lower priority programs and projects. This budget, therefore, contains many tradeoffs. In order to focus on the critical goals of assisting rural communities to prosper, keeping agriculture productive and our food supply secure, enhancing research into conservation practices, developing our bio-economy and ensuring all children have a safe and nutritious food supply, REE has had to recommend a redirection of some of our *existing* work to pay for *new* work.

The 2008 Farm Bill was quite clear in its instruction to the Under Secretary of REE to create the role of the Chief Scientist and to work with the agencies under REE to coordinate and create complementary but not duplicative research. Most of the new work proposed in the 2013 President's Budget on these emerging and higher priority topics derives from a significant cooperative planning project undertaken by all the agencies in REE. In February 2012, we released the REE Action Plan, a plan for USDA science and education written by program leaders from all of the REE agencies after consultation with many customers and stakeholders, both internal to USDA and our agencies, and from outside USDA. We are not only committed

to following this action plan, we are committed to updating it and reporting on it in the coming years. In fact, we have created a short first accomplishment report on the Action Plan that I have included as an appendix to my written testimony.

The Action Plan is critical in more ways than one. First, it brings to fruition work begun at the direction of the 2008 Farm Bill, which resulted in the initial report produced by my predecessor in early 2010 called *A Roadmap for USDA Science*. Now more than ever, careful planning is fundamental to global prosperity and security, and a dynamic and integrated strategic vision can be a guiding force for continued innovation, as well as the means to maximize the potential of our world-renowned system of agricultural science and education. Working with the land grant universities is one of the best tools we have to continue that innovation.

Our partnership with the land grants has paid great dividends over the years. One example is the BeanCAP project, in which NIFA funded collaborative research between five ARS laboratories and six State universities. They discovered genetic markers associated with common bean nutritional traits, and developed applications that could rapidly develop bean varieties with improved nutritional qualities and resistance to disease and other stresses that reduce productivity. BeanCAP fits in well with another collaborative effort – the Feed the Future Initiative – which brings together the Department of State, USAID and USDA to benefit U.S. agriculture and farmers in developing countries, where beans are a staple crop for so many people. These kinds of results highlight the value of partnerships, and the need to reinvigorate the research and development partnership between the Federal government and the States to face today's many challenges.

Our new Action Plan reflects that, collectively, we have—at USDA and with our many partners—a robust infrastructure to perform world-class science. We have many of the world's best scientists working at USDA and in our partner institutions. This rich and deep talent base is capable of addressing almost any problem we can put before it. It is a resource to be cultivated. One of the accomplishments I am most proud of here at REE is the more than 6,000 graduate students we currently have being trained in our laboratories or with our funds. The funds you give us help to maintain that intellectual resource for our future.

Looking forward, yet facing the realities of today's economic climate, we must now simultaneously streamline and enhance our research, education, and extension capabilities while using our resources intelligently and efficiently. We must make tradeoffs. For example, ARS proposes to reallocate over $50 million in current program funding in order to expand research initiatives in crop and livestock protection, food safety, human nutrition, and sustainable agriculture. NASS has begun discussions around a multi-year restructuring and modernization of its processes to maximize its effectiveness and improve its data quality. These are times when we have to focus on our core priorities and build upon them. Under Secretary Vilsack's strong leadership, we continue to find other efficiencies throughout REE. We have reduced travel by 20 percent and have moved to make the administrative wing of REE leaner and more efficient. We provided retirement options across the REE agencies, and we have greatly reduced hiring.

This budget represents the REE agencies' cooperative and collaborative response to critical challenges facing agriculture. We in REE, as documented in our new Action Plan, aim to take

on these problems in a complementary fashion, with intra- and extramural programs conducted in ARS laboratories and land grant universities; through basic science, applied science, economics and statistics.

Now let me get into some specifics for REE and each agency. The 2013 budget proposal for REE is $2.6 billion, an increase of roughly $65 million.

As in years past, we request increases for extramural research that accounts for roughly 48 percent, with intramural (including NASS) accounting for roughly 52 percent. This balanced portfolio is one of USDA's biggest strengths. ARS, ERS and NASS sustain in-house capabilities and facilities vital to meeting both emerging challenges and long-term problems, while formula funds help maintain the Nation's excellent agricultural extra-mural research infrastructure and the programs that enhance scientific discovery through targeted competitive funds. The coordinated thinking and work that have gone into the REE action plan goals and strategies leverage and exploit this intra- and extra-mural partnership to its fullest.

I'll speak briefly about each agency in turn now. You have full written testimony from each of the Administrators, but I'd like to point out some of the highlights.

NASS will conduct data collection for the 2012 Census of Agriculture beginning in December 2012, so you see in our proposal a total of $179 million, which is an increase of $21 million to fund this every five-year census. Excluding the cost of the Census, NASS is actually budgeted at $117 million, which is the same as 2012. However, within that total, NASS will increase

funding to improve the data quality and accuracy of the county estimates program by $3.4 million, using savings generated from the efficiencies created through the creation of the National Operations Center.

Moving on to ARS, you see $1.1 billion for ARS research and information; a net increase of approximately $8 million. Within the total funding, we are proposing $78 million in increases to address the Nation's most critical research needs. These increases are funded by reallocations of $50.4 million from lower priority programs, and elimination of $20 million in lower priority extramural projects. These redirections and eliminations will result in the closure of six ARS laboratories and reallocation of those resources to higher priority areas. We are pleased with the inclusion of a proposal of a $36 million increase for research on environmental challenges facing agricultural production. This highlights our coordination with other Federal agencies and university partners and our responsiveness to customer and stakeholder priorities. Over the last few years drought, excessive flooding and other weather-related challenges to agriculture have created needs for farm and ranch alike.

NIFA requests $1.2 billion budgeted for NIFA discretionary programs; a net increase of roughly $36.7 million. Smith-Lever, Hatch Act and other formula grants accounts for $654 million of this total. Other NIFA discretionary grant programs total $590 million. Of the total request, $325 million is for the Agriculture and Food Research Initiative (AFRI), which is an increase of approximately $61 million from 2012.

Finally, for the Economic Research Service, ERS, you see an overall proposed budget of $77 million, which constitutes a decrease of $326,000, terminating some of ERS' lower priority programs.

Mr. Chairman, as you can see, the President's 2013 budget for USDA's REE mission area agencies continues making critical investments in agricultural science and education. We have worked hard to reallocate resources so that intramural and extramural scientists and researchers can continue to perform at the highest level of achievement, as they always have. But I would be remiss as the Under Secretary of my mission area – and as the Department's Chief Scientist – if I didn't point out that supporting agricultural research is a wise and absolutely necessary investment for our Nation.

No less than the seven former Secretaries of Agriculture who spoke at the Ag Outlook conference recently, as well as philanthropist Bill Gates, have called for making the funding of agricultural research a top priority for our country. There is a global consensus emerging on this score, with agricultural research being placed high on the agenda of the upcoming G-8 and G-20 meetings. The work done by the scientists and researchers of REE is irreplaceable to advancing the health and well-being of our Nation and the world. Keeping our place as international leaders in agricultural science is of paramount importance to fulfilling that mission.

Under Secretary Vilsack's leadership, the REE agencies are focused on streamlining for efficiencies and eliminating redundancies while maintaining a world-class level of science. This 150th year of USDA provides us all a moment to reflect on the importance and impact of our

mandate. We look forward to working with you during this budget process to ensure that the work of the REE agencies can continue to meet the needs of our Nation.

Thank you again for your time and I would be pleased to answer any questions you may have.

APPENDIX TO RESEARCH, EDUCATION, AND ECONOMICS TESTIMONY

ACTION PLAN ACCOMPLISHMENTS

Goal 1. Local and Global Food Supply and Security

The Research, Education, and Economics Mission Area agencies provide information, technologies, analysis, and capacity to enable the U.S. agriculture, food, and fiber systems to produce the food, fiber, and energy to meet growing and changing world demands for these products in an economically and environmentally sustainable manner.

Evans-Allen Program. Virginia State University researchers evaluated and identified grazing goats that show natural resistance and susceptibility to parasites. The ability to track genetic markers that render the animal resistant to disease could further increase market value of breeding stock. With proper marketing strategy, a purebred animal that exhibits disease resistance characteristics can increase the price of goat from $250 to $800 per head.

Food and Agriculture Defense Initiative Program. The National Plant Diagnostic Network (NPDN) is led by diagnostic laboratory centers at Cornell University (New York), University of Florida, Kansas State University, Michigan State University, and University of California at Davis. These institutions receive direct funding from NIFA and provide support to the other land grant plant diagnostic laboratories in their region through subcontracts, training, and leadership. All 50 States and many U.S. territories are connected to the NPDN through digital distance diagnostics, used throughout the Nation to speed early detection of high consequence plant pathogens and solve other agricultural problems. The system allows plant diagnosticians in one location to transmit a digital image across the country to someone with special expertise. Plant disease (and insect) detection criteria have been developed for soybean rust, sudden oak death, Ralstonia stem rot, plum pox virus, pink hibiscus mealybug, potato wart, huanglongbing (citrus greening), Potato Cyst Nematode, Late Blight, Beet Curly Top, Citrus Leprosis and Citrus Blackspot.

The updated USDA Plant Hardiness Zone Map. The updated, on-line version of the USDA Plant Hardiness Zone Map (PHZM) was released in January 2012, and has already registered strong impact on the U. S. gardening public (80 million people strong), the horticulture industry, and the research community. Developed by ARS and Oregon State University researchers, the PHZM depicts geographical patterns across the United States in the average extreme annual minimum temperature, a factor strongly associated with patterns of plant adaptation and survival. It is a tool for gardeners, government agencies, breeders, and growers to identify trees, shrubs, etc. adapted for a specific area. During the first 2 weeks following its release, more than 500,000 total individual visitors (an average of about 25,000 per day) accessed the PHZM Web site, recording more than 20 million page hits. Agricultural extension agents, gardening consultants, and horticultural professionals are already citing information from the PHZM extensively in their recommendations for planting materials. Scientists from USDA and other government agencies are frequently downloading Geographical Information System data from the PHZM web site for their research. Several large garden seed companies are discussing linking their on-line

purchasing sites with the PHZM zip code finder so that clientele can order plants and seeds best adapted to local conditions.

New "FasTrack" breeding technique accelerates progress with breeding tree fruit. Tree fruit breeding is a long-term and expensive process because of the long juvenile non-flowering stage in many trees. ARS scientists in Kearneysville, West Virginia, discovered that introducing a gene from the poplar tree, which promotes early flowering and fruiting, shortened the juvenile stage in plum from 3-4 years to less than 1 year. Following the standard breeding procedures, plum trees with the genetically engineered early flowering trait are culled from the breeding stock during the final selection cycle, and the mature, improved trees without the transgene are reserved for further breeding. This method for producing early flowering and fruiting has been termed "FasTrack," and can significantly accelerate the breeding of new and improved varieties of plum and other tree fruits, and forest and woody ornamental species.

The National Plant Germplasm System. Crop diversity must be collected and safeguarded in genebanks in the form of seeds, bulbs, tubers, etc., termed plant germplasm or plant genetic resources. During the last 5 years, the 20-plus genebanks in the USDA ARS National Plant Germplasm System (NPGS) added more than 70,000 new samples and more than 2,000 new plant species to their collections, bringing to a total of more than 546,000 samples of more than 14,300 plant species being conserved by NPGS genebanks. Scientific interest in this germplasm has increased tangibly during the last 5 years, with NPGS distributing more than 1 million plant samples to researchers and breeders world-wide. These materials are keys for continued progress in crop genetics and breeding requisite for future food security. The information associated with collections of plant genetic resources is also invaluable, describing their biological features, and how farmers and breeders have improved and used them for food, feed, fiber, fuel, and other products critical for humanity. During the last 5 years, world-wide use of the ARS Germplasm Resources Information Network (GRIN) database has more than doubled, from about 750,000 to an average of nearly 2,000,000 distinct visits per year. Furthermore, ARS and its cooperators have transformed GRIN into GRIN-Global, a more effective, easy-to-use information management system for efficient genebank operations. GRIN-Global is currently being implemented in some of the "green revolution" CGIAR Centers (e.g., CIMMYT) and in national genebank systems in the developing world.

Future U.S. Agricultural Productivity Growth. The Economic Research Service characterizes and evaluates trend in agricultural research funding and direction, both public and private; the use of various funding instruments; and key factors affecting research and development and resultant productivity growth. By 2050, global agricultural demand is projected to grow by 70-100 percent due to population growth, energy demands, and higher incomes in developing countries. Meeting this demand from existing agricultural resources will require raising global agricultural total factor productivity (TFP) by a similar level. The ERS report *Public Agriculture Research Spending and Future U.S. Agricultural Productivity Growth* shows that the rate of TFP growth of U.S. agriculture has averaged about 1.5 percent annually over the past 50 years, but stagnant (inflation-adjusted) funding for public agricultural research since the 1980s may be causing agricultural TFP growth to slow down. ERS simulations indicate that if U.S. public agricultural R&D spending remains constant (in nominal terms) until 2050, the annual rate of

agricultural TFP growth will fall to under 0.75 percent and U.S. agricultural output will increase by only 40 percent by 2050.

Determining the Evolution of Wheat. Agricultural Research Service scientists and collaborators deciphered the genetic mechanism responsible for the domestication of wheat. This research led to the discovery and subsequent characterization of the genes involved, which includes three copies of a gene known as *Q*. Moreover, this work yielded knowledge regarding how the *Q* genes were recruited through evolution for domestication and enhanced agronomic performance, which will help scientists develop novel crop improvement strategies.

ARS, NIFA, and APHIS join forces to coordinate research of Huanglongbing of citrus. Huanglongbing disease of citrus (HLB, also called citrus greening) is now established in all of the citrus-producing counties of Florida, and has been recently found in the Rio Grande Valley of Texas. The psyllid insect vector for HLB is found in California, but not yet the disease. ARS, APHIS and NIFA partnered to coordinate a strong national research effort to control HLB. ARS scientists in National Program 303 (Plant Diseases) worked as a broader team with entomology, horticulture, and genetics to identify gaps, establish priorities, and develop a coordinated research plan, partnering with university, industry, and other State and Federal researchers, on HLB. ARS continues to collaborate extensively with industry and Federal regulatory agencies to help in directing a national effort against HLB that includes research, but also coordinating with extension and education efforts. Through these collaborations, the full genomic sequence of the presumed causal bacterium, the insect vector, and citrus rootstock resistant to the disease were determined and the information made publically available. Collaborations resulted in the development of high-throughput, sensitive, and accurate diagnostic techniques and are being used by scientists developing resistant germplasm and other disease control measures. These diagnostic methods are currently used by the California Department of Food and Agriculture to assay for '*Ca.* Liberibacter asiaticus' directly from the Asian citrus psyllid vector to monitor movement of the suspected pathogen as the psyllids (but not yet the bacterium) are increasingly being detected in California. Monitoring will help alert plant health officials to any introduction of the pathogen. The rootstock sequence has already helped to identify citrus genes for use in developing genetically modified citrus using only citrus-specific genes. Genes and control elements derived from the citrus genome are being trialed to produce "intragenic" sources of resistant cultivars. In addition, improved spray technology has been transferred to growers that significantly reduce the volume and amount of pesticides needed for psyllid control, a significant cost savings for growers.

BeanCAP. Common beans (*Phaseolus vulgaris* L) comprise the world's most important food legume, feeding about 375 million people in Latin America and 200 million people in sub-Saharan Africa. In a very successful inter-agency partnership, the BeanCAP project was funded by NIFA and includes collaborations of bean researchers from five ARS laboratories and six State universities. BeanCAP's major objectives are: 1) Discovery of genetic markers associated with common bean nutritional traits, as well as disease and environmental stresses that impact bean productivity; and 2) Application of genetic marker technology to rapidly develop bean varieties with improved nutritional traits and resistance to disease and other stresses that reduce productivity.

Molecular markers from this research effort have been deployed in the United States and developing countries, and the technology is specifically being used by the Generation Challenge Programme, which was created by the Consultative Group on International Agricultural Research (CGIAR) in 2003 as a time-bound, 10-year program to use genetic diversity and advanced plant science to improve crops by breeding for drought-prone and harsh environments. Deployment of BeanCAP research fits well with Feed the Future – a joint effort of the Department of State, USAID, and the USDA to leverage investments by USDA research that benefits U.S. agriculture in new ways, and that can also benefit farmers in developing countries. Major crop diseases are key examples where 'dual-use' technologies can have broad applicability. U.S. farmers benefit because overseas research partnerships provide important first-line defenses or early warnings against new types of plant pests and emerging diseases.

Goal 2. Responding to Climate and Energy Needs

Because production systems are climate-dependent to varying extents, the ability to respond to changes in climates is critical. Foundational research is necessary to identify plant species appropriate for changing climate, to meet increased energy demands, and to determine the role of agriculture in appropriate greenhouse gas reduction opportunities.

Remote sensing tools for agricultural drought detection. Drought-related reductions in agricultural productivity have profound effects on regional food security and global agricultural commodity markets. The ability to mitigate these effects is frequently limited by difficulties in accurately detecting the onset and severity of agricultural drought, particularly in underdeveloped regions of the world prone to food insecurity. To address this limitation, ARS scientists in Beltsville, Maryland, examined the microwave and thermal radiative signature of agricultural landscapes undergoing drought, and developed a series of satellite remote sensing tools to assess the availability of soil water in the root zone over large geographic regions. These satellite-based strategies enable both the earlier detection of agricultural drought and a more detailed spatial description of its extent and severity. These improvements enhance our ability to mitigate the effects of agricultural drought on global food markets, and to anticipate the social/political consequences of changes in food availability and price. Currently, these technologies, and/or the data sets they create, are being shared with operational drought monitoring activities at the Foreign Agricultural Service, the National Oceanic and Atmospheric Administration, the National Environmental Satellite Data and Information Service, and the National Drought Mitigation Center. This research is already having international effects in helping to quantify drought conditions as related to food insecurity in the Horn of Africa.

Reducing ammonia emission from beef cattle feedyards. Ammonia gas escaping from beef cattle feedyards is a loss of valuable fertilizer nitrogen that can negatively affect sensitive ecosystems and degrade air quality. The quantity of ammonia emitted from feedyards and the factors controlling losses are not understood. ARS researchers from the Conservation and Production Research Laboratory in Bushland, Texas, in collaboration with researchers at West Texas A&M University and Texas AgriLife Research, measured ammonia emissions from two feedyards over a two year period to identify the sources and fate of ammonia gas losses. The major factors affecting emissions were ambient temperature and dietary crude protein concentration in feeds, with more than 52 percent to 59 percent of fed nitrogen lost as ammonia at the two feedyards

over the study period. Ammonia emissions are sensitive to crude protein in rations, and increased as crude protein increased above the level needed to meet the physiological needs of cattle. Modifications of diet composition can effectively reduce ammonia emissions by 20 to 50% with only small effects on animal performance. Covering stored manure and incorporating manure when it is land-applied can significantly reduce ammonia losses. The research 1) provides an important database that can be used by scientists to validate and verify process models of gas emissions; 2) assists the cattle industry with accurate science-based information to meet regulatory requirements; and 3) gives regulators more comprehensive real world data to build ammonia emissions inventories.

Oilseed crops for biofuel in crop rotations. Sustainable biodiesel and jet fuel production will require widespread planting of oilseed crops. The several million acres of alternate-year summer fallowed wheat land in Montana is commonly identified for growing oilseed crops. ARS researchers at Sidney, MT in collaboration with South Dakota State University have conducted a long-term study using cool-season *Brassica juncea*, camelina and crambe oilseeds in two-year rotations with durum wheat. They discovered *Brassica juncea* had significantly superior seed and oil yield compared to the other oilseed crops, out-yielding both crambe and camelina by more than 100 and 360 lbs per acre respectively, and oil yield by 145% and 175%, respectively. Most importantly, durum wheat yields in rotations with the three oilseed crops were about 25%-35% lower than durum wheat in summer fallow rotations due to greater soil water use by the oilseed crops than if the alternate year fallow were used. This dispels the common notion that alternate year fallow land is available at no cost to food crop production. The study also showed insertion of the most productive oil seed crop into an every-other-year rotation would earn the farmer a greater overall return despite reduced durum wheat yields. Taken as a whole, this research demonstrates that *B. juncea*'s superior yield and oil producing qualities make it a promising candidate to meet future U.S. biofuel production needs by altering crop rotations in semi-arid areas of the Northern Great Plains.

Ethanol and U.S. Corn Production. The Economic Research Service develops models of bioenergy production, which incorporate social, economic and environmental factors in order to identify sustainable outcomes. The ERS report *The Ethanol Decade: An Expansion of U.S. Corn Production, 2000-09* examined how the farm sector reacted to the increased demand for corn needed to fuel a 9-billion-gallon increase in ethanol production over the last decade. The study showed that harvested corn acreage increased by roughly 10 percent (7.2 million acres) over the same period. Corn acreage increased mostly on farms that previously specialized in soybeans; other farms, however, offset this shift by expanding soybean production. The simultaneous expansion of corn and soybean acreage resulted from a reduction in cotton acreage, a shift from uncultivated hay to cropland, and the expansion of double cropping.

Incorporating manures for improved air and water quality. Manures from animal production systems are increasingly being used as sources of nutrients for agriculture. In contrast to surface application, injecting manure directly into the soil can have both environmental and economic benefits. In collaboration with university partners in five mid-Atlantic states, ARS scientists at University Park, PA, Booneville, AR, and Auburn, AL, conducted research on new methods to incorporate manure directly into soil, as an alternative to the more common method of applying manure directly to the soil surface. By quantifying the benefits of injecting manures into soils

with different technologies, researchers demonstrated the potential of new shallow injection technologies to: 1) lower odor to background levels within 3 hours of application; 2) decrease ammonia emissions by more than 70%; and 3) reduce P in runoff to levels comparable to soils that did not receive added manure. Relative to conventional methods, data from a field site on Maryland's Eastern Shore showed that phosphorus leaching losses were reduced by more than 40% with the manure injection technology. In addition, manure injection caused minimal soil disturbance, thus also reducing erosion in comparison with conventional tillage. The costs of purchasing and maintaining manure injectors were balanced or outweighed by improved use of manure nutrients by crops. As a result of this work, state and federal initiatives in the Chesapeake Bay watershed include plans to expand the use of manure injection technologies to more than 47,500 acres of agricultural lands. The USDA and university research team's work received the 2011 Mid-Atlantic Regional Educational Institution and Federal Laboratory work has been cited in the Watershed Implementation Plans of four Chesapeake Bay watershed states--MD, NY, PA and VA. This research has a focus on capacity building with University of Maryland-Eastern Shore, a land-grant, historically black college.

Goal 3. Sustainable Use of Natural Resources

Research, education, and extension programs that improve soil, air, and water resources while supporting agricultural and forest production on working lands have been the hallmark of USDA for more than a century. Technologies and management prescriptions are developed that produce needed agricultural and forest products while sustaining the natural resources that support their development.

McIntire-Stennis Cooperative Forestry Research. Researchers at the University of Arkansas tested mathematical search techniques to develop management recommendations that will maximize financial return to landowners growing timber. Such computer simulations can study the effects of emerging markets for biomass feedstocks for biofuels and carbon sequestration markets. With training in carbon sequestration methods, the researchers will be able to assist forest landowners in accessing to carbon and biomass markets and obtain payment for ecosystem services from forest lands. Under existing carbon markets and prices, forest landowners in Arkansas can increase returns from a single crop of trees by as much as $150-$180 per acre.

Improved nitrogen management tools released online. Nitrogen losses from agricultural systems impact soil, water, and air quality. There is a need for new tools that can help assess reactive nitrogen losses from agricultural systems. The Nitrogen Trading Tool, Nitrogen Index 4.3, and NLEAP-GIS 4.2 were calibrated and validated using field measurements, and were released via a new ARS webpage (http://www.ars.usda.gov/npa/spnr/nitrogentools). These tools have been downloaded hundreds of times and are being used by international agencies, universities, and national and international peers to assess the effects of management practices on nitrogen losses to reduce nitrogen losses to the environment.

Successful biological control of Melaleuca has restored the Florida Everglades. The Australian wetland tree Melaleuca, *Melaleuca quinquenervia* has invaded more than 500,000 acres of wetland habitat in southern Florida, including the Everglades, and has altered forest structures, degraded wildlife habitat and reduced biodiversity in freshwater marshes by 60-80%. Melaleuca

is the largest weed ever targeted for biological control. The introduction of three biological control agents, discovered by the USDA-ARS Australian Biological Control Laboratory and developed in collaboration with the USDA ARS Invasive Plant Research Laboratory in Florida, has severely limited the ability of this weed to regenerate and reinvade following mechanical and chemical removal (integrated control). The USDA-ARS established The Area wide Management and Evaluation of *M. quinquenervia* (TAME Melaleuca) to facilitate the landscape level adoption and integration of biological control with conventional control tactics. Over two million biological control agents were redistributed throughout the melaleuca infested regions of Florida to augment their natural dispersal and promote biologically based management on private lands. As a result, flowering has been reduced by over 95% which has drastically impacted seed production, 85% of saplings and seedlings are now killed, and there has been a fourfold increase in biodiversity. Melaleuca is now under control and the project is considered a major success.

High Resolution Cropland Data Layer. The National Agricultural Statistics Service provides additional data on crop conditions, soil moisture, and/or drought monitoring by publishing cropland data layer technology for all 48 contiguous states. NASS completed its second 48 state Cropland Data Layer (CDL) in 2011 for the 2010 crop year. The 2010 CDL was produced at a higher resolution of 30 meter pixels verses the 56 meter pixels for the 2009 CDL. The higher resolution improves the accuracy of the classifications and the precision of the acreage estimates, generated for 41 states and 18 different crops.

Nitrogen in Agricultural Systems and Conservation Policy. Culminating a major interagency effort by ERS and Agricultural Research Service (ARS) researchers, the ERS report Nitrogen in Agricultural Systems: Implications for Conservation Policy describes nitrogen's ability to affect the environment, and examines the degree to which it is inappropriately applied for agricultural uses and the pros and cons of programs and policies for improving its use. Water quality impairments from nitrogen are an important environmental issue for the Environmental Protection Agency (EPA) - the EPA has been given three different briefings on this research report's findings. Our research findings are helping EPA evaluate State watershed implementation plans in the Chesapeake Bay watershed and elsewhere.

Goal 4. Nutrition and Childhood Obesity

The Research, Education, and Economics Mission Area agencies build the evidence base for food-based and physical activity strategies and develop effective education/extension translational activities to promote health and reduce malnutrition and obesity in children and high-risk populations.

Smith-Lever 3(d) Funding and the Expanded Food and Nutrition Education Program. The Expanded Food and Nutrition Education Program (EFNEP) program continues to be highly effective in changing participants' behaviors, resulting in significant improvements in daily living skills. Ninety-four percent of adults reported improvements in their diets including consuming the equivalent of nearly one additional cup of fruits and vegetables, 84 percent of recent graduates improved food management practices, 89 percent improved nutrition practices, and 67 percent improved food safety practices. Multiple cost-benefit studies in past years show that every dollar invested in EFNEP results in $3.63 to $10.64 in saved health care costs and

$2.48 saved in food expenditures. State success examples include: The University of Kentucky EFNEP reported that 98 percent of EFNEP program participants made an improvement in the nutritional quality of their diets. The University of Rhode Island EFNEP reported over 82 percent of its EFNEP families showed improvement in one or more nutritional practices.

Intensive lifestyle changes needed to help children prevent obesity. Although many factors contribute to development of obesity, many interventions target a single factor such as one food group or exercise and follow subjects for relatively short periods of time. ARS-supported scientists at Houston, Texas, found that focusing on improved eating and exercise habits using behavioral modification strategies to individualize plans led to decreases in body mass index, subcutaneous fat, serum cholesterol and triglycerides in a group of overweight Mexican-American adolescents and these changes were maintained over 2 years. These findings indicate the benefit of intensive, daily intervention and point to future development of more cost-effective programs that can achieve the same benefits.

USDA Food Desert Locator Tool. In May 2011, ERS released a new mapping tool, the *USDA Food Desert Locator* tool -- an internet-based mapping tool that pinpoints the location of food deserts around the country. It provides data on population characteristics of census tracts where residents have limited access to affordable and nutritious foods. The Food Desert Locator tool is used along with other data being developed across the country for Healthy Food Finance Initiative (HFFI) grant applications. In addition, the Locator Tool has also been used by food retailers to identify underserved communities for new store locations and health and nutrition researchers investigating the impact of food access and the food environment on food choices and health outcomes.

Food Security Status of Americans. Each year, ERS calculates and reports on the food security status of Americans. The latest report, Household Food Security in the United States in 2010, found that an estimated 85.5 percent of American households were food secure throughout the entire year in 2010, meaning that they had access at all times to enough food for an active, healthy life for all household members. The remaining households (14.5 percent) were food insecure at least some time during the year, including 5.4 percent with very low food security—meaning that the food intake of one or more household members was reduced and their eating patterns were disrupted at times during the year because the household lacked money and other resources for food. The prevalence rate of very low food security declined from 5.7 percent in 2009, while the change in food insecurity overall (from 14.7 percent in 2009) was not statistically significant. The typical food-secure household spent 27 percent more on food than the typical food-insecure household of the same size and household composition. Fifty-nine percent of all food-insecure households participated in one or more of the three largest Federal food and nutrition assistance programs during the month prior to the 2010 survey.

ARRA and SNAP. The American Recovery and Reinvestment Act of 2009 increased benefit levels for the Supplemental Nutrition Assistance Program (SNAP) and expanded SNAP eligibility for jobless adults without children. The ERS study *Food Security improved following the American Recovery and Reinvestment Act of 2009 (ARRA) increase in SNAP Benefits* shows that that food expenditures by low-income households increased by about 5.4 percent and their food insecurity declined by 2.2 percentage points from 2008 to 2009. Food security did not

improve for households with incomes somewhat above the SNAP eligibility range. These findings suggest that the ARRA SNAP enhancements contributed substantially to improvements for low-income households.

Goal 5. Food Safety

The production, processing, and distribution system for food in the U.S. is a diverse, extensive, and easily accessible system. This open system is vulnerable to the introduction of contaminants through natural processes and global commerce, and by intentional means. Research, Education, and Economics Mission Area agencies provide the means to ensure that the food supply is safe and secure for consumers, and that the food and feed meet domestic and foreign regulatory requirements. Accomplishments and outcomes are utilized in national and international strategies delivering research results to regulatory agencies, commodity organizations, industry, and consumers.

Foodborne Illness Cost Calculator. The ERS *Foodborne Illness Cost Calculator* provides information on the assumptions behind foodborne illness cost estimates—and gives users the opportunity to make their own assumptions and to calculate their own cost estimates. ERS's estimates of the costs of illness and premature death for a number of foodborne illnesses have been used in regulatory cost-benefit and impact analyses. Like all cost estimates, the ERS estimates include assumptions about disease incidence, outcome severity, and the level of medical, productivity, and disutility costs. Changes to any of these assumptions could change the cost estimates and as a result, change the way policy makers rank risks, prioritize spending, and formulate food safety policies.

AFRI Funding and E. coli. A project at the University of California is focusing on the factors affecting E. coli O157:H7 survival on lettuce. Researchers suggest the project outcome can be used for improved control measures aimed at mitigating the risk of the organism surviving after a contamination event. Developers established a laboratory system to measure the growth and survival of virulent and attenuated E. coli O157:H7 isolates in the growth chamber on lettuce exposed to environmental regimes that mimic those found in the field. The identification of the factors influencing the survival of E. coli O157:H7 on lettuce is expected to develop agricultural practices that may reduce outbreaks associated with these economically valuable and otherwise healthy crops.

1890 Institutions and Foodborne Illness. The National Institute of Food and Agriculture funded research scientists and extension personnel at the Southern University Agricultural Center in Louisiana collaborated to inform the citizens of Louisiana the impacts of food borne illnesses. The goal was to help citizens, especially the elderly, low income, educationally disadvantaged and poor families, enhance their skills in proper food selection, storage and preparation. To ensure sustainable and safe food production practices, research and educational information was also directed at producers, food businesses and food handlers. Nutrition educators reached over 2,965 families with 95 percent of the participants learning how to make their own healthy snacks and adhering to food safety guidelines. Additionally, 90 percent of all participants can now correctly identify healthy foods, 89 percent can correctly read the nutrition facts label, 90 percent practice comparison shopping, and 70 percent plan meals.

Recent foodborne outbreaks have increased the awareness that certain Shiga toxin-producing E. coli (STEC) serogroups, including E. coli O26, O45, O103, O111, O121, and O145 cause a similar illness in humans as E. coli O157:H7. Since these "top six" non-O157 STEC serogroups can be as dangerous as E. coli O157:H7, the USDA Food Safety and Inspection Service (FSIS) has very recently declared these STEC as adulterants in beef. At the request of the FSIS, ARS researchers at Wyndmoor, Pennsylvania, developed a step-wise protocol to detect and identify and characterize these non-O157 STEC pathogens in beef. The steps consist of enrichment, detection by the polymerase chain reaction targeting important genes involved in the disease process and serogroup-specific genes, and strain isolation. Further, ARS developed, evaluated, and transferred a latex agglutination test (LAT) for confirmation of the STECs. The method for developing and purifying the polyclonal antibodies used in the LAT assay was released early so as to allow commercialization and availability to industry, a critical concern for FSIS. The impact of developing the detection, isolation and confirmation for the non-O157 STEC protocol cannot be overestimated. Although regulatory/industry monitoring for non-O157 STECs has now been postponed from March 2012 to June 2012 the technology ARS developed will be employed by the FSIS and industry to monitor through regulations these important pathogens in beef.

Faster and better methods of analysis to monitor pesticide residues in foods. ARS researchers at Wyndmoor, Pennsylvania, validated both qualitatively and quantitatively the updated QuEChERS (quick, easy, cheap, effective, rugged, and safe) version coupled to low-pressure gas chromatography-tandem mass spectrometry for fast analysis of 150 pesticides in a variety of foods including, cantaloupe, broccoli, lemon, sweet potato, and catfish. The enhanced selectivity and sensitivity of this technology allowed pesticide residues to be separated in less than 7 minutes and to achieve less than 5ng/g limits of quantification. Qualitatively, no false positives or false negatives were observed for randomly spiked and blinded extracts at contamination levels greater than 10ng/g in the different matrices. The impact of this technology development is very high. This is a new state-of-the-art method of analysis to be implemented by the FSIS National Residue Program, be transferred to the FDA Center for Veterinary Medicine for validation by this agency for their use, and will be evaluated in an AOAC International collaborative study for enhanced technology transfer to regulatory monitoring laboratories around the world. The method is likely to become the "international gold standard" for monitoring pesticide residues in foods.

Noroviruses are the most frequent cause of outbreaks of foodborne illness in the U.S. and other parts of the world. Illnesses caused by the consumption of virus contaminated shellfish are a worldwide problem and result in severe economic closes to the shellfish industry due to product recalls. Interventions such as depuration do not work for viruses, and while cooking does kill the virus, it also alters the organoleptic qualities of the shellfish meat. ARS, in collaboration with academia and industry, evaluated the use of high hydrostatic pressure (HHP) technology as a commercial intervention. HHP is known to maintain the appearance, quality and texture of foods and could serve as a practical application facilitating the shucking process by separating meat from the shell. The research showed that murine norovirus, a surrogate for human Norovirus, and hepatitis A virus, in both shucked oyster meat and in whole in-shell oysters were inactivated by HPP. Shellfish producers in Washington State employ HHP technology for processing and developing oyster products. These HHP products are exported internationally due to their high

quality, safety and extended shelf-life. Further, ARS researchers at Dover, Delaware, collaborated with the University of Bari, Italy, to confirm that HHP was a viable intervention for eliminating hepatitis A virus in commercial blue mussels from the Mediterranean. HHP is now being evaluated in Italy as an alternative to commercial mussel depuration.

Goal 6. Education and Science Literacy

The Research, Education, and Economics Mission Area agencies play an important role in the recruitment, cultivation, and development of the next generation of scientists, leaders, and highly-skilled workforce for food, agriculture, natural resource, forestry, environmental systems, and life sciences. If America is going to hold its leadership position in the global economy, it is vital that we leverage the talents and skills of students across the broad spectrum of economic, ethnic, and social segments of the U.S.

Hispanic Serving Institutions Education Grants Program. Reedley College in California, partnered with California State University, Fresno; California Polytechnic State University, San Luis Obispo; University of California, Davis; California State University, Chico; the Kearney Agriculture Research Center (California) and USDA to develop and implement a competitive agricultural leadership and education program. The program supports undergraduate and graduate students from underrepresented groups to prepare them for careers in and related to the food, agriculture and natural resource system. As a result of this program, survey results revealed that 90 percent of the participants increased their knowledge of California agricultural issues. Also there was a 14 percent increase of freshmen declaring agricultural majors.

1890 Institutions Capacity Building Grants Program. A Kentucky State University (KSU) teaching project implemented biotechnology training from middle school through post-secondary education. The project presented summer workshops for middle school and high school students, K-12 teachers, and non-traditional students, and enhanced current biotechnology-related courses at the university. This project had positive effects on the participating KSU undergraduate students. Students learned modern techniques, scientific thinking, and transferable skills in a laboratorial environment with the goal of enhancing their interests and confidence in science, technology, engineering, and mathematics fields.

Tribal Colleges Education Equity Grants Program. Educators at North Dakota's Turtle Mountain Community College are developing and implementing two new degree based curricula in Plant Sciences and Natural Resources. The project is expanding opportunities for Native American agricultural education in areas that address community needs. The Plant Sciences curriculum is focused on the areas of Horticulture, Gardening and Greenhouse operations. The Natural Resources curriculum is enhances development in culturally appropriate areas that include Global Positioning System/Geographic Information Systems (GPS/GIS), fish and wildlife and environmental ecology. This project has impacted the community by providing gardening activities, entrepreneurship training, GPS/GIS training for secondary science teachers and computer technicians. Additionally, the entrepreneurship program provided ideas for cottage industries and small businesses for over 200 persons.

NASS and the USDA-1890 National Scholars Program. The National Agricultural Statistics Service worked closely with USDA-1890 National Scholars Program to establish a two year scholarship option to complement the traditional four year option. This additional flexibility provides more incentive for the agencies to participate in the program. There are several benefits such as proven academic performance at the university level, scholars are available to join the workforce sooner, agencies may sponsor two students for the price of one, and it helps agencies improve staff diversity goals.

Goal 7. Rural Prosperity/Rural-Urban Interdependence

A central element in the debate about the future of rural America is how rural areas position themselves to better compete in a global environment where skills, knowledge, and innovation are key drivers of economic growth and prosperity. Research, Education, and Economics Mission Area agencies provide effective research, education, and extension that inform public and private decisionmaking in support of rural and community development.

Hatch Act Funding for Small Business. Small businesses, including those in the agriculture and biotechnology fields, constitute the backbone of Maine's economy. Value-added contributions from the agriculture community leverage these positive impacts, including increased revenues and several employment opportunities for rural workers. University of Maine food scientists are helping Maine’s agricultural and biotechnology industries grow and find new markets for their products. Their work with a State biotechnology firm in the area of melamine/cyanuric acid analysis has helped the firm to refine its rapid assay kit and has led to the creation of several scientific research jobs.

Smith-Lever 3(b) and (c) Funding and Dairy Production. The total economic impact of one dairy animal is about $14,000, which includes the ripple effects from the milk production on the farm through the creation of products for human consumption. University of Missouri Extension provided educational programs to increase knowledge and understanding of pasture-based dairy systems, including classroom and on-farm workshops, discussion groups and mass media. In 2010, a new pasture-based dairy was started and several other producers began work toward establishing systems as the economy improves. As a result of such recent extension programs, growth in Missouri by new grazing dairies created $100 million in new investment, generated $40 million in annual milk sales, added $124 million in total output, and added 1,100 additional jobs to the State.

Beginning Farmers and Ranchers Program. The goal of a Pennsylvania Beginning Farmers and Ranchers program is to increase the success of beginning farmers and ranchers in the Southeast Region of Pennsylvania. Beginning farmers and ranchers in the region were trained in production, marketing, financial management and land acquisition skills necessary for successful farm entry. One year after completion of courses participants were surveyed which resulted in 89 percent of participants adopting new best practices. On average they adapted four new practices. Also as a result, 43 percent saw improved productivity increase due to new practices they adopted; and more than half, 58 percent, noted their new practice had improved their products' quality.

Outreach to Better Represent the Agricultural Population. The National Agricultural Statistics Service conducted outreach efforts to promote partnerships among colleges, universities, local and regional community-based organizations, and field based organizations to identify and address the needs of underserved populations. As the Census of Agriculture data show, NASS increased the counts of operators for the minority populations and for female operators, demonstrating the agency's commitment to better serve and represent the entire agricultural population in the Census figures. As a result of a request from several of the CBO partners, NASS developed a database of statistics based on race, ethnicity, and gender that is now available at the county level. These micro-level data are invaluable to the CBOs and university partners as a means to identify populations that CBOs and academia can reach out to and help educate these producers about USDA programs. The data are also being used by agency staff, legislators, and researchers.

2012 Census of Agriculture Preparation. In preparation for the 2012 Census of Agriculture, NASS focuses great effort on building and maintaining a list of farms and ranches. Over the last three years NASS has conducted three pre-census screening surveys aimed at extending and improving coverage of U.S. farms. The final screener, mailed out in December 2011, reached over one million potential new farms. This extensive screening process is critical for developing a proficient mail list that covers sales, production, production practices, and operator characteristics in providing an accurate snapshot of American agriculture. During these list building processes, NASS has a keen focus on expanding coverage of minority populations and specialty commodities. Since the last census of agriculture, NASS has enhanced and expanded partnerships with Community Based Organizations to gather more lists of potential farmers and ranchers and increase awareness of the importance of responding to the Ag Census. NASS staff continuously evaluates the coverage of its farm's database and often directs staff in field offices to target particular commodities that are known to have less coverage, such as specialty livestock.

ERS Studies Outmigration. The Economic Research Service produces new knowledge about the economic and social forces that encourage return migration to geographically disadvantaged (remote, low-amenity) rural areas, with emphasis on the role of local institutions and community leadership, as well as on the social, cultural, and educational opportunities. Population loss through net outmigration is endemic to many rural areas. The ERS report *Nonmetropolitan Outmigration Counties: Some Are Poor, Many Are Prosperous* showed that over a third of non-metro counties lost at least ten percent of their population through net outmigration over 1988-2008. Some of these counties have had very high poverty rates, substantial loss in manufacturing jobs, and high unemployment. Lack of economic opportunity was likely a major factor in their high outmigration. Most high net outmigration counties, however, are relatively prosperous, with low unemployment rates, low high school dropout rates, and average household incomes. For these counties, low population density and less appealing landscapes distinguish them from other nonmetro counties.