Introduction

ARS Annual Performance Report for FY 2012 and Performance Plan for FY 2013 - 2015

The Agricultural Research Service (ARS) was established on November 2, 1953, pursuant to authority vested in the Secretary of Agriculture by 5 U.S.C. 301 and Reorganization Plan No. 2 of 1953, and other authorities.

ARS is the principal in-house research agency of the U.S. Department of Agriculture (USDA). Congress first authorized federally supported agricultural research in the Organic Act of 1862, which established what is now USDA. That statute directed the Commissioner of Agriculture "... To acquire and preserve in his Department all information he can obtain by means of books and correspondence, and by practical and scientific experiments..." The scope of USDA's agricultural research programs has been expanded and extended more than 60 times since the Department was created.

ARS research is authorized by the Department of Agriculture Organic Act of 1862 (7 U.S.C. 2201 note), Agricultural Research Act of 1935 (7 U.S.C. 427), Research and Marketing Act of 1946 (P.L. 79-733), as amended (7 U.S.C. 427, 1621 note), Food and Agriculture Act of 1977 (P.L. 95-113), as amended (7 U.S.C. 1281 note), Food Security Act of 1985 (P.L. 99-198) (7 U.S.C. 3101 note), Food, Agriculture, Conservation, and Trade Act of 1990 (P.L. 101-624) (7 U.S.C. 1421 note), Federal Agriculture Improvement and Reform Act of 1996 (P.L. 104-127), and Agricultural Research, Extension, and Education Reform Act of 1998 (P.L. 105-185). ARS derived most of its objectives from statutory language, specifically the “Purposes of Agricultural Research, Extension, and Education” set forth in Section 801 of FAIR.

The ARS mission 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.

The Agency’s research focuses on achieving the goals identified in the USDA and Research, Education, and Economics (REE) mission area Strategic Plans. The Government Performance and Results Act (GPRA) mandates each agency to establish general goals that will contribute to achieving beneficial societal outcomes that shape and drive the work of the Agency during the five years covered by the plan.

Verification, Validation and Program Evaluation: ARS conducts a series of review processes designed to ensure the relevance and quality of its research work and to maintain the highest possible standards for its scientists. This process involves customer input to help keep the research focused on the needs of the American food and agricultural system. Each of the approximately 1,000 research projects, which are organized into 22 National Programs, undergoes a thorough independent external prospective peer review conducted by the Office of Scientific Quality Review (OSQR). All ARS employees, including the scientific workforce, are subject to annual performance reviews. Senior scientists undergo a rigorous peer review (Research Position Evaluation System-RPES) on a 3- to 5-year cycle. These processes ensure the continuing high quality output of the ARS research addressing the needs of American agriculture.

Beginning in FY 2005, ARS' National Program Leaders (NPLs) and Area Directors annually review more than 1,000 research projects by applying the **Research and Development (R&D) Investment Criteria** of **relevancy**, **performance**, and **quality**. The information gained from this review helps the Agency identify low performing and/or low priority research. This information is used in shaping the annual budget; it is also be used to make future program management decisions. The R&D investment criteria are applied as follows:

- For **relevance**, the NPLs assess whether ARS' research is consistent with the Agency's mission and relevant to the needs of American agriculture, as identified by the Administration and ARS' customers and stakeholders.
- For **performance**, the NPLs review the annual project reports submitted by each research unit. Beginning with FY 2004, these reports provided information on how well each research project did in achieving the milestones in its Project Plan.
- For **quality**, the Area Directors rely on data from the ARS OSQR reviews of each research project at the beginning of its 5-year program cycle. OSQR conducts rigorous reviews of ARS' research projects by independent external peer panels to ensure their quality. In addition, the Area Directors use information from the RPES reviews of individual scientists in making this assessment. RPES conducts rigorous peer reviews of ARS' scientists on a regular schedule (i.e., every three, four, or five years). The Area Directors also assess the capacity (i.e., facilities, human and fiscal resources, equipment, etc.) of each project to meet its research objectives, an important consideration for intramural programs.

The National Programs focus the work of the Agency on achieving the goals defined in the ARS Strategic Plan 2003-2007. The research priorities for each National Program are established with extensive input from customers, stakeholders, and partners, which is received, in part, at a series of National Program Workshops. A detailed Action Plan developed for each National Program is available on the ARS home page, www.ars.usda.gov; open "Research" and select the National Program of interest. The GPRA Annual Performance Plans, the GPRA Annual Performance Reports, and the National Program Annual Reports which serve to keep the work of the Agency focused on achieving the goals established in the ARS Strategic Plan are also available on this website. The aggregate effect of these processes is a strengthened research program and an accountability system that measures more effectively the progress made towards achieving established goals and outcomes.

Key External Factors that Affect the Ability of ARS to Achieve its Goals and Objectives: The future of American agriculture depends on its ability to respond to critical external factors. Effective planning within ARS will take these factors into consideration when establishing and executing the Agency's research programs.

Globalization: The globalization of all aspects of the food and fiber system is having a major impact on American agriculture. Profound changes are seen worldwide from competitive markets around the world, from diseases not limited to national boundaries, to population growth and evolving diets. These changes have led to a dramatically new trade environment, threats of exotic diseases and pests to domestic production, and international controversies over the use of biotechnology. To remain competitive, the food and agriculture sector needs to respond to these developments.

Information Access and Communication: The explosion of information technology, the worldwide use of the Internet, and the major advancements of cyberspace communications are changing the way private industry, government, and individuals conduct daily business. Vast amounts of information are available in "real time," more people from around the world will be able to retrieve the information, and advanced computer software will make the information more useful and meaningful. Advancements in communication technology offer benefits and opportunities for everyone involved in the American food and agriculture sector.

Workforce: A very important employment issue is the need to recruit and retain a highly skilled and technically well trained Federal workforce. The relatively low U.S. unemployment rate makes recruitment

highly competitive. This competitive environment is expected to require more employer emphasis on recruitment, retention, student employment, upward mobility, and training/retraining programs. The public sector will need to recruit a diversity of people and to maintain a highly qualified and technically competent workforce. Expanding job opportunities for women and minorities in science and engineering will help to tap the Nation's human potential.

Technology: Advances in technology--such as bioengineering, precision agriculture, remote sensing, and decision modeling--enable agricultural production to enhance nutrition, protect the environment, and continue to make the food supply safe. Biotechnology offers great promise for increasing production efficiency, improving food quality, and enhancing nutritional value. However, concerns about genetically modified organisms (GMOs) have had a marked impact on international exports of affected commodities, and prompted questions about the potential benefits and risks. Precision agriculture, remote sensing, and decision modeling will both increase production efficiency and mitigate adverse environmental impacts of agriculture. Public concern about food safety has led to new rapid detection technologies that, when fully implemented, will make the food supply safer.

Changing Demographics: Growing global populations, demographic changes, and economic growth will substantially increase the demand for agricultural products, thus creating new markets for U.S. products. At the same time, however, increased agricultural competitiveness from other countries will force U.S. agriculture to become more efficient. Because arable agricultural land is limited, the growing demands will increase pressure to maximize yields, protect marginal areas from unsustainable development, and minimize the harmful effects of agriculture on the environment and the natural resource base.

Changing Structure of Agriculture: The structure of the food and fiber system--from farm to market--changed dramatically in the last decades of the 20th century, and is likely to continue. Change can be seen all across the food and agriculture sectors. An increasing share of U.S. food and fiber is being produced on fewer, larger, and more specialized farms. Production and marketing are more vertically and horizontally integrated. Concentration is greater causing sharp declines in the number of buyers and sellers of a product. Consumer preferences, new technologies, and global markets bring about continuing changes that affect farmers, processors, marketers, and consumers.

Congressional Support: The ability of ARS to respond to the diverse needs of producers and consumers is determined by the level of Congressional support. As a consequence of inflation and higher operating costs associated with advances in research equipment and technology, the ARS scientific workforce, which reached a maximum of about 3,400 scientists in 1970, decreased by almost 40 percent during the ensuing 25 years. More recently, appropriations have allowed the Agency to expand its research program and hire additional scientists to bring the current number of scientists to almost 2,200.

Drug-Free Workplace: ARS will continue to use the applicable contract clauses and regulations to ensure compliance with drug-free workplace debarment and suspension requirements in all of its acquisition programs.

General Comments: In January 1998, ARS requested a waiver from the Office of Management and Budget's (OMB) requirement "to describe specific and tangible products, steps, intermediate goals, and/or accomplishments that will demonstrate that the Agency has successfully met each Performance Measure/Goal in a given fiscal year." With OMB's concurrence, ARS is able to use narrative descriptions of intermediate outcomes and indicators of progress instead of numerical metrics as specified in GPRA. The research and technology transfer activities listed in this report are not all inclusive of the Agency's work. The reported accomplishments reflect, but do not adequately capture, the broad range of basic applied and developmental research that underpins the Agency's work.

Only Federal employees were involved in the preparation of this report.

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Strategic Goal 1:
Enhance International Competitiveness of American Agriculture

Expanding global markets for agricultural products is critical for the long-term economic health and prosperity of our food and agricultural sector. U.S. farmers have a wealth of natural resources, cutting-edge technologies, and a supporting infrastructure that result in a production capacity beyond domestic needs. Expanding global markets will increase demand for agricultural products and contribute directly to economic stability and prosperity for America's farmers.

To expand overseas markets and facilitate trade, various USDA agencies assist in the negotiation of new U.S. trade agreements, the monitoring and enforcement of existing trade agreements, the administration of market development and export promotion programs, and the adoption of science-based regulatory systems and standards. In supporting these USDA activities, ARS plays a significant role, particularly under Objective 1.3: Improve the Sanitary and Phytosanitary System to Facilitate Agricultural Trade. However, ARS research in this capacity falls under Goals 1 and Goal 4. In working to protect crops from diseases, ARS also enhances the international competitiveness of American agriculture. Therefore, ARS has elected to report this category of research under Objective 4.2: Reduce the Number, Severity, and Distribution of Agricultural Pest and Disease Outbreaks. Relevant information is reprinted under both Objective 1.3 and Objective 4.2 for the reader's convenience.

Objective 1.1: Expand and Maintain International Export Opportunities

Activities related to this objective are primarily carried out by other USDA agencies.

Objective 1.2: Support International Economic Development and Trade Capacity Building

Activities related to this objective are primarily carried out by other USDA agencies.

OBJECTIVE 1.3: IMPROVE THE SANITARY AND PHYTOSANITARY (SPS) SYSTEM TO FACILITATE AGRICULTURAL TRADE

Sanitary and Phytosanitary (SPS) barriers put in place to protect humans, animals, and plants from foreign pests, diseases, and contaminants continue to increase due to the lack of regulatory capacity in various countries and/or the lack of sound science. These technical barriers impede agricultural trade around the world. Reduced trade flows due to SPS barriers limit U.S. exports and efforts of developing countries to participate in and benefit from global trade. In response to these problems, USDA uses its extensive expertise and works closely with other U.S. agencies to strengthen regulatory coordination, streamline procedures to enhance trade, and encourage the use of sound science in addressing SPS and biotechnology issues.

ARS provides the sound scientific basis that USDA can use to work aggressively with its private sector trading partners and international organizations to develop a stronger system of international guidelines. These new guidelines will foster the widespread adoption of science-based regulatory systems, helping to protect the life and health of humans, animals and plants within the United States as well as facilitating trade.

Key Outcome: An improved global SPS system for facilitating agricultural trade.

The ARS research in support of Strategic Goal 1, Objective 1.3 is reported as Performance Measure 4.2.5 under Strategic Goal 4, Objective 4.2.

Strategic Goal 2:

Enhance the Competitiveness and Sustainability of Rural and Farm Economies

American consumers benefit from agricultural products that minimize their food costs and maximize their consumption choices. However, many within the agricultural production sector are suffering from low commodity prices that have remained relatively unchanged for decades, while the costs of fuels and other purchased inputs have continued to rise. The Nation's rural economic vitality depends on the ability of producers to profitably produce agricultural products, including food, fiber, industrial products, and fuels, while at the same time enhancing the natural resource base upon which crop and livestock production depends. Future financial success will depend on increasing productivity and production and conversion efficiencies, accessing new markets for specialized products, developing biobased technologies that provide new opportunities for U.S. farmers, and utilizing tools and information to mitigate risks and rapidly make adjustments to changing market conditions. Because there is great diversity in the farm sector driven by varying available resources, climate, and individual preferences, an equally diverse range of solutions is needed. Also, the needs, concerns, and opportunities of large farms may differ from those of smaller or intermediate sized farms, regardless of location. Therefore, research will need to provide producers options in terms of what is best for them for their respective circumstances.

ARS conducts basic and applied research to develop new and more efficient technologies and systems for producing and processing agricultural products that can enhance the efficiency and profitability of producers as well as provide improved and new products for consumers. ARS researchers work to produce biofuels and other biobased products that expand markets for agricultural products, reduce national dependence on foreign sources, and enhance environmental sustainability. ARS also promotes livestock and crop productivity through genetic and genomic research, and the development of technologies that enhance the economic value of agricultural products.

Objective 2.1: Expand Domestic Market Opportunities

Technological progress is creating new and expanded markets for agricultural products. New technologies will provide consumers with new and improved food, textiles, and fibers. Biobased technologies promise new opportunities for U.S. farmers to take advantage of energy and industrial markets. Currently, U.S. agriculture is the source of various products such as biopolymers, industrial chemicals and films, and clean burning bioethanol and biodiesel that are derived from plants and livestock byproducts rather than petroleum or other nonrenewable natural resources. New markets are also emerging for products and strategies to mitigate environmental concerns, such as the use of carbon sequestration to offset greenhouse gas emissions. ARS is in a position to bring biological and physical sciences together with engineering in a coordinated research program to expand a variety of market opportunities,

particularly for the sustainable commercial production of bioenergy, biofuels, and biobased products.

Performance Measures

Measure 2.1.1 Create new scientific knowledge and innovative technologies that represent scientific/technological advancements or breakthroughs applicable to bioenergy.

Baseline 2004
Four technological breakthroughs or scientific advancements that make significant contributions toward reducing the cost and increasing profitability, improving the efficiency, increasing the yield, and increasing the sustainability of producing or converting biobased feedstocks into biofuels.
Target 2012
Cumulatively, 24 technological breakthroughs or scientific advancements that make significant contributions toward reducing the cost and increasing profitability, improving the efficiency, increasing the yield, and increasing the sustainability of producing or converting biobased feedstocks into biofuels.

Indicator 1

During FY 2012, ARS will develop new or improved, or more environmentally friendly processing technologies.

FY 2012 Accomplishments*:*

New antimicrobials for controlling bacterial contamination in fuel ethanol plants. Antibiotics are routinely used to control bacterial contamination in fuel ethanol plants, but their use may be increasingly constrained by new strains of antibiotic-resistant bacteria or more stringent regulations to limit the presence of antibiotics in livestock feed. ARS scientists in Peoria, IL discovered laparaxin, a polypeptide produced by a lactobacillus, inhibits growth of bacteria that contaminates ethanol plants.

> ***Impact:*** Improved biorefinergy productivity by reducing yield losses that result from bacterial contamination.

Discovered inorganic activator for hemicellulase enzymes. The relatively high cost of enzymes that hydrolyze biomass is a key barrier to converting biomass into transportation fuels and co-products. ARS researchers in Peoria, IL discovered that adding inexpensive calcium increases the activity of an ARS-discovered b-xylosidase by an amazing 30-fold. The resulting dramatic reduction in the amount of enzyme required for reactions may be applicable to other enzymes and could help to enable commercial biorefineries to efficiently convert biomass into fuels and other biobased products.

Impact: There is a 30X increase in activity of enzyme that depolymerizes hemicelluloses into sugars that can then be converted into ethanol or other biofuels.

Indicator 2

During FY 2012, ARS will develop new or improved methods to measure or predict quality.

FY 2012 Accomplishments*:*

One-step analytical method for characterizing pyrolysis oil quality. Bio-oils produced from various biomass sources are complex chemical mixtures whose composition depends on the material processed. Characterizing bio-oils is challenging and requires several techniques. ARS researchers at Wyndmoor, Pennsylvania developed a rapid 13C nuclear magnetic resonance (NMR) method that can look at the entire bio-oil rather in one step.

***Impact*:** Enables one-step, rapid analysis method for pyrolysis oil quality.

Indicator 3

During FY 2012, ARS will develop technologies leading to new or improved products from renewable resources and agricultural residues and wastes.

FY 2012 Accomplishments*:*

Developed new yeast strain that can produce ethanol from pectin-rich feedstocks such as coffee or food processing wastes. Half of the coffee cherry is composed of cellulose-rich polysaccharides. USDA scientists at Peoria, Illinois developed a mutant yeast to convert coffee bean waste to ethanol at 46° C to prevent bacterial contamination without sterilization.

***Impact*:** Enables value-added ethanol fuel to be produced in rural communities from coffee wastes that would otherwise create environmental disposal problems.

Used catalysts to reduce the oxygen content of pyrolysis oil. ARS researchers in Wyndmoor, PA showed that zeolite catalysts used either inside or downstream of the pyrolysis reactor produce pyrolysis oils of much lower (17-20%) oxygen. With this technology, pyrolysis oil could be produced at or near farms where biomass is produced, thereby reducing biofuel prices due to high transportation costs. However, a major barrier to commercial pyrolysis oil production is its high oxygen content (~40%) relative to petroleum (<4%) that makes it corrosive and unstable. This new treatment makes pyrolysis oil stable.

***Impact*:** Reduces the corrosiveness of pyrolysis oil and thereby makes it a more stable, storable, and suitable for upgrading to heating oil or fuel.

Measure 2.1.1 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported on 5 technological breakthroughs or scientific advancements that made significant contributions toward reducing the cost and increasing profitability, improving the efficiency, increasing the yield, and increasing the sustainability of producing or converting biobased feedstocks into biofuels.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
New antimicrobial for ethanol producing biorefineries	Patent application	All ethanol biorefineries	Reduce waste and improve profitability for ethanol producers.
Inorganic enzyme activator for stabilizing pyrolysis oil	Scientific publication	Possible use by all advanced biorefineries	Reduce biorefinery costs and increase profitability
One-step analytical method for characterizing pyrolysis oil quality	Scientific publications	Possible use by all advanced biofuel biorefineries	Increased efficiency and profitability in pyrolysis-based biorefineries
New yeast strain to convert coffee processing waste to ethanol	Patent application, technology adoption as a part of the U.S. State Department supported Energy Climate Partnership of the Americas (ECPA)	U.S. State Department and USDA Foreign Agricultural Service; coffee producers world-wide, particularly those remote from existing power grids; and for applications by many food processing facilities	Increased profitability and reduced waste disposal to surface waters, a contribution that contributes to rural community sustainability in developing countries
Enable catalytic pyrolysis technologies	Two CRADA with private partner, Scientific publications	All pyrolysis-based biorefineries	Increased profitability in pyrolysis-based biorefineries

Measure 1.2.3 : Develop technologies to enable sustainable commercial production of bioenergy feedstocks and other biofuels. (Formerly 2.1.1)

Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

enable technologies that can reduce business risks, increase the value of co-products, and/or expand the number of revenue streams for existing biorefineries.

enable technologies for the production of new biofuels which are compatible with the Nation's existing fuel distribution infrastructure.

During FY 2014, ARS will

enable technologies that can reduce business risks, increase the value of co-products, and/or expand the number of revenue streams for existing biorefineries.

enable technologies for the production of new biofuels which are compatible with the Nation's existing fuel distribution infrastructure.

During FY 2015, ARS will

enable technologies that can reduce business risks, increase the value of co-products, and/or expand the number of revenue streams for existing biorefineries.

enable technologies for the production of new biofuels which are compatible with the Nation's existing fuel distribution infrastructure.

Measure 2.1.2 Develop cost effective, functional industrial and consumer products, including higher quality, healthy foods, that satisfy consumer demand in the United States and abroad.

Baseline 2004
Non-food, non-fuel biobased products derived from renewable agricultural resources represent a small fraction of the market for petroleum-based industrial products and some are not yet economically competitive. Also, many agricultural products are marketed as low-value commodities, with post-harvest spoilage decreasing return to producers. Healthy foods are often not convenient or readily accepted by significant numbers of consumers. In FY 2005, four new biobased products and food items with improved quality, nutritional or functional characteristics were developed by ARS and used by customers, both domestic and foreign.
Target 2012
Cumulatively, 20 new technologies developed by ARS and adopted for uses that provide food crops and products with higher quality and extended shelf life; convenient and acceptable healthy foods; non-food, non-fuel biobased products with cost and performance features comparable or superior to petroleum-based products; and valuable co-products from agricultural residues and processing wastes.

Indicator 1

During FY 2012, ARS will develop technologies leading to new or improved products from renewable agricultural resources, residues and wastes.

FY 2012 Accomplishments*:*

Significant reductions in greenhouse gas emissions for off-farm processors are practical only if processors know the energy hotspots in their dairy plants and if the costly upgrades will reduce greenhouse gas emissions. ARS scientists partnered with dairy processors, creating a computer-based model of the fluid milk process to lower greenhouse gas emissions. This model can offer multiple ways of making changes in individual processing plants, and instantly calculate both greenhouse gas reductions and costs of implementing the changes. The model has been distributed to over 100 processors in the U.S. and should help the dairy industry realize its goal of reducing greenhouse gas emissions by 25 percent per gallon of milk by the year 2020

> ***Impact*:** This research provides the first real-time assessment of greenhouse gas emissions from dairy plants and models how to significantly reduce those emissions nation-wide by 2020.

While nanoparticles have attractive industrial properties, when used in liquids, over time, they bind together and fall out of solution becoming ineffective. ARS scientists developed a bio-degradable solution of protein nanoparticles when applied to solid surfaces like glass that spread out preventing the beading of water. Near-term application includes solar panels and side-windows on vehicles which have no wipers. This technology, applicable to the manufacturing of glass-window cleaners, is expected to show superiority over current, commercially available cleaners.

***Impact*:** This research helps provide bio-products that improve safety and function by eliminating beading of water on glass solar panels and windshields.

The promise of nanotechnology to add value to agricultural applications has been slowed by the inability to scale-up production of nano-materials and be cost-effective. ARS scientists have developed a new 'blow'-spinning process to produce nano-materials, which is much cheaper and rapidly scaled-up compared to the industry standard, electrospinning. The specific advantages of nano-scale 'blow'-spinning are: a higher fiber production rate, an ability to scale-up production using inexpensive commercially-available components, an ability to 'blow' nano-materials onto surfaces without consideration of their electrical charge, relative portability, and cost savings in that high-voltage equipment is not required. Currently 'blow'-spinning, using biobased materials, is being tested by a large convenience-food company to reduce "noisy" packages.

***Impact*:** This research helps advance nanotechnology through the newly developed 'blow'-spinning process which improves nano-material production rate and reduces costs.

Current lubricant additives require the use of phosphorous, zinc, and sulfur in order to be effective, but can react with water, forming acids that corrode engine parts and bearings, and they are often incompatible with plant (bio-based) lubricants. ARS scientists in collaboration with an industrial partner have synthesized new organic additives, made primarily from boron compounds, for formulations utilizing gel-stabilized (hardened/epoxidized) bio-based oils. From this research, anti-wear and anti-oxidation, boron additives have been shown to be highly effective with soybean oil lubricants.

***Impact*:** This research helps in the creation of new bio-based lubricants which can be used in a wide variety of industrial applications.

Indicator 2

During FY 2012, ARS will develop new or improved methods to measure or predict quality, or to sort by quality.

FY 2012 Accomplishments*:*

Single-grain wheat sorting is traditionally a human hand-held visual detection of mold, weather, disease, and storage damaged grains. Although several attempts have been made over the decades to develop instrument based alternatives, inspection still remains a challenge. ARS scientists have developed a digital imaging system that captures images of individual seeds in freefall. The digital imaging system, coupled with rapid-image processing, surface scans greater than 82 percent of each seed during high speed sorting. This new system will impact the inspection/grading of U.S. wheat and its trading and milling industries; and is being tested by a pharmaceutical company for assessing quality control of pill coatings. Licensing and patent applications are being filed.

***Impact*:** This research helps automate the U.S. grain inspection system.

Decay of fresh produce, especially small fruits like strawberries and blueberries, which cannot be pre-washed, contributes to a short postharvest shelf life. ARS scientists in collaboration with a CRADA partner, developed small, single use packets which when inserted into packaged fruit release an antimicrobial vapor (Curoxin®) that surrounds the fresh fruit. The vapor extended the postharvest shelf life of blueberries and strawberries by maintaining fruit firmness, reducing water loss and decay and maintaining color and overall quality. It was also used to treat citrus fruit infected with citrus canker. Canker is a problem for the fresh citrus market as fruit coming from

groves where canker is found cannot be marketed internationally. Packets, containing the vaporizing compound, placed inside containers of citrus significantly reduced bacterial canker counts. The antimicrobial vapor packets are being tested in pilot studies with commercial packing houses and could save the international fresh produce industry over $1 billion annually in costs incurred by postharvest losses.

> ***Impact*:** This research helps extend the postharvest shelf life of small fruits by maintaining fruit firmness, reducing water loss and decay, and maintaining color and overall quality.

Oat studies revealed that the 'soft-solid' characteristics of various oat carbohydrates (beta-glucan) provided creamer, less runny properties valuable for developing new functional foods such as yogurt, instant puddings, custard, batter, smoothies, and ice cream. ARS scientists developed the oat concentrates which appear to have great potential for health concerned consumers.

> ***Impact*:** This research promotes oats properties in developing new functional foods.

ARS scientists found that grape seed flour from white wine chardonnay grapes (a problematic waste byproduct of wine making), but not red grapes or grape skins, prevented increases in plasma cholesterol and weight gain in hamsters on a high fat diet. Changes in the metabolic pathways of cholesterol and fat metabolism supported the physiological observations. An invention disclosure has been submitted, and human clinical trials are underway at the Mayo Clinic.

> ***Impact*:** This research helps reduce wine industry grape-seed wastes and promotes white grape-seed flour as a functional food.

Currently, both defective and sound apple fruits are not sorted at harvest, but are combined, causing significant storage losses due to the defective fruits being susceptible to pest and disease infestation. The result is costly postharvest handling to remove unmarketable fruits. ARS scientists developed an in-orchard mobile system which automatically sorts and grades apples into culls (defective), processing, and fresh-market quality fruits by measuring fruit color, size, shape and weight using color-imaging, machine-vision technology. This system incorporates harvest aid functions to reduce safety hazards for fruit harvesters. This technology will enable apple growers to leave defective fruit in the orchard, resulting in less postharvest disease/pest problems and lowering postharvest storage and packing costs, and will assure a better fruit quality inventory at the warehouse. The Michigan Apple Industry Committee is testing this novel harvesting aid in commercial orchards.

> ***Impact*:** This in-orchard apple harvesting aid helps promote consistently best-quality postharvest fruit.

Measure 2.1.2 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported on 9 new technologies adopted for uses that provide food crops and products with higher quality and extended shelf life; convenient and acceptable healthy foods; non-food, non-fuel biobased products with cost and performance features

comparable or superior to petroleum-based products; and valuable co-products from agricultural residues and processing wastes that are in use.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
Lowering greenhouse gas emission in dairy plants	Technology being tested by industry	Dairy plants	Provides a real-time reduction in dairy plant greenhouse gas emissions
Plant protein-based nanoparticles that eliminate beading of water	Technology is being patented and tested by glass-cleaning industry	Glass-cleaning industry	Improves safety and function by eliminating beading of water
Improved production of nanofibers at reduced cost	Technology is being patented and tested by industry	US packing industry	Faster production and lower cost nanomaterils
Bio-based lubricants made from boron	Technology is being tested by industry	Bio-based lubricant industry	New bio-based lubricants which can be used in a wide variety of industrial applications
Automated US grain inspection system	Technology is being used by US grain inspection service and pharmaceutical industry	US grain inspection service and pharmaceutical industry	New rapid digital-imaging wheat sorting system
Fresh produce packaging inserts reduce decay and extend postharvest shelf-life	Technology is being tested by industry	US and international fresh produce industry	Packaging inserts that fights decay of fresh produce
Oats properties unique in developing new functional foods	Industrial partner has licensed this patented product	Functional food industry and USDA school lunch program	New healthy functional foods from oats
White grape-seed flour is a potentially cholesterol - lowering functional food.	An invention disclosure has been submitted	US wine and functional food industries	White grape seed-flour may lower cholesterol and weight gain
Novel apple harvesting aid assures better quality fruit	Michigan Apple Industry is testing this harvesting aid in commercial orchards	US fruit-tree industry	A computerized, in-orchard, apple sorting harvesting aid

Measure 1.1.3 : Develop methods and technologies to better define, measure, preserve or enhance qulaity and improve utilization of food crops, animals and agriculutral fibers, as well as non-food, non-fuel biobased products and sustainable technologies/processes. (Formerly 2.1.2)
Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

Develop technologies leading to new or improved products from bio-based (agricultural) renewable resources, residues, and wastes

Develop new or improved methods to measure or predict marketable and or nutritional quality, or to sort by quality

During FY 2014, ARS will

Develop technologies leading to new or improved products from bio-based (agricultural) renewable resources, residues, and wastes

Develop new or improved methods to measure or predict marketable and or nutritional quality, or to sort by quality

During FY 2015, ARS will

Develop technologies leading to new or improved products from bio-based (agricultural) renewable resources, residues, and wastes

Develop new or improved methods to measure or predict marketable and or nutritional quality, or to sort by quality

OBJECTIVE 2.2: INCREASE THE EFFICIENCY OF DOMESTIC AGRICULTURAL PRODUCTION AND MARKETING SYSTEMS

Fundamental to the long-term sustainability of agricultural production is the maintenance of an efficient, profitable, and economically competitive operation. Intense competition in global markets and pressure on U.S. farm policy to reduce price supports continue to emphasize the need for American agriculture to pursue and market higher value agricultural products. Furthermore, U.S. agricultural production and marketability is constantly influenced by factors such as unpredictable weather, disease and pest outbreaks, and changing consumer demands. Research must respond to consumer demands for healthy and safe products to ensure a sustainable and profitable agricultural production system that capitalizes on an abundant source of raw material for value-added food, fiber, and industrial products. The resulting technologies must effectively differentiate U.S. agricultural products from competing sources and provide customers with value-added processes that enhance product quality and value.

ARS research programs work to develop and transfer technology and information that make up the centerpieces of an efficient and economically sustainable agricultural sector. To improve the value and production efficiency of American crops and crop production, ARS takes responsibility for maintaining genetically diverse germplasm resource collections, which protects our genetic resource base and aids in plant and animal genetic research. In addition, ARS develops and disseminates science-based information to help U.S. agricultural producers manage unforeseen risks from climate, weather, pests, and disease outbreaks. Through these activities, ARS works to improve production efficiency and productivity to maintain profitability while enhancing the natural resource base upon which agriculture depends.

Key Outcome: Information and technology producers can use to compete more economically in the market place.

Performance Measures

Measure 2.2.1 Develop systems and technologies to reduce production costs and risks while enhancing natural resource quality.

Baseline 2006
Twelve new technologies and systems developed and used by customers to reduce the cost and increase profitability, improve the efficiency, or increase yield, and increase the sustainability of production.

Target 2012
Cumulatively, 29 technologies and systems developed and used by customers that utilize new configurations of practices and technologies to reduce the cost and increase profitability, improve the efficiency, or increase the yield, and increase the sustainability of production.

Indicator 1

During FY 2012, ARS will develop new production practices and decision support tools that increase profitability and improve environmental quality.

FY 2012 Accomplishments*:*

Oat and rye cover crops substantially reduce nitrate losses in drainage water. Much of the nitrate in the Mississippi River comes from land used to produce corn and soybean. Cover crops grown between maturity and planting of these crops are one approach for reducing losses of nitrate. ARS scientists in Ames, Iowa, showed that a rye winter cover crop reduced the concentration of nitrate in drainage water by 48% over five years. The oat fall cover crop reduced nitrate concentrations by 26%.

> ***Impact*:** Both oat and rye cover crops are viable management options for reducing nitrate losses to the Mississippi River from land used for corn and soybean production.

Integrated crop-livestock systems maintain soil quality. Integrated crop-livestock systems, which combine crops and cattle, benefit farmers agronomically and economically. An unanswered question, however, is how livestock influence soil quality for succeeding crops. ARS scientists at Mandan, North Dakota compared the soil quality of an integrated winter grazing management system with perennial grass pastures, which are considered the “gold standard” for soil quality. After nine years of detailed observation, the soil quality of the integrated winter grazing system equaled that of the perennial grass system on these northern Great Plains soils.

> ***Impact*:** This new information will benefit farmers in the northern Great Plains by assuring them that they can graze crop residue without a negative impact on soil quality.

Powered rolling and crimping device for cover crop termination. In small vegetable/organic systems, bigger tractors are not used because they are too expensive, heavy, and large for small planting areas. Instead, 2-wheel walk-behind tractors and small implements are utilized widely, but there were no small rollers/crimpers available to effectively crimp and terminate cover crops without herbicides (as required in organic systems). An effective, low weight roller/crimper compatible with 2-wheel tractors was needed. An ARS scientist from the National Soil Dynamics Laboratory in Auburn, AL, developed a unique powered roller/crimper for self-propelled walk-behind tractors that allows growers with small farms to successfully terminate and manage cover crops without commercial herbicides.

> ***Impact*:** The development of this patented powered roller/crimper is important for small no-till organic vegetable systems, where commercial herbicides are banned, and traditional rollers are too heavy for limited power 2-wheel tractors and too large for narrow beds typical of smaller farms in the USA and worldwide.

Sheep grazing can help lower agricultural greenhouse gas emissions. ARS scientists from Sidney, Montana collaborated with scientists from Montana State University to show that using sheep to control weeds during fallow periods of crop rotations may also reduce greenhouse gas emissions. Currently, agriculture contributes about 6% of the United States' greenhouse gas emissions. A two-year study showed that sheep grazing has little impact on greenhouse gas emissions compared to the herbicide method of weed control under dryland cropping systems, while still maintaining crop yield and quality. Less intensive sheep grazing with reduced nitrogen fertilization rates can be used to mitigate greenhouse gas emissions and sustain crop yields.

> ***Impact*:** Both animal and crop producers may benefit from sheep grazing during fallow as an effective and potentially inexpensive method of weed control that not only can sustain crop yields, but also mitigate greenhouse gas emissions.

Measure 2.2.1 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported on 4 new technologies and systems developed and used by customers that utilize new configurations of practices and technologies to dreduce the cost and increase profitability, improve the efficiency or increase the yield, and increase the sustainability of production.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
Shared research data and ideas on growing tall cereal varieties and harvesting with a stripper header	Invited presentation at the Palouse and Clearwater Direct Seed Breakfast Meetings, Colfax, Washington, (October, 2011) and Lewiston, Idaho (November, 2011).	Information presented to growers, scientists, and conservation district personnel.	Shared research data and ideas on growing tall cereal varieties and harvesting with a stripper header
In-season nitrogen fertilization of winter wheat	Two oral presentations for non-science audiences at annual field day of Pendleton Agricultural Research Center.	Non-science audiences: Oregon Wheat Growers League, Washington Association of Wheat Growers, USDA-NRCS, Oregon Wheat Commission	In-season nitrogen fertilization of winter wheat
'Colorado Water Optimizer' is a spreadsheet decision tool for determining optimum crop selection, water allocation, and level of limited irrigation to different crops for maximum net return on a farm.	A Beta version of the Optimizer was provided to the CRADA partner along with the Crop Water Productions Functions described above for corn, wheat, and bean crops in several Colorado counties needed for the optimizer.	The ultimate customers are extension, other farm advisors, and farmers.	'Colorado Water Optimizer' is a spreadsheet decision tool for determining optimum crop selection, water allocation, and level of limited irrigation to different crops for maximum net return on a farm.
Demonstration of rolling/crimping technology for small limited power source tractors.	Three oral presentations including one international presentation. Southern Sustainable Agriculture Working Group in Little Rock, AR, Georgia Organics Annual Conference in Columbus, GA, International Conference of Agricultural Engineering (CIGR-AGENG) in Valencia, Spain	Other scientists, cooperative extension, producers, NRCS specialists, and industry professionals.	Demonstration of rolling/crimping technology for small limited power source tractors.

Measure 1.2.6: Develop integrated solutions to solve challenges related to agricultural system productivity, profitability, energy efficiency, and natural resource stewardship. (Formerly 2.2.1)
Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

develop integrated solutions to solve challenges related to agricultural system productivity, profitability, energy efficiency, and natural resource stewardship.

During FY 2014, ARS will

develop integrated solutions to solve challenges related to agricultural system productivity, profitability, energy efficiency, and natural resource stewardship.

During FY 2015, ARS will

develop integrated solutions to solve challenges related to agricultural system productivity, profitability, energy efficiency, and natural resource stewardship.

Measure 2.2.2 Develop new technologies, tools, and information contributing to improved precision animal production systems to meet current and future food animal production needs of diversified consumers, while simultaneously minimizing the environmental footprint of production systems and enhancing animal well-being.

Baseline 2006
Ten new technologies developed and used by ARS customers to increase production efficiency and enhance the economic value and well-being of U.S. food animal production while decreasing the environmental footprint of production systems.
Target 2012
Cumulatively, 35 new technologies developed and used by ARS customers.

Indicator 1

During FY 2012, ARS will identify underlying genetic and physiologic mechanisms impacting reproductive efficiency, nutrient conversion, and growth in food animals.

FY 2012 Accomplishments*:*

Commercial salmon producers in the Eastern U.S. are legally required to culture stocks certified to be of North American origin. Therefore they use stocks that are only a few generations removed from wild, unselected stocks with relatively poor performance under farming conditions. ARS researchers at the National Cold Water Marine Aquaculture Center at Franklin, Maine are selectively breeding salmon of North American origin for faster growth and evaluated the growth of salmon from their breeding program in commercial sea cages in collaboration with industry.

> ***Impact*:** A salmon line selected for increased growth, more than 50% larger than unselected control fish, has been generated and germplasm was released for commercial production. Genetic gain has been 7-10% per generation. Utilization of improved germplasm will increase the profitability and sustainability of coldwater marine aquaculture in the United States while providing a quality seafood product to U.S. consumers.

Sexual maturity affects growth and meat quality in most terrestrial livestock but little is known about their actions in fish. Understanding how sex steroids affect muscle growth and quality will enable development of strategies for more efficient fillet production. ARS researchers at the National Center of Cool and Cold Water Aquaculture at Leetown, West Virginia discovered increased rates of muscle protein degradation occur in sexually maturing rainbow trout with high sex steroid levels, even when feeding rate is high. Subsequent studies indicated that estrogens, but not androgens, act directly in muscle to reduce protein retention by both increasing rates of protein degradation and decreasing rates of protein synthesis.

***Impact*:** These data demonstrate that harvesting before sexual maturation and sex steroid exposure should result in the most efficient production of high quality fillets in the rainbow trout.

Finding novel antimicrobials that kill multi-drug resistant pathogens is a problem world-wide for both the livestock industries and human medicine. In collaboration with Spanish scientists, ARS scientists in Beltsville, MD identified a bacterial cell wall degrading protein from a virus of staphylococcus bacteria that when applied externally binds and kills Staphylococcus aureus bacteria. This protein was then fused to lysostaphin; another protein that is lethal for Staphylococcus aureus bacteria; and then to a third bacterial cell wall degrading protein. The combination of these three proteins effectively kills both bovine and human strains of Staphylococcus aureus, including multi-drug resistant strains. This 3 protein fusion strategy; to create cell wall degrading enzymes with multiple simultaneous lethal activities; is potentially applicable to any bacteria with externally exposed cell wall components and should enable production of antimicrobials that are highly refractory to resistance development while not targeting beneficial strains of bacteria.

***Impact**:* This novel fusion protein has the potential to effectively treat persistent mastitis on dairy farms and multi-drug resistant Staphylococcus aureus (MRSA) in human hospitals and clinics.

Cows excrete urea nitrogen in urine, which is converted rapidly to ammonia gas and volatized into the atmosphere. Milk urea nitrogen (MUN) testing was developed to help dairy producers and nutritionists evaluate protein levels and nitrogen use efficiency of dairy cattle diets. A large component of protein is nitrogen. ARS scientists at Madison, WI determined that MUN is also a reliable indicator of concentrations of urea nitrogen in urine and ammonia emissions from dairy farms. Six feeding trials were analyzed to determine the relationships between feed nitrogen intake, MUN, and ammonia emissions from dairy barns. Ammonia emissions dropped between 10% and 34% when MUN levels decreased relatively; while milk production and animal well-being were maintained.

Impact: Feeding less dietary nitrogen would save dairy producers approximately $740 million annually in reduced feed protein (nitrogen) costs while reducing the environmental footprint of the dairy industry through reduced ammonia (green house gas) emissions.

Indicator 2

During FY 2012, ARS will develop technologies leading to improved marketability of animal products.

FY 2012 Accomplishments*:*

Under fish farming conditions, fish are routinely exposed to crowding, handling and similar stressors. How fish respond to such stressors impacts their growth, feed efficiency, immune response, and reproductive development. Through genetic mapping approaches ARS researchers at the National Center for Cool and Cold Water Aquaculture (NCCCWA) at Leetown, West Virginia identified 8 chromosomal regions linked to stress response in rainbow trout and are measuring genetic variation for this trait within and between populations.

***Impact*:** This research will improve our understanding of the physiology of the stress response as well as provide a more rapid and accurate way to identify rainbow trout best able to perform well under routine farming stressors.

Feed is the highest variable cost in aquaculture production, with fish oil being one of the most expensive feed ingredients. Fish oil in trout feed is the primary source of the healthy omega-3 fatty acids EPA and DHA found in trout fillets. Scientists with the Small Grains and Potato Germplasm Research Unit in Aberdeen, Idaho evaluated the ability of several families of rainbow trout to convert plant oils to long chain omega-3 fatty acids and store them in their tissues. The study clearly demonstrated that genetic variation exists between families for this ability.

> ***Impact:*** Rearing rainbow trout improved for this trait should maintain the beneficial fatty acids currently found in trout fillets while reducing feed costs and the industry's current reliance on fish oil.

Previously, no links between CNV and phenotype differences in cattle were known. ARS scientists in Beltsville, MD, and Clay Center, NE using next-generation whole genome sequencing, completed the first comprehensive discovery of CNV in cattle in relation to phenotypic differences. CNV regions from indicine and taurine cattle were linked to genes associated with health and production traits including fertility, parasite resistance, and feed efficiency. In related research, ARS scientists evaluated over 700,000 genome markers in beef cattle for fertility. Evidence of CNV regions were found on all chromosomes associated with reproductive efficiency and a DNA region was identified specific to cattle that fail to conceive. These results were validated in over 300 Bos indicus x Bos taurus pregnant females confirming the negative impact of the CNV related gene deletions.

> ***Impact:*** These findings are a major step forward to identify components affecting genetic variation beyond typical mutations, which are not accounted for in current genetic evaluation systems, and will lead to greater genetic insight and greater genetic progress in cattle breeding programs. These results will also enable development of DNA marker tests to improve reproduction and production efficiencies for the beef industry.

Extensive genotyping of U.S. dairy populations by ARS scientists has revealed portions of the genome that contain five lethal mutations causing embryonic death. ARS scientists in Beltsville, MD discovered the causative mutations underlying two of these recessive lethal mutations in the Holstein and Jersey cattle breeds. The HH1 mutation in Holsteins caused a deletion of a gene and the deletion induces spontaneous abortion after the first trimester. This work was done in conjunction with the University of Illinois. The JH1 mutation in Jerseys causes a deletion of a gene important in regulating proper RNA splicing and the deletion induces spontaneous abortion during the first trimester of pregnancy. These relatively late term abortions are particularly costly, because affected cows would have been confirmed pregnant by the producer and would be receiving management appropriate for pregnant females. The subsequent abortion creates stress for the cow, increases costs, decreases efficiency and delays the onset of the next lactation.

> ***Impact:*** DNA tests for both mutations are now available to producers. Results are being used to guide future mating decisions in both breeds, thus increasing reproductive efficiency in dairy cows by preventing embryonic loss.

Indicator 3

During FY 2012, ARS will identify genes and their function leading to DNA tests for use in food animal genetic improvement programs.

FY 2012 Accomplishments*:*

Genetic security was increased from 675,000 units to 720,000 in 2012 at a time when globally, genetic diversity is contracting across livestock species. This problem was addressed by further

developing a comprehensive ex-situ cryopreserved germplasm collection. In addition the livestock sector has utilized 302 animals in the collection for research or for adding genetic diversity to live populations. By building and expanding the germplasm collection the livestock industry and research community are able to access the collection's genetic resources as needed. Genetic resources are increasingly considered to be national assets for increasing agricultural productivity and trade revenue. Using molecular DNA approaches it was shown that there were no significant differences between sheep from Kazakhstan (near the center of domestication) and the US. This discovery has significant ramifications for executing livestock conservation programs. In addition, the results provide insight that can be used in international discussions concerning the development of access and benefit sharing arrangements under the Nagoya Protocol of the Convention on Biological Diversity.

> ***Impact:*** The new germplasm acquisitions increased the level of genetic security for the livestock industry and research community. Industry can use these results in determining their options for utilization and exchange of genetic resources.

Indicator 4

During FY 2012, ARS will develop genomics infrastructure and tools that will enhance efficiency and speed of gene identification, and utilization of DNA data in genetic improvement programs of food animals.

FY 2012 Accomplishments*:*

High daily summertime feeding rates can result in concentrations of ammonia in pond water that are toxic to hybrid striped bass. In response, farmers may curtail feeding or switch to a lower protein feed, both of which reduce production. With input from Mississippi-based hybrid striped bass producer, Nature's Catch, scientists at the Stuttgart National Aquaculture Research Center demonstrated that a diet with higher digestible protein and fat that was supplemented with deficient amino acids, maximized growth and nutrient retention and reduced ammonia waste production.

> ***Impact*:** Fish feed manufacturers are using new digestibility coefficients, recently developed at this lab, in their diet formulations for hybrid striped bass, feeding the new summer diet formulation, and improving summer production.

Approximately 2 billion pounds of almonds are produced in the U.S. each year and approximately 25% is considered waste in the form of broken pieces and fines and is fed to cattle. Scientists with the Small Grains and Potato Germplasm Research Unit in Aberdeen, Idaho, in collaboration with U.S. based Adaptive Bio-Resources LLC, developed a process to partition this waste into several new products for both the human food and aquafeed markets. Trout feeding studies have demonstrated high digestibility and palatability for the ~60% protein almond meal.

> ***Impact:*** Identifying and developing new sources of plant-based protein for aquafeeds will increase the profitability and sustainability of aquaculture production and increase the value of co-products.

There is increasing production of fuel ethanol from grains in the U.S. and the primary co-product is corn distiller's dried grains with solubles (DDGS). The quantity of this relatively low value product is also increasing and is used primarily in cattle but its use for feeds is limited due to an imbalance of nutrients. Scientists with the Small Grains and Potato Germplasm Research Unit in Aberdeen, Idaho developed a new processing method that will produce more consistent, higher protein DDG and two new products, a protein and a mineral source with improved nutrient

profiles. Feeding trials with rainbow trout demonstrated that both products are highly digestible, which is vitally important to the trout industry.

Impact: This new process can be easily added to the existing process and it 1) reclaims valuable phosphorus and protein from the solubles and 2) separates the nutrients into distinct products, thus increasing the overall flexibility, economic value, and sustainability of ethanol production.

Measure 2.2.2 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported on 9 technological breakthroughs or scientific advancements that made significant contributions toward developing new technologies, tools, and information contributing to improved precision animal production systems to meet current and future food animal production needs of diversified consumers, while simultaneously minimizing the environmental footprint of production systems and enhancing animal well-being.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
Dairy industry genetic tests for fertility, a critical and high priority for the industry	DNA tests developed for commercial application	Dairy industry producers	Significantly improved reproductive efficiency for the dairy industry, resulting in greater production efficiency and lower costs of production.
Sheep industry genetic tests for susceptibility to Ovine Progressive Pneumonia	DNA tests developed for commercial application	Sheep industry producers	Significantly reduced incidence of OPP infections in the sheep industry, resulting in greater production efficiency and lower costs of production.
New semen preservation technology for turkey semen	A new extender formulation was developed for turkey industry use	Turkey industry producers	Sperm fertility in frozen semen was improved from 30 to 85% survival making the use of frozen semen a viable option for the turkey industry, resulting in greater production efficiency and lower costs of production.
Milk Urea Nitrogen (MUN) test developed to control Nitrogen/Ammonia emissions in the dairy industry.	MUN test developed to target more exact protein feeding levels in dairy rations.	Dairy industry stakeholders and environmental sustainability advocates.	Reduced protein costs produced annual savings of $740M to the dairy industry while reducing ammonia emissions by as much as a third.

An effective vaccine to protect against an emerging Weisella sp. like bacteria in trout.	Developed an autogenous vaccine at the request of industry for use in commercial trout production facilities	Trout industry producers	Early pathogen detection and the rapid development of a vaccine are aiding control efforts and reducing further pathogen dissemination in the U.S.
Improved salmon strains selected for 50% faster growth	Improved higher growth salmon strains released to industry for commercial application	Coldwater marine aquaculture industry	A 50% increase in growth rate results in improved production efficiency and lower costs of production for the industry
Catfish protected against enteric septicemia of catfish	A live attenuated vaccine and in-pond vaccination platform was developed for industry	Catfish industry producers	Feed conversion improved by 40%. Decreased feed costs of 30%. Increased gross sales of adopters of 100%.
New protein source for aquafeeds.	A 60% protein meal was developed using almond products.	Trout industry producers	Alternative plant based protein supplement will improve production efficiency and lower costs of production for the industry.
Improved summer diet formulations for hybrid striped bass	Diets higher in digestible protein and fat and supplemented with amino acids	Striped bass industry producers	Improved growth and reduced ammonia in summer diets improve production efficiency and lower costs of production for the industry.

Measure 1.4.1: Provide scientific information to maximize the production efficiency of our food animal production systems. Develop new technologies and tools contributing to improved those systems to meet current and future food animal production needs of diversified consumers, while ensuring economic and environmental sustainability and animal well-being. (Formerly 2.2.2)
Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

identify underlying genetic and/or physiologic mechanisms relating to food animal production and production efficiencies for traits associated with growth physiology, nutrient utilization, reproductive physiology, health, and well-being in food animals.

develop genomics infrastructure and tools to efficiently identify genes, their function, and interactions with environmental factors for exploitation in genome enabled improvement programs for food animals

develop and improve sustainable production systems for food animals; incorporating strategies to optimize production system efficiency while ensuring economic and environmental sustainability.

characterize nutrient requirements of food animals; measure nutrient availability of traditional and non-traditional feedstuffs; and develop strategies for improving nutrient use efficiency.

characterize food animal germplasm for traits of importance and continue to increase the inventory of germplasm stored within the National Animal Germplasm Repository to preserve biodiversity.

During FY 2014, ARS will

identify underlying genetic and/or physiologic mechanisms relating to food animal production and production efficiencies for traits associated with growth physiology, nutrient utilization, reproductive physiology, health, and well-being in food animals.

develop genomics infrastructure and tools to efficiently identify genes, their function, and interactions with environmental factors for exploitation in genome enabled improvement programs for food animals

develop and improve sustainable production systems for food animals; incorporating strategies to optimize production system efficiency while ensuring economic and environmental sustainability.

characterize nutrient requirements of food animals; measure nutrient availability of traditional and non-traditional feedstuffs; and develop strategies for improving nutrient use efficiency.

characterize food animal germplasm for traits of importance and continue to increase the inventory of germplasm stored within the National Animal Germplasm Repository to preserve biodiversity.

During FY 2015, ARS will

identify underlying genetic and/or physiologic mechanisms relating to food animal production and production efficiencies for traits associated with growth physiology, nutrient utilization, reproductive physiology, health, and well-being in food animals.

develop genomics infrastructure and tools to efficiently identify genes, their function, and interactions with environmental factors for exploitation in genome enabled improvement programs for food animals

develop and improve sustainable production systems for food animals; incorporating strategies to optimize production system efficiency while ensuring economic and environmental sustainability.

characterize nutrient requirements of food animals; measure nutrient availability of traditional and non-traditional feedstuffs; and develop strategies for improving nutrient use efficiency.

characterize food animal germplasm for traits of importance and continue to increase the inventory of germplasm stored within the National Animal Germplasm Repository to preserve biodiversity.

Measure 2.2.3 Expand, maintain, and protect our genetic resource base, increase our knowledge of genes, genomes, and biological processes, and provide economically and environmentally sound technologies that will improve the production efficiency, health, and value of the Nation's crops.

Baseline 2006
Ten new technologies developed and used by ARS customers to increase production efficiency and enhance the economic value and quality of U.S. crop production while decreasing the environmental footprint of production systems.
Target 2012
Cumulatively, 35 new technologies developed and used by ARS customers.

Indicator 1

During FY 2012, ARS will develop crop production systems and technologies that harness genetic potential; optimize crop productivity and quality; mitigate losses due to weeds, nematodes, pathogens, and arthropod pests; and utilize appropriate automation to provide a secure food, fiber, feed, and flower supply that is competitive in the global marketplace.

FY 2012 Accomplishments*:*

Maximizing benefits to energycane and sugarcane production systems. ARS scientists at the Sugarcane Research Unit's (SRU) Ardoyne research farm completed a five-year study comparing the flood tolerance of energycane and sugarcane. Production practices vary whether sugarcane is grown primarily for sucrose (sugarcane) or as a biofuels feedstock (energycane), and energycane increases management flexibility for the existing sugarcane production system. Energycane tolerated the flooded conditions better than sugarcane when biomass and sucrose yields were compared between treatments.

> ***Impact*:** In some areas of Louisiana, where sugar production is not economical because of delayed planting or flooded conditions, utilization of energycane for production of cellulosic biomass may be a sustainable option.

Ultra-violet light as a non-chemical plant growth regulator. Traditional floriculture crop production relies upon synthetic plant hormones or hormone derivatives for controlling plant growth and development. ARS scientists in Wooster, Ohio, found that a single dose of UV light on seedlings of 10 crop species decreased photosynthesis immediately after exposure, and it remained low for 1 to 10 days. Leaf expansion also decreased leading to reduced overall growth in the following weeks. Depending on the species, UV light suppressed growth in a predictable manner, similar to a chemical plant growth regulator (lower photosynthesis, decreased leaf expansion, changed height, and no delay in flower development).

> ***Impact*:** This research provides a new method for non-chemical plant growth regulation.

New wheat germplasm developed with more effective resistance genes to Ug99 stem rust from wild wheat relatives***.*** Stem rust strain Ug99 threatens wheat production worldwide. ARS researchers in Manhattan, Kansas, and in St. Paul, Minnesota, along with Kansas State University collaborators, developed a wheat germplasm line with Ug99 resistance gene (Sr47) derived from a wild wheatgrass species. ARS researchers in Fargo, North Dakota, and in St. Paul, Minnesota, used chromosome engineering techniques to successfully transfer small segments of goatgrass chromosomes carrying the Ug99-resistance gene (Sr47) to durum wheat.

The sources of the wild wheat relatives were seeds safeguarded in the USDA Small Grains Repository in Aberdeen, Idaho.

> ***Impact*:** These new lines with highly effective resistance genes from the wild relatives of wheat will help wheat breeders throughout the world develop more durable protection of the global grain supply.

Bee health possibly affected by pesticide-fungicide and pesticide-pathogen interactions. The sublethal effects of pesticides and their synergistic interactions with other bee mortality factors are prime suspects in Colony Collapse Disorder (CCD). In a comprehensive survey, ARS scientists and university collaborators were able to identify 98 pesticides in the beeswax and pollen of dying and healthy colonies alike. While there was no apparent association of any particular pesticide with CCD, the evaluation did document the persistence of some products in the hive. Two results of ARS research support the need to continue this line of inquiry. First, a fungicide (Vanguard) used by almond growers in California was found to interact with a miticide (Hivastan, fenpyroximate), to increase bee mortality. These results, from ARS in Weslaco, Texas, support previous findings that pesticide-fungicide interactions can overload cytochrome P450 detoxification mechanisms in bees and suggests that one or the other product (i.e., either the fungicide or miticide) should not be used during bloom. Second, honey bee adults exposed to sublethal doses of imidacloprid (a neonicotinoid insecticide) developed higher levels of nosema spores than did nonexposed bees. The research, performed in Beltsville, Maryland, showed reduced queen emergence and higher virus levels in colonies fed virus-contaminated pollen.

> ***Impact*:** Thus, pesticides, even at sublethal exposure levels, might contribute to honey bee colony collapse, thus adding important evidence to the growing consensus that maladies such as CCD might be the result of a synergism of multiple factors.

Agroenvironment impact on mamey sapote, a tropical tree fruit. The demand for tropical fruits has increased significantly during the last decade as consumers seek healthy and more diverse food products. There is a lack of formal experimentation to determine yield performance and fruit quality traits of mamey sapote (*Pouteria sapota*) cultivars. Six mamey sapote cultivars ('Copan,' 'Magana,' 'Mayapan,' 'Pace,' 'Pantin,' and 'Tazumal') grown on ultisol and oxisol soils were evaluated for 5 years at Corozal and Isabela, Puerto Rico, respectively. There was a significant difference in the number and weight of fruit per hectare between locations, averaging 25,929 fruit/ha and 16,527 kg/ha at Corozal and 17,887 fruit/ha and 11,920 kg/ha at Isabela. 'Tazumal' had the highest 5-year mean number and weight of fruit per hectare, but fruit of this cultivar was very small and contained several seeds, which could reduce its marketability. At Corozal, cultivars 'Tazumal' and 'Magana' had significantly higher fruit yield per hectare than the rest of the cultivars, whereas 'Magana,' 'Tazumal,' and 'Pantin' had the highest fruit yield at Isabela. At both locations, 'Pantin' had relatively high yield, above-average soluble solids concentration values, and adequate fruit size and weight for domestic and export markets (650–900 g), making this cultivar suitable for planting at various agroenvironments typical of the humid tropics.

> ***Impact*:** This evaluation provides, for the first time, valuable information to growers and extension specialists on yield, fruit quality traits and adaptability of mamey sapote cultivars grown in various agroenvironments.

Fertilizer value of recovered phosphorus from animal manures. Many fields around large animal feeding operations in the southeastern United States have excessive soil phosphorus from land-applied animal manures. Previously, a method to recover phosphorus from animal waste in a concentrated form was developed by ARS scientists in Florence, South Carolina. These ARS scientists field-tested the recovered phosphorus for its value as a fertilizer product and found that the material can be processed into commercial-sized fertilizer pellets with relative ease. They

discovered that when it is land-applied as small particles (between 0.5 and 1.0 mm diameter) recovered phosphorus is effective as a fertilizer source.

> ***Impact*:** Since recovered phosphorus can be transported in concentrated form and recycled as plant fertilizer, adoption of this technology by animal producers will reduce the environmental impact of excessive phosphorus in soils around these animal farms. In addition, recycling manure phosphorus will lengthen the duration of the world's finite supply of minable phosphorus.

Indicator 2

During FY 2012, ARS will maintain and enhance genetic and genomic databases and make information accessible via standard software from the Internet.

FY 2012 Accomplishments*:*

Documenting crop wild relatives occurring in the United States***.*** More than 700 primary, secondary, and tertiary gene pool relatives for 20 of the most economically important crops were identified in the GRIN database. A Web interface (www.ars-grin.gov/~sbmljw/cgi-bin/taxcrop.pl) was constructed by ARS researchers in Beltsville, Maryland, to query and retrieve information about the occurrence of crop wild relatives in the United States.

> ***Impact*:** Access to this information will assist scientists in the United States and other countries with developing strategies for filling gaps in genebank collections and for *in situ* conservation of crop wild relatives.

Indicator 3

During FY 2012, ARS will describe in model plants and crop plants the structure, function, and regulation of agriculturally important genes that control plant composition and yield.

FY 2012 Accomplishments*:*

Genes that control the production of a key component of grape varietal aroma are mapped***.*** Meothoxypyrazines, a class of volatile aromatic compounds, are commonly generated by grape varieties traditionally grown in Bordeaux, such as Cabernet Sauvignon and Sauvignon Blanc. At moderate to low levels, these compounds are considered a desirable and key component of wines fermented from these grapes. However, at high concentrations, these compounds are considered undesirable because they yield wines that are excessively "vegetal" in their aromatic profile. ARS researchers in Geneva, New York, demonstrated that variation in the concentration of these compounds is quantitatively inherited and controlled by two unlinked genes with large genetic effects.

> ***Impact*:** Mapping this trait is the first step in developing methods that will improve the efficiency for selecting this trait during grape breeding and will lead to further insights into how developing grape berries produce these compounds.

Rice grain yield increased 25 percent by genes from wild species***.*** Most cultivated rice belongs to the species *Oryza sativa*. However, breeders have crossed that species with wild relatives of rice to enhance pest and disease resistance. ARS scientists in Stuttgart, Arkansas, and Cornell University researchers determined that these wild species are genetic reservoirs for new grain yield enhancing genes. When genes from the wild rice species *Oryza rufipogon* were crossed

into the commercial rice cultivar Jefferson, two genetic insertions from *Oryza rufipogon* in the Jefferson genome increased grain yield by 25 percent.

> ***Impact*:** These results demonstrated that wild ancestral species, with no obvious agronomic merit, are an important genetic resource for improving the yield potential of cultivated rice.

Identifying a sorghum gene for superior livestock feed and bioenergy value***.*** Lignin is the principal substance that makes cell walls resistant to breakdown either by livestock digestive systems or during the cellulosic bioenergy conversion process. The mutant gene brown midrib 2 (*bmr2*) reduces lignin content and alters the lignin composition of sorghum cell walls. The specific genetic mutation causing *bmr2* was identified by ARS researchers in Lincoln, Nebraska, and their colleagues at the University of Florida as affecting an enzyme involved in lignin synthesis. The function of the enzyme was characterized and determined to be largely responsible for an initial step in lignin synthesis.

> ***Impact*:** This new information about the *bmr2* gene can be applied to manipulate lignin content in sorghum and to improve that crop as a source of animal forage and as a bioenergy feedstock.

New sugarbeet germplasm with improved processing properties***.*** Sodium, potassium, and amino-nitrogen accumulate in sugar beet roots and impede sucrose recovery during normal processing. ARS researchers in Fargo, North Dakota, released three germplasm lines with substantially reduced levels of each of these substances.

> ***Impact*:** These lines, the result of numerous plant breeding cycles conducted in conjunction with chemical analysis of individual roots, will provide germplasm for future improvement in sugar beet processing quality and sucrose recovery, thereby increasing grower profits and improving factory efficiency.

Release of new sugarcane variety with disease/pest resistance and high yields***.*** Varieties are the life-blood of the sugarcane industry in Louisiana, and a continuous pipeline of new varieties is needed to sustain that industry. Researchers at the Sugarcane Research Unit in Houma, Louisiana, selected, evaluated, and released to the Louisiana sugarcane industry the variety Ho 05-961. The new variety produces sustained yields through the third harvest, particularly in sugar per acre. It is resistant to the diseases rust, smut, leaf scald, and both the sugarcane borer and Mexican rice borer. Therefore it is an appropriate variety for planting in areas not suited to insecticide application.

> ***Impact*:** The positive performance of Ho 05-961 for many important traits suggests that it will contribute to the economic sustainability of the sugarcane industry.

Indicator 4

During FY 2012, ARS will improve plant genetic transformation systems to expand their utility and improve exploitation of genome sequence information to identify valuable genes in germplasm collections.

FY 2012 Accomplishments*:*

Successful field trial of transgenic potatoes expressing a gene conferring resistance to multiple viruses***.*** Potato viruses such as Potato Virus Y, Potato Virus X, Potato Virus A, and Potato Leaf Roll Virus seriously impact potato growers and processors in the United States by way of

production losses and rejection of seed lots by seed certification agencies. ARS scientists in Albany, California, constructed an artificial gene designed to confer resistance to all four viruses and introduced it into Premier Russet, Norkotah Russet, and Atlantic potatoes. These potatoes were entered into a field trial in cooperation with ARS scientists in Aberdeen, Idaho, to determine virus susceptibility.

> ***Impact*:** The transgenic potatoes demonstrated field resistance to both Potato Virus Y and Potato Leaf Roll Virus indicating that a combination of genes can confer multiple virus resistance.

Indicator 5

During FY 2012, ARS will develop new genetic and genomic methods and tools to identify specific genes that affect end-product traits desired by consumers, such as oil and grain quality, nutrient composition, disease resistance, and stress tolerance in agricultural crops.

FY 2012 Accomplishments*:*

New genetic stock with Fusarium Head Blight (scab) resistance developed for durum wheat**.** Fusarium Head Blight (FHB), often called scab, is a damaging disease of durum wheat for which there is no reliable source of resistance for current durum cultivars. ARS researchers in Fargo, North Dakota, used a wild grass species as a source of FHB resistance to produce plants in which one pair of durum chromosomes was replaced by a pair of wild grass chromosomes.

> ***Impact*:** This unique genetic stock will accelerate breeding durum wheat with FHB protection.

The first recombinant inbred line (RIL) population in beet**.** Precise genetic analyses of agronomic and other traits of sugar and table beets are very difficult because these plants are open-pollinated by the wind. ARS researchers in East Lansing, Michigan, began 12 years ago to inbreed populations of beets to assist with general genetic analyses, mapping of single gene traits, and dissection of traits important for the production, profitability, and expansion of beet products to new markets. These populations were analyzed to determine the genetics of morphological characters that define differences between sugar beet and red table beet as well as define the minimum number of genes that contribute to economic sucrose production of sugar beet.

> ***Impact*:** These “recombinant inbred line” populations of beet demonstrate that deeply inbred sugar beet germplasm can be created for precise and repeatable molecular determinations of agronomic traits that will lead to improved varieties.

Identifying genes in tomato which originated from wild relatives**.** Tomato is unusual because of the many key horticultural traits that originated from its wild relatives. In addition to those traits, theory would predict that additional “hidden variation,” genetically linked to such features, might also have been introduced into tomato breeding stocks. ARS researchers in Geneva, New York, applied new statistical genetic approaches to identify in tomato breeding stock such latent genes from wild relatives. They uncovered not only genes from wild relatives introduced into tomato through deliberate breeding, but also other genes simply genetically-linked to the target traits. Furthermore, previously unrecognized hybridizations in nature between tomato and wild relatives were identified.

***Impact*:** These results will enable even more detailed examinations of such genes introduced from wild relatives so that tomato genetic resources can be more effectively conserved and utilized in tomato breeding.

Designing healthy soybean oils for margarines and shortenings**.** There are two types of saturated fatty acids in soybean oil, palmitic and stearic. Although some saturated fats have been implicated in raising blood serum cholesterol, which is associated with heart disease, stearic acid has been shown to be neutral in this regard. Increasing stearic acid in soybean oil would make hydrogenation, a process used to increase the functionality of soybean oil, but which adds unhealthy trans-fats, less necessary. Global efforts have been underway for the last two decades to raise the saturation of soybean oil by trying to manipulate genes that are highly expressed in the seed. While examining genes that are expressed throughout other plant tissues, ARS scientists in Raleigh, North Carolina, in collaboration with North Carolina State University, identified a novel soybean mutation that, when combined with previously known genes expressed in the seed, significantly raises the saturated fatty acids in soybean oil. Molecular markers were developed to select for these mutated genes. The additive effects for stearic acid obtained when combining these newly discovered genes with previously identified genes increases stearic acid in soybean oil from 4 to 15 percent, a 3.75-fold increase.

***Impact*:** Breeders are using this new discovery to develop commercial products.

Genetic control of essential dietary minerals in beans**.** Dry beans (*Phaseolus* species), a staple food world-wide, are a valuable source of dietary zinc (Zn) and iron (Fe) for populations with largely plant-based diets. ARS researchers in East Lansing, Michigan, analyzed dry bean cultivars with different concentrations of zinc and identified genes in two navy bean cultivars with divergent gene expression patterns that yielded a 30 percent difference in seed zinc concentration. They determined that ten differentially expressed genes are involved in Zn or Fe transport in dry beans.

***Impact*:** The identification of these differentially expressed Zn and Fe transport genes will enable more effective breeding for increased seed Zn and Fe levels in dry beans to benefit human nutrition.

Identification of a novel mechanism regulating corn defense to insects**.** Damage caused by insect feeding causes yield losses and renders corn plants more susceptible to infection by fungal pathogens, including those which produce mycotoxins that can contaminate grain used for food or livestock feed. Knowledge of molecular mechanisms providing protection against insect feeding in crop plants is desirable, but little is known. ARS corn researchers in Gainesville, Florida, determined that a corn protein signal ZmPep3 conferred enhanced resistance to caterpillar damage.

***Impact*:** Results from experiments using ZmPep3 indicate that this protein and related proteins in a number of other crop species can be used to activate plant anti-insect defenses and increase plant resistance to insect damage and subsequent pathogen infection.

Indicator 6

During FY 2012, ARS will construct and maintain physical, genetic, and transcript maps to facilitate comparative analyses among plant genomes.

FY 2012 Accomplishments*:*

Tomato genomes sequenced. The full genome sequence for a crop constitutes a powerful research tool, most importantly by enabling breeders to accelerate the development of superior varieties. Tomato, one of the most important vegetables globally, provides key vitamins and minerals to populations worldwide and generates billions of dollars of economic value in the United States. The International Tomato Genomics Consortium led by ARS scientists from Ithaca and Cold Spring Harbor, New York, sequenced the genomes of the domesticated tomato and its wild ancestor, generating an invaluable knowledgebase for uncovering the genetic bases for tomato fruit taste, quality, size, yield, nutritional content, and host-plant resistance to diseases, pests, and environmental extremes.

> ***Impact*:** Access to this new knowledge should enable tomato breeders and geneticists to enhance the efficiency and effectiveness of tomato breeding for key, high-value horticultural traits.

More than 150 corn traits mapped to specific regions of the corn genome. ARS corn researchers in Columbia, Missouri; Ithaca, New York; and Raleigh, North Carolina, completed extensive evaluations of biochemical and agronomic traits for 5,000 corn lines that collectively included much of the total variation found in the corn breeding gene pool. These evaluations located the regions of the corn genome associated with more than 150 traits of major agronomic importance. Also, ARS researchers in Ithaca, New York, characterized more than 55 million variable regions in the corn genome as a first step for identifying genetic markers for breeding those traits, or the actual genes controlling the traits. All this important new information and corn genetic stocks are accessible through the Maize Genome Database.

> ***Impact*:** The data, and analytical ("informatics") tools for managing those data and relating them to other genome data for other plants, will enable geneticists and breeders to more rapidly identify genes for improved crop performance, quality, and yield.

Completion of a draft citrus genome. The sequencing of the complete genome of crop plants provides a foundational scientific tool for characterizing crop gene structure and evolution as well as for identifying genes for crop improvement. ARS scientists in Albany, California, completed a draft genome of the citrus rootstock Carrizo with sufficient coverage (15X) to enable assembly of approximately 80 percent of the genome. The Carrizo genome contains the only known source of resistance to citrus greening disease in citrus, a disease that has the potential to eliminate the juice processing industry in Florida.

> ***Impact*:** Potential citrus greening-resistance genes have been identified in the Carrizo genome and can now be evaluated for application in controlling citrus greening..

Construction of a new high-quality cotton genetic map. ARS researchers in New Orleans, Louisiana, and U.S. and French colleagues constructed a new, high-quality (termed an ultra-dense or "UD") genetic map for commercial "Upland" cotton by combining six separate "high density" maps, including more than 8,200 unique DNA markers. Statistical comparisons of those mapped markers with the smaller and simpler genome sequence of a wild cotton species revealed strong structural similarities so that information from the simpler genome can be applied to locate genes or other genetic features on the larger genome of "Upland" cotton.

> ***Impact*:** This UD map is a valuable resource for mapping the genes controlling complicated traits such as fiber yield and quality, isolating and "cloning" key cotton genes, and understanding more comprehensively cotton genome structure and evolution. It will also serve as the standard reference and starting point for additional research on the structure of the genomes of different cotton populations and species.

Construction of a saturated genetic map for marker identification in peanut**.** A saturated genetic linkage map can help peanut breeders to visualize the structure of peanut genomes and accelerate peanut cultivar selection. ARS scientists in Tifton, Georgia, developed this saturated map, incorporating 249 loci distributed on 23 linkage groups.

> ***Impact*:** This map was applied to pinpoint the location of a genetic locus linked to tomato spotted wilt virus resistance, as well as three major genetic loci linked to late leaf spot resistance. It also confirmed the relative contribution of two known genes implicated in controlling the high oleic trait in peanuts, and will likely continue to make selection more precise in peanut breeding.

Indicator 7

During FY 2012, ARS will identify, acquire, and expand plant germplasm collections so as to enhance their diversity.

FY 2012 Accomplishments*:*

Seed longevity is detectable through non-invasive assays**.** ARS scientists in Fort Collins, Colorado, developed assays that noninvasively detect very early signs of seed deterioration during storage. Assays are based on volatile emission from seeds detected through gas chromatography of the storage headspace; seed oil crystallization kinetics detected by differential scanning calorimetry; and molecular relaxations within seed structures detected from dynamic mechanical analysis.

> ***Impact*:** These sensitive non-destructive assays do not deplete samples of valuable germplasm that are normally consumed during viability monitoring tests. These assays help preserve seed supplies in long-term storage more efficiently and effectively than do traditional approaches.

Determining redundancy within the NPGS onion germplasm collection with genetic markers**.** Conserving genetically redundant accessions can constitute a suboptimal allocation of genebank curatorial resources and can reduce the efficiency of crop germplasm characterization, evaluation, and enhancement. ARS researchers in Pullman, Washington, and their collaborators found that patterns of genetic variability in two different types of genetic markers (simple sequence repeat (SSR) and targeted region amplified polymorphisms (TRAP)) led to sometimes different conclusions regarding the genetic identity and divergence among a set of 35 short-day onion accessions.

> ***Impact*:** These results underscored the importance of combining a sufficiently large genetic marker data set with passport information, and of patterns in morphological markers when examining genetic redundancy of problematic samples.

Genetic characterization of the NPGS cotton germplasm collection**.** ARS researchers in College Station, Texas, and Stoneville, Mississippi, and their collaborators genotyped more than 2,300 accessions, or approximately 25 percent of the total NPGS cotton collection, with 105 simple sequence repeat markers. They determined species introgression, redundancy among accessions, and within-accession variation with the markers.

> ***Impact*:** These data provide valuable information on the patterns and distribution of genetic diversity within the collection to guide curatorial decision-making and reveal sources of unique genetic variation to exploit for cotton improvement.

Expansion of the switchgrass and other warm-season grass germplasm collections**.** The ARS warm-season grass collection for species native to the United States did not contain adequate genetic diversity to meet the needs of requesters. The switchgrass (*Panicum*) collection was expanded with 94 accessions collected by ARS researchers in Griffin, Georgia, from areas in the United States previously underrepresented. The newly collected switchgrass accessions were tested for germination, regenerated, characterized genotypically with SSR markers, and the ploidy levels were determined.

> ***Impact*:** These efforts provided well-characterized, readily available, and viable material to scientists for bioenergy feedstock development.

Discovery of the third site in Mexico for a rare wild relative of maize**.** Some types of teosinte, the ancestor to maize, are generally cross-fertile with maize, enabling teosinte to serve as a potential source of genes for maize improvement. ARS scientists from Fort Collins, Colorado, and their collaborators in Mexico have found another field location for a rare wild perennial teosinte (*Zea perennis*) in Mexico. Previously, only two sites for this perennial species were known in Mexico.

> ***Impact*:** This find is significant as it represents a potentially unique population of this key evolutionary relative of maize.

Indicator 8

During FY 2012, ARS will strengthen evaluation and breeding programs for specialty crops that have increasing economic importance.

FY 2012 Accomplishments*:*

Genetics of salad-cut lettuce shelf-life**.** Lettuce with commercially acceptable or extended shelf-life must be bred to sustain the market for packaged salads, which is vital to lettuce producers and this industry. ARS researchers in Salinas, California, determined the genetics of leaf decay, which in an experimental population is inherited as a major quantitative trait locus (QTL) describing 30 to 80 percent of the differences (depending on the experiment) in decay.

> ***Impact*:** Breeding for reduced decay in lettuce is now feasible because the trait can be modified with molecular markers.

Watermelon Vine decline resistant germplasm line**.** Watermelon Vine decline, a serious disease that has plagued watermelon growers for the past several years, has resulted in losses of over $60 million in southwest and west central Florida. ARS scientists in Charleston, South Carolina, developed the watermelon germplasm line “392291-VDR” with resistance to this disease which is caused by a whitefly transmitted virus.

> ***Impact*:** This resistant germplasm line will enable breeders to develop watermelon varieties with resistance to this dreaded disease and help reduce insecticide use.

Development of improved tepary (Phaseolus acutifolius) germplasm**.** Improved lines of tepary, a desert species related to common bean with far higher levels of abiotic stress tolerance, have been developed by ARS scientists in Mayagüez, Puerto Rico, and colleagues from the University of Puerto Rico. These lines have larger seed size than most teparies and have multiple stress tolerance, including tolerance to high ambient temperature and drought, and resistance to bacterial blight.

***Impact*:** These lines could increase legume production in arid/high temperature environments directly and contribute to further tepary genetic improvement.

Import of genetically-engineered (GE), PRSV-resistant 'Rainbow' papaya to Japan approved**.** A major portion of the U.S. market share of papayas sold in Japan was lost when the Hawaiian papaya industry was devastated in the 1990s by the papaya ringspot virus (PRSV). The first shipments to Japan of 'Rainbow,' a transgenic PRSV-resistant variety, occurred in December, 2011, following final regulatory approval by the Japanese government. The 'Rainbow' import application package was prepared and submitted through a collaborative effort involving ARS researchers in Hilo, Hawaii, and researchers or representatives from several U.S. universities and the papaya industry.

***Impact*:** 'Rainbow' papaya is the first fresh genetically-engineered fruit to be marketed commercially in Japan.

Measure 2.2.3 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported on 10 new technologies developed and used to increase production efficiency and enhance the economic value and quality of U.S. crop production while decreasing the environmental footprint of production systems.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
New USDA Plant Hardiness Zone Map Released: The 2012 edition of the PHZM combines leading-edge geographical information systems analytical technology, internet/World Wide Web information delivery, and traditional horticultural and climatological scientific expertise and clientele input to transform what had been a static, paper map into a dynamic, Web-accessible, multi-functional interactive information resource.	ARS researchers, information technology staff, information staff, and researchers from Oregon State University developed the new PHZM as a dynamic, Web-accessible, multi-functional interactive information resource, accessible around the world via an interactive web site delivered by Esri, Inc. The PHZM web site attracted more than 500,000 visitors during the first two weeks after release in January 2012 and 2.7 million total visitors during its first year of operation.	The country's estimated 60 million gardeners, nurseries, horticultural producers, plant breeders, and government agencies. The PHZM earned a Special Achievement in Geographical Information Systems (SAG) Award from Esri, Inc., one of 150 chosen for awards from 100,000+ Esri clients worldwide.	The new PHZM has benefitted the general public, gardeners, researchers, and the nursery industry and other companies that sell plants, trees, shrubs and seeds. The companies rely on this information to market high-quality, successfully-performing products, and plant enthusiasts rely on the information to choose optimal varieties for their specific locations.
RNAi technology – a new strategy for controlling infectious diseases and parasites of bees: the	ARS scientists in Fort Pierce, Florida, in collaboration with university, industry (Beeologics/Monsanto),	Beekeepers, world-wide.	This RNAi strategy not only controls Israeli acute paralysis virus, and thus

	RNAi product protects bees when fed in sugar solutions routinely used by beekeepers as a honey substitute.	and military partners, have successfully developed a new control strategy that uses RNA interference (RNAi) technology. World-wide, this was the first large-scale field proof-of-concept use of RNAi for pest control. The bee treatment product is now commercialized as Remebee©.		has potential for reducing CCD, but it could also be adapted to target and control other diseases and pests of bees and other insects.
	New protocols for spray drift reduction. Numerous new spray technologies including nozzles, spray formulations, adjuvants, and operational practices may significantly reduce spray drift potential, a critical concern for aerial applicators.	In cooperation with EPA and other research and manufacturing entities, ARS scientists in College Station, Texas, refined and tested protocols to evaluate droplet size and drift of aerially applied spray using drift reduction technologies. ARS scientists provided these standardized methods to applicators for enhancing drift reduction.	These new protocols will be used by applicators to counter meteorological and other in-field conditions that can elevate drift potential.	Results will be better on-target deposition of aerial sprays, less drift, and more environmentally sensitive utilization of agricultural chemicals.
	Novel method for identifying different nitrogen-fixing bacteria and determining	ARS researchers in Beltsville, Maryland, developed novel methods	Soybean breeders	Genetic types of rhizobia in each root location can be identified, nitrogen
	their benefits to soybean growth and production.	for describing soybean rhizobia genotypes and analyzing how these bacteria occupy soybean roots.		fixing efficiency determined, and soybean varieties identified that form symbioses with the most efficient rhizobia, thereby helping the plant to produce its own nitrogen, thus eliminating the need for nitrogen fertilizer applications.
	Improved technology for producing long-cane blackberry plants.	ARS researchers in Kearneysville, West Virginia, developed a unique trellis and cane training system which can be manipulated to produce off-season fruit, and they provided these new cultivation	U.S. blackberry growers and nurserymen.	These long cane plants produced more fruit clusters, clusters with more fruit, larger fruit, and 250 percent increase in fruit production compared to long-cane plants

		methods to producers.		produced by traditional methods.
	Release of grape varieties and rootstock: 'Valley Pearl,' a white seedless table grape for the early to mid-season that is high yielding with superior good storage quality; 'C51-63,' a very productive, late ripening red seedless grape with desirable berry size and storage ability; and 'Demko 10-17A,' a grape rootstock with a moderately vigorous rootstock that protects against many nematodes as well as phylloxera.	ARS has released two table grape varieties and one rootstock following extensive development and testing in Parlier, California.	Table grape growers and consumers.	Gain of seedless table grape cultivars with superior productivity and storage quality for commercial production.
	Development of soft white winter and soft white club wheats with protection to stripe rust losses.	ARS scientists in Pullman, Washington, applied marker-assisted selection, in collaboration with regional wheat breeders, to publically release new varieties with stripe rust resistance.	Wheat growers, processors, exporters, and consumers.	These new varieties will reduce grower risk and benefit growers and end users by saving money on fungicide sprays and providing a dependable supply of high quality wheat.
	New pinto bean germplasm line, 'USPT-WM-12,' with partial resistance to white mold disease.	ARS researchers in Prosser, Washington, and collaborators at Michigan State University and University of Nebraska, developed and released 'USPT-WM-12' pinto bean germplasm line, which has performed exceptionally well under severe white mold pressure in national trials in 2010 and 2011, with better yield performance and better overall resistance to white mold than earlier germplasm.	U.S. and international breeders and growers. Bean breeders from public universities, private seed companies, and international organizations have requested this germplasm for use in their programs for breeding beans with improved resistance to white mold disease.	This new line enables breeders to develop pinto bean cultivars with improved resistance to white mold which will save growers millions of dollars from lost production.

	Release of Potato Variety 'Teton Russet,' an early maturing variety suitable for processing and fresh consumption, which has resistance to common scab and dry rot; high protein and Vitamin C content; and a low concentration of the amino acid asparagine which contributes to lower acrylamide concentrations in its processed potato products.	This cultivar will be released from the Northwest Potato Variety Development Program. Cooperating state institutions include the University of Idaho, Oregon State University, and Washington State University.	U.S. potato industry and consumers.	'Teton Russet' is a superior alternative to the variety, 'Russet Norkotah.'
	Release of a high yielding and high beta-glucan food barley.	ARS researchers in Aberdeen, Idaho, developed and released 'Transit' barley, a specialty food-grade variety that combines very high levels of heart-healthy beta-glucan with good productivity characteristics.	Barley producers and the food industry.	'Transit' is expected to create new opportunities for farmers and the food industry to provide healthy grain products to consumers.

Measure 1.3.1: Develop knowledge, strategies, systems and technologies that maximize the production efficiency of our annual, perennial, greenhouse and nursery cropping systems. Develop new technologies and tools contributing to improving these systems to meet current and future food crop production needs of diversified consumers, while ensuring economic and environmental sustainability and production efficiency, health, and value of our nations crops.
(Formerly 2.2.3)
Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

breed superior new crops, varieties, and enhanced germplasm.

devise innovative approaches to crop genetic improvement and trait analysis.

expand crop genomic information resources and advanced bioinformatic capabilities.

conserve and encourage the use of plant and microbial genetic resources and associated information.

expand fundamental knowledge of plant biological and molecular processes.
develop more effective means for plant biotechnology risk assessment.

develop crop production strategies to optimize crop genetic potential, mitigate losses due to biotic and abiotic stresses, and increase production efficiency.

improve pollinator health, bee systematics and germplasm lines, and pollination.

During FY 2014, ARS will

breed superior new crops, varieties, and enhanced germplasm.

devise innovative approaches to crop genetic improvement and trait analysis.

expand crop genomic information resources and advanced bioinformatic capabilities.

conserve and encourage the use of plant and microbial genetic resources and associated information.

expand fundamental knowledge of plant biological and molecular processes.
develop more effective means for plant biotechnology risk assessment.

develop crop production strategies to optimize crop genetic potential, mitigate losses due to biotic and abiotic stresses, and increase production efficiency.

improve pollinator health, bee systematics and germplasm lines, and pollination.

During FY 2015, ARS will

breed superior new crops, varieties, and enhanced germplasm.

devise innovative approaches to crop genetic improvement and trait analysis.

expand crop genomic information resources and advanced bioinformatic capabilities.

conserve and encourage the use of plant and microbial genetic resources and associated information.

expand fundamental knowledge of plant biological and molecular processes.

develop more effective means for plant biotechnology risk assessment.

develop crop production strategies to optimize crop genetic potential, mitigate losses due to biotic and abiotic stresses, and increase production efficiency.

improve pollinator health, bee systematics and germplasm lines, and pollination.

OBJECTIVE 2.3: PROVIDE RISK MANAGEMENT AND FINANCIAL TOOLS TO FARMERS AND RANCHERS

Activities related to this objective are primarily carried out by other USDA agencies.

Strategic Goal 3:

Support Increased Economic Opportunities and Improved Quality of Life in Rural America

Programs and activities related to this goal are primarily carried out by other USDA agencies. However, ARS has a large and very positive impact on rural America. For example, the National Agricultural Library operates the Rural Information Center (RIC). The Center assists local communities by providing information and referral services to local, tribal, state, and Federal government officials; community organizations; libraries; businesses; and citizens working to maintain the vitality of America's rural areas. The RIC Web site contains over 3,000 links to sources of current and reliable information on a wide variety of rural resources and funding sources, including RIC's Database: Federal Funding Sources for Rural Area Databases.

The Rural Information Center information and referral services include:

- Responding to a broad array of information requests on topics such as successful strategies, models, and case studies of community development projects; small business attraction, retention, and expansion; housing programs and services; tourism promotion and development; recycling programs and community water quality; and technology transfer to rural areas.

- Developing customized information products in response to specific inquiries (e.g., assistance in economic revitalization issues; local government planning projects; funding sources; technical assistance programs; research studies, etc.)

In addition, in support of the White House Initiative on Tribal Colleges and Universities (TCU), ARS provides opportunities to American Indian communities through Memoranda of Understanding, specific cooperative agreements, and various programs and activities. ARS helps to strengthen the management and administrative infrastructure of TCU libraries; provides facilities and equipment to the libraries; sponsors internships, fellowships, lectures, career fairs, workshops, and other learning and training opportunities for TCU students and faculty; and provides student tuition assistance. These outreach efforts are intended to improve the quality of life in Native American communities by ensuring their access to USDA sponsored programs.

However, in planning research, ARS organizes its research program around the other four programmatic USDA/ARS Strategic Plan goals. In conducting research to ensure the quality and safety of food and other agricultural products, assess the nutritional needs of Americans, sustain a competitive agricultural economy, and enhance the natural resource base and the environment, ARS helps to provide economic opportunities for rural citizens, communities, and society as a whole.

Strategic Goal 4:

Enhance Protection and Safety of the Nation's Agriculture and Food Supply

A secure and efficient agricultural production system is critical to providing the American consumer with a safe and healthy food supply. To maintain such a system, it is necessary to minimize production losses; maintain market viability; promote responsible environmental stewardship; and prevent, monitor, and control diseases that affect animals and humans. Diseases can negatively affect agricultural production systems by causing direct harm to livestock, threatening the health of agricultural workers and the public, and impacting trade.

ARS is an essential partner in ensuring the safety of the Nation's crop and animal products, producing the knowledge that the Nation needs to constantly improve and protect agricultural processes and products. As the agroecosystem evolves in response to changing conditions and human needs, ARS develops the knowledge to protect the Nation's agricultural supply from new threats presented by pathogens, parasites, environmental stresses, and arthropods. The Agency also participates in the development of new, practical technologies, and in the transfer of commercially viable concepts to industry. ARS research and technologies are used by many other Federal and private groups and action agencies, such as the Departments of Defense and Homeland Security, to protect the health of personnel, the integrity of property, and the environmental safety of logistic operations.

Objective 4.1: Provide the Scientific Knowledge to Reduce the Incidence of Foodborne Illnesses in the U.S.

For the Nation to have safe and affordable food, the food system must be protected at each step from production to consumption. The production and distribution system for food in the United States encompasses a diverse, extensive, and easily accessible system that is open to the introduction of pathogens (bacteria, viruses and parasites), bacterial toxins, fungal toxins (mycotoxins), and chemical contaminants through natural processes, global commerce, and intentional means. In response to these threats, crop and livestock production systems must be protected during production, processing, and preparation from pathogens, toxins, and chemicals that cause disease in humans.

To ensure the security of production systems, ARS conducts basic, applied, and developmental research resulting in new technologies, new and improved management practices, pest management strategies, sustainable production systems, and methods of controlling potential contaminants. These ARS activities are key to providing a safe, plentiful, diverse, and affordable supply of food, fiber, and other agricultural products.

Key Outcome: Reduction in foodborne illness associated with the consumption of meat, poultry and egg products.

Performance Measure

Measure 4.1.1 Develop new technologies that assist ARS customers in detecting, identifying, and controlling foodborne diseases that affect human health.

Baseline 2006
Thirteen new technologies developed and used by ARS customers to detect, identify, and control the most critically and economically important foodborne contaminants causing illness, death, or chronic disease that impact public health and industry, as determined by FSIS, APHIS, ERS, CDC, FDA, DHS, DoD, Risk Assessment Consortium, Codex Alimentarius Commission, and consumer and commodity organizations.
Target 2012
Cumulatively, 40 new technologies developed and used by ARS customers.

Indicator 1

During FY 2012, ARS will utilize new detection and quantitative methodologies, including genomic technologies; and, through the study of epidemiology, ecology and host pathogen relationships, intervention strategies, and antibiotic resistance in food producing animals, develop practices, products, and information that will reduce preharvest pathogen and toxic residue contamination of animal-derived food products. Ensure that these technologies can be utilized by regulatory agencies and/or producers to help assure safe food products.

FY 2012 Accomplishments*:*

Campylobacter and Salmonella are the most commonly reported bacterial pathogens causing foodborne infections in the U.S. Epidemiological evidence has implicated poultry products as a significant source of these pathogens. A novel probiotic method developed by ARS at Fayetteville, Arkansas, is capable of inhibiting growth of specific enteric pathogens. These probiotic cultures (composed of non-pathogenic "healthy" bacteria) target Salmonella and Campylobacter in the gastrointestinal system of poultry.

> ***Impact*:** This discovery to inhibit the growth of human pathogens in poultry was licensed to an Arkansas-based start-up company in cooperation with the University Arkansas. The commercial product (FloraMax-B11) now used by the poultry industry is marketed in 16 countries with approximately 300 million birds dosed per/year.

Beef cattle are a major asymptomatic carrier of the pathogen, and development of a vaccine for cattle to eliminate the pathogen is a major goal for government and industry. E. coli O157:H7 colonize the terminal portion of the large intestine in cattle by "sticking" to a specific type of tissue. Specific bacterial proteins are required for adherence and studies have implicated the protein (intimin) responsible for adherence. However, ARS researchers at Ames, Iowa, have now determined that E. coli O157:H7 lacking the intimin protein use additional proteins for adherence.

***Impact*:** This finding is significant in the context of developing efficacious vaccines for blocking adherence of the bacteria. Therefore, better vaccines would be those that would include not only the intimin protein but other proteins to reduce adherence. ARS will redirect its vaccine development studies to address this critically important observation.

The use of antibiotics in animal production is a controversial issue due to the concern of transmission of antibiotic resistance genes. Young swine are often fed dietary antibiotics to improve health, reduce pathogen load, and enhance performance. Few natural alternatives have been identified to replace these compounds if producers are required to eliminate antibiotic use. ARS scientists at Clay Center, Nebraska, determined that a commercial product containing lysozyme (naturally found in eggs) could replace dietary antibiotics.

***Impact*:** This research is critical, particularly for industry, is that the use of lysozyme in diets of young piglets could maintain a safe food supply and reduce the use of prophylactic antibiotics that are typically used for swine production.

Pathogen contamination of shell eggs is a critical concern for industry and regulatory agencies such as USDA-Food Safety and Inspection Service and the Food and Drug Administration. While the layer hen production environment is known to contribute to the microbial quality of shell eggs, it is more important to consider any residual effects after processing has been completed. ARS scientists from Athens, Georgia, sampled and examined eggs from traditional cages, aviary, enriched cages, and eggs from the floor of aviary housing before and after processing (washed as required for retail shell eggs). Studies showed that none of the washed eggs were contaminated with Salmonella or Campylobacter and counts for aerobic microorganisms and Enterobacteriaceae were very low.

***Impact*:** This research indicates that the current commercial process is sufficient for decreasing shell contamination of eggs, regardless of where they are collected. There is not a significant effect to shell egg safety based on housing, indicating that including floor eggs from producers that use an aviary style of housing can add to increased profits for industry.

Several bacteria have been linked to produce associated foodborne illness outbreaks. ARS researchers in Albany, California, in collaboration with the Food and Drug Administration and National Aeronautics and Space Administration conducted a survey of the Salinas watershed for the presence of E. coli O157, non-O157:H7 Shigatoxin-positive E. coli (STEC), Salmonella, Listeria, and Campylobacter.

***Impact*:** Data collected indicated substantial differences in the prevalence of the various pathogens with a definite correlation to sampling region and date. Results allowed the development of a predictive geospatial risk assessment model (PGRAM), while overall the study provided industry and public health regulatory agencies with valuable epidemiological data for development of a risk assessment for this important agricultural region of the U.S.

Indicator 2

During FY 2012, ARS will utilize new detection and quantitation methodologies, including genomic technologies, and through the study of crop/fungal/toxin relationships, production practices and expert systems, breeding targets for resistant crops, biocontrol technologies and chemical toxicity, develop practices, products, and information that will reduce preharvest fungal/toxin contamination of plant-derived food products. Ensure that

these technologies can be utilized by regulatory agencies and/or producers to help assure safe food products.

FY 2012 Accomplishments*:*

Deoxynivalenol (DON) is a toxin produced by certain species of fungi that can infest wheat, barley, and corn. It results in substantial losses to the quality and value of grain worldwide. Due to the toxicity of DON and the desire to protect human and animal health, the U.S. conducts extensive monitoring of commodities both for domestic use and export. ARS scientists at Peoria, Illinois, investigated ways to improve upon a biosensor that they developed which uses a novel analytical technology, biolayer interferometry (BLI). ARS discovered that the signal from the sensor could be substantially increased through the use of an antibody labeled with colloidal gold, allowing the assays to be conducted more rapidly. The technique was successfully used to measure DON in samples of naturally contaminated wheat, with results that agreed well, but which were obtained more quickly than with a reference method.

> ***Impact*:** The result is technology dent of a rapid and reusable sensor that can be used by industrial, academic, or government laboratories to monitor contamination of wheat and assist in the protection of the human food supply.

T-2 (trichothecene) mycotoxin is produced by a variety of fungi that commonly infest grains. T-2 is acutely toxic and has been found at low levels in crops such as wheat, corn, barley, oats, and rye, and has also been found in human food and animal feeds. Fungi and plants have evolved mechanisms to reduce toxicity of small molecules such as T-2 toxin through metabolism to forms that are less hazardous or that can be excreted. ARS scientists at Peoria, Illinois, discovered the production of novel metabolites of T-2 toxin: the gluocoside derivatives of T-2 and HT-2. These are referred to as “masked mycotoxins” Such metabolites may be important because the modified versions of the toxins may evade the techniques normally used for toxin analysis, yet may retain the ability to be converted back into toxins following consumption by animals.

> ***Impact*:** This discovery provides the developers of analytical methods for toxin detection assays, and for regulatory agencies such as the Food and Drug Administration, and USDA-Grain Inspection Service insights into which compounds are important to include in monitoring programs to assure the safety of grain products.

Fusarium species rank among the most economically destructive plant pathogens and mycotoxigenic fungi, posing a constant threat to plant and animal health, and food safety. ARS scientists at Peoria, Illinois, in collaboration with agricultural scientists in Denmark, Israel, Japan, The Netherlands, and Norway, determined that DNA sequence data could be used to accurately type agriculturally important pathogens and help predict toxin potential. In addition, the researchers identified genes responsible for the production of several toxins injurious to humans and plants in the whole genome sequence of two phytopathogenic Fusarium species. Lastly, the DNA sequence data have been incorporated into Fusarium-ID (http://isolate.fusariumdb.org, at the Pennsylvania State University, Philadelphia, Pennyslvania, and Fusarium MLST (http://www.cbs.knaw.nl/fusarium) at the Centraalbureau voor Schimmelcultures (CBS-KNAW) Biodiversity Center, Utrecht, The Netherlands, two web-accessible sites dedicated to promoting DNA sequence-based identifications of pathogenic and toxigenic fusaria via the Internet.

> ***Impact*:** The two websites promote agricultural biosecurity worldwide by facilitating global molecular surveillance of pathogenic fusaria and by enabling plant quarantine officials, plant breeders, and plant pathologists to accurately detect and identify these pathogens for the first time.

Biocontrol through competive exclusion is a new method to control plant infections. The biocontrol yeast, Pichia anomala WRL-076 has been demonstrated to repress the expression of aflatoxin and cyclopiazonic acid biosynthetic genes from Aspergillus flavus by quantitative reverse transcriptase PCR (qRT PCR). Genes demonstrated to be repressed in aflatoxin biosynthesis are: aflR (coding for transcription activator), aflJ (coding for transcription enhancer), omtB (coding for 0-methyltranferase B) and pksA (coding for polyketide synthase). Genes demonstrated to be repressed in cyclopianzonic (CPA) acid biosynthesis are: pks-npls1 (coding for polyketide synthase and nonribosomal peptide synthase), hydA (coding for CPA amidohydrolase and ctfR1 (coding for CPA C6-type transcription factor).

> ***Impact*:** The technological use of the yeast P. anomala to control mycotoxin production has been patented and the molecular data validated to show indusurty that the yeast is a suitable biocontrol agent for reducing both aflatoxin and cyclopiazonic acid in plant food products.

Of the six inbreds previously developed and released by ARS New Orleans, Louisiana, and the International Institute of Tropical Agriculture and aflatoxin-resistance maize breeding program, five were tested as single-cross hybrids (combination of different varieties) in field trials held in Mississippi, Texas, and Louisiana. Aflatoxin resistance was demonstrated in at least two of the five on a consistent basis and at levels comparable to other well-known resistant lines. Promising yield numbers were also attained by two of the lines compared to other resistant lines and to two commercial hybrids (mixed between two types of parents).

> ***Impact*:** The development of new resistant corn lines with good agronomic backgrounds (suitable for desired environmental conditions) offers the possibility of enhancing resistance of commercial lines through marker-assisted breeding. New linkages of resistance genes have also been facilitated through the breeding of these lines. New maize inbred (pure breeding line) lines demonstrate resistance to aflatoxin contamination in field trials. This information is critical for grain producers/industry, both nationally and globally.

Indicator 3

During FY 2012, ARS will develop innovative methods and advanced technology systems that: rapidly and accurately detect, identify, and differentiate the most critical and economically important foodborne contaminants, such as bacterial, viral, and protozoan pathogens; drug and chemical residues; and pathophysiological and processing surface contamination. Ensure that the technologies are transferred to the Food Safety Inspection Service (FSIS) and the Food and Drug Administration (FDA); the Department of Homeland Security; and industry for implementation into Hazard Analysis Critical Control Point (HACCP) programs, and Good Manufacturing Practice (GMP) protocols for both large and small producers and processors.

FY 2012 Accomplishments*:*

Certain Shiga toxin-producing Escherichia coli (STEC) serogroups, including E. coli O26, O45, O103, O111, O121, and O145 cause a similar illness in humans as E. coli O157:H7. The USDA Food Safety and Inspection Service (FSIS) recently declared these STECs as adulterants in beef. At the request of the FSIS, ARS researchers at Wyndmoor, Pennsylvania, developed and validated a rapid and simple testing method (LAT) for confirming presumptive positive non-O157 STECs to better protect the food supply and consumers.

***Impact*:** The reagents and test protocols for the technologuy were transferred to FSIS for regulatory validation, and the (LAT) agglutination method has now been incorporated into the FSIS Microbiology Laboratory Guidebook (MLG) Chapter 5B.02. Adoption of this method contributed to the implementation of the USDA 'zero tolerance policy' for the six non-O157 STECs in June 2012. The scientists who developed the LAT technology received the USDA Secretary's Award.

Salmonella species remain one of the leading pathogens causing outbreaks of illness. Unfortunately, the serotype implicated in actually causing any outbreak (clinical disease) is often difficult to determine since there may be many contaminating strains. During outbreak investigations it is critical to isolate the relevant strain from food and/or environmental sources. ARS researchers in Albany, California, determined that some Salmonella strains were more likely to be isolated than others. Current selective enrichment media shows a bias for Salmonella enterica strains while strains of serogroup B, which include serovars Typhimurium, Saint- Paul, and Schwarzengrund were less likely to emerge as dominant strains.

***Impact*:** This work provides critical information to public health agencies at the Federal and State level, as well as to the industry, stressing that during investigations, multiple enrichment protocols should be used to ensure isolation of target strains.

The USDA-Food Safety and Inspection Service recently declared Escherichia coli strains O26, 045, O103, O111, O121, and O145 adulterants in beef trim and recently started regulatory screening for these pathogens. The current method for detecting these specific (serotypes) takes several days because there is not a specific genomic marker for each serotype. ARS scientists at Clay Center, Nebraska, identified strain specific DNA markers for each serotype by comparing portions of the DNA.

***Impact*:** The DNA markers were licensed to a company that makes diagnostic kits for foodborne pathogens and are being used as part of a commercially available assay. This assay will be useful for industry and government researchers, and regulatory agencies such as the USDA-Food Safety and Inspection Service.

Produced by the common soil bacterium, Clostridium botulinum, botulinum neurotoxins (BoNTs) are potent toxins that can cause the severe foodborne disease, botulism, and could be used by bioterrorists. ARS scientists in Albany, California, have developed a rapid, sensitive lateral flow device (like a pregnancy test) that detects and distinguishes between BoNT/A and B, two of the four serotypes that are known to intoxicate humans and together account for >80% of naturally occurring botulism.

***Impact*:** This rapid diagnostic method for BONTs is a valuable tool in the areas of food safety and homeland security since it could be used by minimally trained personnel in the event of a foodborne outbreak or a bioterrorist threat.

Until now, USDA-FSIS used a 7-plate microbial growth inhibition assay to screen for antimicrobial drug residues in beef samples from slaughter establishments throughout the U.S. Last year, ARS researchers at Wyndmoor, Pennsylvania, developed, validated, and transferred to FSIS an improved screening method using ultrahigh performance liquid chromatography – tandem mass spectrometry (UHPLC-MS/MS) that improved their screening logistics and capabilities for 60 of the most important drugs of regulatory concern. In this past year the qualitative screening and identification plus quantitative method was optimized and extended to 120 drugs and validated for meat tissue.

***Impact*:** A single analyst can perform sample preparation of 60 samples with the method in an 8-hour day for a series of sequential 10 minute analyses. Implementation of the

method in the USDA-Food Safety and Inspection Service Nattional Residue Program has already found additional residues of concern missed previously. This new method serves to improve the monitoring and enforcement of veterinary drug residues, and thereby assure better animal husbandry practices, reduce environmental contamination, decrease microbial antibiotic resistance, and increase food safety.

Indicator 4

During FY 2012, ARS will determine the microbial ecology and transmission of human pathogens during animal, plant, and seafood (shellfish) processing, and identify the critical control points to reduce contamination. Develop innovative postharvest intervention strategies for improving the microbial and chmical safety of foods while reducing the impact on quality and consumer acceptance. Ensure that these technologies can be implemented into HACCP and GMP protocols and have efficacy for approval by FSIS and FDA.

FY 2012 Accomplishments*:*

Significant efforts have been made to control Listeria monocytogenes (Lm) in foods over the past decade. Outbreaks of foodborne illness are especially associated with ready-to-eat foods such as deli-meats, soft cheeses, raw and smoked fish, and raw or partially processed vegetables. At the request of the Food and Drug Administration and the USDA-Food Safety and Inspection Service, ARS researchers at Wyndmoor, Pennsylvania, undertook a study to determine the current prevalence and levels of Lm in deli-packaged versus pre-packaged RTE foods purchased at retail establishments in four FoodNet sites. The study indicated an observed Lm prevalence from 0 to 1.0 percent for seven product categories.

> ***Impact*:** This is the most comprehensive survey of L. monocytogenes in retail RTE foods in the past decade. The findings provide data to assess changes in Lm prevalence and levels in RTE foods, information that is critical for policy decisions on further controls of this pathogen, and its contribution to the public health burden. The data from this study will be used to revise the 2003 Interagency Risk Assessment on Ready-to-Eat Foods. The study received the FDA Commissioners Award for 2012.

Escherichia coli O157:H7 (ECOH) and non-O157:H7 Shiga toxin producing E. coli (STEC) are the cause of many outbreaks of illnesses and deaths. Infections are generally foodborne with ground beef a major conduit. ARS researchers at Wyndmoor, Pennsylvania, evaluated the fate of E. coli O157:H7 and non-O157 strains in both flattened and wafers of ground beef in a heated water bath and commercial grills.

> ***Impact*:** Data showed that regardless of the level of fat or type of heat/grill used, cooking ground beef patties to an internal temperature of ~71.1 degrees C was effective for destroying the pathogens lessening the threat of illness associated with this food borne pathogen. ARS data also established that cooking times/temperatures for ground beef patties. These data were transferred to the USDA-Food Safety and Inspection Service for their use in consumer related advice for safe food handling.

Passive transfer of pathogens in the food processing environment plays a major role in contaminating products for human consumption. Listeria monocytogenes, a human pathogen, can be found contaminating the food processing environment especially in floor drains inside many plants, including poultry processing plants. It was unclear to regulators that in the poultry environment if and/or how Listeria can travel from a floor-drain to product. ARS scientists in Athens, Georgia, examined if a simple, accidental discharge of water from a processing hose into

a contaminated floor drain could result in airborne transfer of live Listeria cells to other surfaces. Using experimental model drain systems, the study was able to detect airborne Listeria within the experimental rooms, where Listeria was detected settling out-of-the-air as far away as 4.0 m (13 ft) on the floors and even 2.4 m (8 ft) high on the walls.

> ***Impact*:** This study showed that inadvertent watering may play a significant role in pathogen transfer in food processing plants. Food processers will use this information to develop stronger guidance for standard sanitation operating procedures relative to avoiding inadvertent hose spray into floor drains. Researchers will find this information critical as they design and test alternative intervention strategies to prevent the escape of Listeria from contaminated sites during wash down.

Cantaloupes have been implicated in some of the deadliest foodborne illness outbreaks due to contamination with Salmonella and Listeria monocytogenes. ARS scientists at Wyndmoor, Pennsylvania, developed a rapid, easy to implement, cost effective surface pasteurization process which involves very brief, direct-from-field treatment of the product in 70C (160F) hot water. The studies revealed a reduction of bacterial contamination of greater than 99.9% with a destruction of pathogens to non-detectable levels.

> ***Impact*:** This 45 second intervention process dovetails into existing commercial cantaloupe processing lines. Collaboration between ARS and industry is also underway to evaluate and validate the effect of this commercial process on microbial quality, shelf-life, and sensory quality of fresh and fresh-cut cantaloupes.

Pathogenic contamination of food usually starts from food surfaces, and the presence and potential growth of pathogens in food during storage and transportation is a safety concern. ARS researchers at Wyndmoor, Pennsylvania, have developed and evaluated antimicrobial coatings that will effectively inactivate foodborne pathogens on food surfaces and to prevent further cross-contaminations during transportation, storage, and store display. Studies show the coating treatments were capable of reducing Salmonella by more than 99.9999% on cantaloupe, tomato stem scar, and shell eggs, and no re-growth during 14 days storage at 10 degrees C.

> ***Impact*:** Results from this research will provide food processors with viable options for designing antimicrobial coatings to improve the microbiological safety and quality of various food products.

Indicator 5

During FY 2012, ARS will undertake genomic and proteomic analyses of pathogens affecting food safety. Develop bioinformatic databases and tools, and predictive user-friendly models to understand pathogen behavior and acquisition of virulence characteristics under various stress conditions. Determine the key risk factors of human pathogens in foods, and evaluate systems interventions for their impact, which will enable regulatory/action agencies to make critical food safety decisions that impact public health and food security.

FY 2012 Accomplishments*:*

Microbial water quality of irrigation and recreation water is known to be affected by wildlife inputs and solar radiation, which are not currently accounted for in water quality predictive models. ARS researchers in Beltsville, Maryland, in collaboration with Korean scientists, developed models to take into account variations in solar radiation and in wildlife contribution to surface water fecal

contamination. Testing these models with the long-term microbiological water quality monitoring data has demonstrated improvement of the model accuracy.

> ***Impact*:** Results of this work will be useful for Federal and State regulatory agencies, and production industry in development of watershed management programs in which the effect of agriculture on water quality will be estimated more accurately than it is currently.

Cronobacter sakazakii is a deadly foodborne pathogen found in dehydrated powdered infant formula. This pathogen causes rare, but invasive infections with a case mortality rate from 40 to 80 percent in infants who are fed with reconstituted infant formula. ARS researchers at Wyndmoor, Pennsylvania, conducted a study to investigate the growth kinetics of C. sakazakii in reconstituted powdered infant formula, and develop predictive models.

> ***Impact*:** The results of this work will be helpful for industry and Federal regulatory agencies, such as the Food and Drug Administration in conducting risk assessments of reconstituted powdered infant formula exposed to various temperature-abuse conditions, as well as for parents and other caretakers in properly storing and preparing reconstituted powdered infant formula.

Fungi that colonize and kill other fungi are potential sources of novel antifungal agents and other compounds useful to agriculture or medicine. ARS at Peoria, Illinois, in collaboration with the University of Iowa have isolated several antifungal compounds which scientists in the Division of Integrated Toxicology, U.S. Army Medical Research Institute of Infectious Diseases, Frederick, Maryland, have identified as inhibitors of Clostridium botulinum neurotoxins (BoNTs). These toxins cause life-threatening illnesses and are a biosecurity threat agent.

> ***Impact*:** These are the first fungal metabolites reported to inhibit the botulinum neurotoxin and can serve as lead compounds for further chemical modifications to improve potency and other pharmacological parameters. This work is critically important for the defense, military and regulatory agencies and reveals an opportunity for human therapeutic treatment.

To understand how harmful bacteria survive and persist within the food supply, it is necessary to be able to identify and measure the products that the bacteria produce, their proteins. This field of research is referred to as proteomics and can be studied using various techniques. However, a bacterium produces a very large number of proteins and studying them can be complicated. ARS researchers at Wyndmoor, Pennsylvania, developed a novel and easy to perform proteomics method that allowed analysis of a large number of proteins produced by bacteria grown under different conditions, and the method was sensitive and reproducible.

> ***Impact*:** The workflow developed from this research will become an essential part of different research projects directed to increasing the understanding of how pathogens are able to overcome environmental stresses inherent in food settings.

The dynamics of mixed biofilm formation that include E. coli O157:H7 leading to its persistence in produce processing environments are unknown. ARS researchers in Albany, Califronia, have observed that E. coli O157:H7 produces thick biofilms on stainless steel surfaces in the presence of spinach lysates. Using physiological and metagenomic approaches, they determined that the early success of E. coli O157:H7 in these mixed biofilms was associated with its efficient utilization of spinach nutrients, whereas its population decline at later stages of the biofilm was due to its poor competition for macronutrients.

***Impact*:** This study provides risk assessment information for industry and Federal and State regulatory agencies in their investigations of factors that may compound the occurrence of outbreaks linked to produce.

Measure 4.1.1 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported on 6 new technologies developed and used to detect, identify, and control the most critically and economically important foodborne contaminants causing illness, death, or chronic disease that impact public health and industry, as determined by FSIS, APHIS, ERS, CDC, FDA, DHS, DoD, FBI, CIA, Risk Assessment Consortium, Codex Alimentarius Commission, academia, and consumer and commodity organizations.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
Developed new probiotic method capable of inhibiting the growth of enteric pathogens	Validated new method in poultry production	Poultry meat industry. Commercialized under product name FloraMax-B11	Technology marketed in 16 countries, and used for the production of >300 million birds
Develop a new biosensor for the detection of two critical mycotoxins, commonly found in cereal commodities	Develop a new biosensor for the detection of the trichothecene toxin T2, that is of worldwide concern for causing human disease	FDA, cereal industry, USDA-Grain Inspection Service, international regulatory agencies such as UK-Food Standards Agency, EFSA-European Food Standards Agency, Food Regulatory agencies in Japan and China	Technology will find immediate national and international regulatory use for the monitoring of cereals and cereal based foods, which will assist in the diversion of contaminated commodities from human food and animal feed supplies
Developed a new screening method that targets 120 of the most important drug residues in meats	Validated a new, rapid, cost effective method that targets drug residues at concentrations below current regulatory tolerance levels	USDA-FSIS, FDA-Center for Veterinary Medicine, other international regulatory agencies	Technology will be implemented by the FSIS National Residue Program, and evaluated by international bodies (AOAC) for international regulatory use
Developed a rapid, simple, cost effective, easy to implement intervention to decontaminate cantaloupes	Validated a hot-water pasteurization process to decontaminate pathogens from the surface of cantaloupes	Fresh produce industry. FDA	Technology ca be implemented through FDA and indusurty regulated GMP for fresh produce
Developed laterial flow device for the detection of Clostridium botulinum neurotoxins	Validated a new, rapid, cost effective, simple method for the detection of BoNT type A and B neurotoxins	USDA, FDA, CDC, Military and defense agencies	Technology can be used by minimally trained personnel in the vent of a foodborne outbreak or bioterrorist threat
Developed new methods for the detection of Shiga toxin producing E. coli	Validated new methods for the detection and characterization of Shiga-toxigenic E. coli	USDA-FSIS and meat industry. FSIS Microbiology Laboratory Guidebook Chapter 5B.02	Technology will be implemented through regulation for mandatory testing

Measure 4.2.1: Develop new technologies that assist ARS customers in detecting, identifying and controlling foodborne diseases associated with the consumption of animal products that affect human health. (Formerly 4.1.1)

Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

determine how population systems in animals, plants, or the environment, or any combination of these influence the safety of food. Determine the conditions under which microorganisms exist. Determine how microorganisms may in turn influence the conditions prevailing in the environment. Ensure that these technologies can be utilized by regulatory agencies, producers and/or processors to help assure safe food products.

develop an understanding of bacterial, viral, and fungal pathogenicity through a systems biology approach. Utilize this data for pathogen intervention and control, modeling, and providing data for the development of risk assessments by regulatory agencies. Ensure that these technologies can be utilized by regulatory agencies, producers and/or processor to help assure safe food products.

develop innovative methods and advanced technology systems that rapidly and accurately detect, identify, and differentiate the most critical and economically important foodborne bacterial, viral, and protozoan pathogens. Ensure that these technologies can be utilized by regulatory agencies and/or producers to help assure safe food products.

develop intervention and control strategies will help to significantly decrease or eliminate pathogens in food animals and their derived products (eggs/milk), seafood and plant crops (produce/grains/ tree nuts) during critical periods of production and processing. Develop and subsequently combine new/innovative processing technologies using the intelligent hurdle concept. Ensure that these technologies can be utilized by producers and/or processors to help assure safe food products.

develop bioinformatic databases and tools, and predictive user-friendly models to understand pathogen behavior and acquisition of virulence characteristics under various stress conditions. Determine the key risk factors of human pathogens in foods, and evaluate systems interventions for their impact, which will enable regulatory/action agencies to make critical food safety decisions that impact public health.

develop innovative methods and advanced technology systems that rapidly and accurately detect, identify, veterinary drugs, chemical residues, heavy metals, persistent organic pollutants, and biological toxins derived from bacteria, fungi and plants. Evaluate contaminant toxicity, and mechanism of action. Provide data which will enable regulatory/action agencies to make critical food safety decisions that impact public health.

During FY 2014, ARS will

determine how population systems in animals, plants, or the environment, or any combination of these influence the safety of food. Determine the conditions under which microorganisms exist. Determine how microorganisms may in turn influence the conditions prevailing in the environment. Ensure that these technologies can be utilized by regulatory agencies, producers and/or processors to help assure safe food products.

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During FY 2015, ARS will

determine how population systems in animals, plants, or the environment, or any combination of these influence the safety of food. Determine the conditions under which microorganisms exist. Determine how microorganisms may in turn influence the conditions prevailing in the environment. Ensure that these technologies can be utilized by regulatory agencies, producers and/or processors to help assure safe food products.

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OBJECTIVE 4.2: REDUCE THE NUMBER, SEVERITY AND DISTRIBUTION OF AGRICULTURAL PEST AND DISEASE OUTBREAKS

Safeguarding workers, property, domestic animals, and crop plants from pests and diseases is essential to American agriculture. Left without protection, agricultural production would decrease dramatically, threatening the Nation's prosperity and security. Because the United States is the world's largest exporter of agricultural goods, threats to U.S. agriculture are threats to our trading partners as well. Many pests and diseases are native to the United States; others have succeeded in becoming invasive pests, and yet others are likely to be introduced and established. Resources for preventing these problems are always going to be scarce in relation to the challenges, so the best knowledge available is necessary to focus the effort. An increasingly global agricultural economy and the threat of agroterrorism make the recognition and identification of potential new problems important and their prevention all the more challenging.

In the course of agricultural production, processing, and marketing, a wide array of pathogens and pests can threaten efficiency. The extent of damage depends on several factors. Influences such as globalization, international commerce, and the industrialization of agriculture can necessitate the increased movement of animals during production, lead to an increased presence of arthropod vectors, and increase the resistance of disease-carrying pathogens, ultimately increasing the severity of diseases and pests for crops, livestock, or even humans. Researchers' efforts to improve the efficacy of early detection and surveillance systems; increase the availability of vaccines, biotherapeutics, insecticides, and other protection systems; and develop effective quarantine measures can greatly decrease the severity of diseases and pests.

ARS plays a vital role in defending the Nation's agriculture from pathogens and pests, providing the knowledge necessary for agriculture to adapt to changing conditions. To shape its research efforts, the Agency regularly examines Homeland Security issues that might affect the quality of the Nation's food and fiber. ARS conducts research to find the best methods of protecting and treating agricultural commodities in storage facilities; reduce contamination from improper storage practices; and develop integrated systems for risk assessment, surveillance, treatment,

and monitoring of pests and diseases. ARS maintains partnerships with Federal and State agencies and industry and professional organizations, whereby knowledge and discoveries are refined and applied to develop products and integrated systems to optimize protective efforts against pests and pathogens.

Key Outcome: The knowledge the Nation needs for a secure agricultural production system and healthy food supply.

Performance Measures

Measure 4.2.1 Provide scientific information to protect animals, humans, and property from the negative effects of pests, infectious diseases, and other disease-causing entities.

Baseline 2006
Two research studies completed that had significant impact on the scientific community and will lead to new technologies for protection of humans, property, and livestock from harm due to pests or diseases.
Target 2012
Cumulatively, complete 10 research studies that have significant impact on the scientific community, leading to development of technologies for the integration of prevention and treatment strategies to manage top priority endemic and exotic threats to livestock, humans, and property.

Indicator 1

During FY 2012, ARS will further investigate the biology and genomics of important animal pathogens (target two priority diseases) arthropods that transmit pathogens to humans and animals, and arthropods that damage property to better understand essential life cycle processes, interaction with commodities that require protection, and means of detection.

FY 2012 Accomplishments:

Transmissible spongiform encephalopathies (TSE) such as BSE are characterized by a novel transmissible “infectious” protein called a prion that converts the cellular form of the prion protein (PrP^c), normally expressed by many cells in the body, to a misfolded, disease-associated form (PrP^d) that causes pathological lesions in the central nervous system. The complete pathologic and biochemical features of a genetic form of BSE were defined and reported for the first time by ARS scientists at the National Animal Disease Center, Ames, IA. The genetic form of BSE is analogous to the most prevalent hereditary form of human TSE. Heritable BSE along with spontaneous BSE forms are also referred to as atypical BSE cases which have important implications in that they are not associated with the feedborne epidemic of classical BSE first recognized in the United Kingdom in the 1980s.

Impact: The ability to differentiate classical from atypical BSE cases is critical as the feedborne nature of the classical BSE epidemic has been demonstrated to negatively impact export markets in various countries around the world, whereas atypical BSE does not connote the same concern.

The amino acid, lysine, at position 171 of the sheep prion protein delays development of scrapie. ARS scientists demonstrated the affect of the amino acid lysine at position 171 of the sheep prion protein on susceptibility to scrapie, a transmissible spongiform encephalopathy of sheep. Amino acid differences in the prion protein are known to play a major role in scrapie susceptibility in sheep and these genetic differences are utilized in the strategy to remove scrapie from our nation's sheep flock. Natural scrapie had previously only been described in one sheep with lysine at position 171 of the prion protein, hence not enough information was available from natural cases to determine the affect of lysine at position 171 on scrapie susceptibility. ARS scientists at the National Animal Disease Center, Ames, IA demonstrated that sheep with a prion protein containing lysine at position 171 are susceptible to scrapie but have a prolonged scrapie incubation period, and that the abnormal prion protein accumulates throughout the central nervous system and lymphoid organs.

Impact: Because sheep with lysine at prion amino acid position 171 develop scrapie at a slower rate than other known susceptible genotypes this information is critical to sheep breeders that want to eradicate genotypes susceptible to scrapie.

Gastrointestinal nematode infections in ruminants remain a major impediment to the efficient production of both meat and dairy products and an important factor in constraining global food availability. Effective parasite control strategies are currently limited and based largely upon heavy drug usage. The treatments can be expensive and labor intensive, thus reducing profitability. There has been a recent increase in parasite resistance to anti-parasitic drugs making development of new strategies imperative. In order to develop new and novel strategies, the use of bioinformatic tools enables us to better understand host-parasite relationships. ARS scientists in Beltville, Maryland characterized the response of the abomasal transcriptome to gastrointestinal parasites in parasite-susceptible and parasite-resistant Angus cattle using RNA-seq technology. These cattle displayed distinctly separate resistance phenotypes as assessed by fecal parasite egg counts. After assessing 15,432 bovine genes expressed in the abomasum, 64 genes were identified as significantly over-expressed in resistant cattle. Several specific biological pathways were found to be impacted in resistant animals suggesting their potential involvement in the development of parasite resistance.

Impact: Defining the mechanisms used by either the host or the parasite to resist or reduce parasites will enable the development of alternative strategies of control including genetic selection in the host.

Bed bugs are a blood-sucking pest that lives in homes, hotels, shelters, vehicles, and businesses. The bugs feed at night causing a variety of reactions from mild irritation to extensive blistering and allergic reaction. Bed bugs had been controlled effectively in the U.S. since the 1950s until they became much more numerous starting in approximately 2002. They are now a chronic problem in many American cities, especially affecting hotels, shelters, and multi-family homes. In response to stakeholder input in 2007, ARS started a program to study chemical ecology and control of bed bugs at Beltsville, Maryland. ARS participation in the Federal Bed Bug Task Force has facilitated extensive discussions with other agencies, including the CDC. Although the CDC participates, it does not consider bed bugs a public health pest because they do not transmit any pathogens. ARS scientists at worked in collaboration with The University of Mississippi Medical Center and Harvard Medical School to show that bed bug bites can cause a very severe,

localized inflammation of blood vessels. Moreover, the type of inflammation that occurs has the potential to affect major body organs.

> ***Impact:*** These data show that bed bugs are not only an annoyance, but also a health threat. The impact of this research may be greater involvement proponents of public health in control of the national bed bug problem.

Indicator 2:

During 2012, ARS will further investigate the epidemiology and ecology of important animal pathogens (target two priority diseases) arthropods that transmit pathogens to humans and animals, and arthropods that damage property to improve risk assessment, surveillance, prevention, and control by veterinarians and entomologists.

FY 2012 Accomplishments*:*

Swine influenza A virus causes a respiratory disease in swine similar to that in humans. In collaboration with NIH scientists, ARS scientists at the National Animal Disease Center (NADC), Ames, Iowa, investigated the genetic evolution of novel reassortant swine influenza A viruses detected in the United States and Canada between 2009-2011 with a focus on H3N2 viruses. Analyses included H3N2 viruses designated A(H3N2) variant (v) because of their capability to also infect humans as recently discovered in the United States, July 2011. Analyses of samples from twelve human cases revealed that the variant swine-lineage H3N2 viruses contained the pandemic matrix (pM) gene from pandemic H1N1 viruses. The A(H3N2)v viruses are distinct from contemporary H3N2 circulating in humans and the flu viruses incorporated in the human seasonal flu vaccine, and hence represents a potential pandemic threat.

> ***Impact*****:** Monitoring and reporting evolutionary dynamics of gene segments in swine at a detailed level is critical to understand how these novel H3N2 viruses emerged in swine and to assess and predict the potential epidemic and/or pandemic threat of variant influenza viruses pose to humans.

Respiratory pathogens of domestic sheep including *Mannheimia haemolytica* (*Mh*) lead to millions of dollars in production losses annually. In addition to production losses in domestic sheep, *Mh* is an important bacterial pathogen of bighorn sheep. Data indicate that domestic sheep transmit pathogenic subtypes of *Mh* to bighorn sheep, and a currently debated intervention is separation of domestic from bighorn sheep areas. However, the current separation strategy consisting of removing domestic sheep grazing rights in the West economically threatens a large fraction of the U.S sheep industry, and additional intervention strategies are urgently needed. Researchers from Washington State University and ARS scientists at Pullman, Washington, administered equivalent doses of *Mh* simultaneously to bighorn and domestic sheep and the bighorn sheep failed to remove the bacteria from their lungs as quickly or as thoroughly as the domestic sheep. As a result, bighorn sheep tend to have more severe lung damage associated with *Mh* pneumonia than domestic sheep, but the reasons for lack of bacterial clearance is not clear. These findings did not rule out that an overactive immune response in the as part of the explanation for differing lung damage between these closely related species.

> ***Impact:*** The differences in the ability of the two sheep species to clear bacteria from their lungs will provide an important baseline to determine potential explanations for the severity of respiratory disease in bighorn sheep that may lead to new and novel intervention strategies.

Sand flies transmit pathogens that cause a variety of diseases in humans, including verruga, kala azar, cutaneous leishmaniasis, and sand fly fever. Cutaneous leishmaniasis was a major problem for the U.S. military in Iraq and kala azar accounts for hundreds of thousands of childhood deaths in Africa. ARS scientists at Kerrville, Texas identified, cloned, and sequenced sand fly acetylcholinesterase, an enzyme which is the target for many kinds of effective pesticides. Collaborative research with the University of Florida is identifying compounds that closely target sand fly acetylcholinesterase. Such active ingredients will not only be effective, but safe for people and other non-target organisms.

Impact: These findings offer the opportunity to develop new insecticides for effective sand fly control.

Measure 4.2.1 Summary of the Major Scientific Discoveries, Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported 7 new scientific discoveries, transferred and used by the scientific community, the private sector, and government agencies to develop control meansures to manage priority endemic and foreign animal disease threats.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
Pathologic and Biochemical Characterization of a Genetic Form of Bovine Spongiform Encephalopathy (BSE)	This technical information was communicated to the cattle industries and APHIS and published in a peer-reviewed publications: Greenlee, J.J. et al. 2012. Clinical and pathologic features of H-type bovine spongiform encephalopathy associated with E211K prion protein polymorphism. PLoS ONE. 7(6):e38678.	The U.S cattle industries	The ability to differentiate classical from atypical BSE cases is critical as the feedborne nature of the classical BSE epidemic has been demonstrated to negatively impact export markets in various countries around the world, whereas atypical BSE does not connote the same concern
A Genetic Marker Associated with Resistance to Scrapie	This technical information was communicated to the sheep industry and APHIS and published in a peer-reviewed publications: Greenlee, J.J. et al. 2012. Prolonged incubation time in sheep with prion protein containing lysine at position 171. Journal of Veterinary Diagnostic Investigation. 24(3):554-558.	The U.S sheep industry	Genetic information critical to sheep breeders that want to eradicate animals genetically susceptible to scrapie
Swine influenza A virus causes a respiratory disease in swine similar to that in humans.	This information was communicated to the pork industry and published in a peer-reviewed publications: Nelson, M.I. Vincent, A.L., Kitikoon, P., Holmes, E.C., Gramer, M.R. 2012. The evolution of novel reassortant A/H3N2 influenza viruses in North American swine and humans, 2009-2011. Journal of Virology. 86(16):8872-8878.	The Pork industry	Monitoring and reporting evolutionary dynamics of gene segments in swine at a detailed level is critical to understand how these novel H3N2 viruses emerged in swine and to assess and predict the potential epidemic and/or pandemic threat of variant influenza viruses pose to humans.
Genetic Resistance to Nematode Infection in Cattle	This information was communicated to the cattle industry and published in a peer-reviewed publication Li, R.W., Rinaldi, M., Capuco, A.V. 2011.	The cattle and small ruminant industries.	Genetic information critical to the cattle and small ruminant industries to control nematode parasites.

	Characterization of the abomasal transcriptome for mechanisms of resistance to gastrointestinal nematodes in cattle. Veterinary Research. 42(1):114.		
Reduced Bacterial Clearance From the Lungs of Bighorn Sheep	The information was disseminated to the sheep industry and the forest service and published in a peer-reviewed journal: Subramaniam, R., Herndon, C.N., Shanthalingam, S., Dassanayake, R.P., Bavananthasivam, J., Potter, K.A., Knowles Jr, D.P., Foreyt, W.J., Srikumaran, S. 2011. Defective bacterial clearance is responsible for the enhanced lung pathology characteristic of *Mannheimia haemolytica* pneumonia in bighorn sheep. Veterinary Microbiology. 153(3-4):332-8.	The sheep industry and the US Forest Service	Disease ecology information critical to understanding the interaction between domestic and bighorn sheep in the transmission of pneumonia.
New biocontrol against imported fire ants	Released *Pseudacteon cultellatus* and showed establishment	USDA APHIS PPQ, local communities	Attacks small ants associated with multi-queen colonies of fire ants
Economic analysis of stable fly damage to cattle	Published scientific study	Cattle industry	Shows that stable flies are a significant cost to cattle producers, costing the national herd $2 billion per year

Measure 4.4.2: Provide scientific information to protect animals, humans, and property from the negative effects of pests and infectious diseases. Develop and transfer tools to the agricultural community, commercial partners, and government agencies to control or eradicate domestic and exotic diseases and pests that affect animal and human health. (Formerly 4.2.1)
Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

describe 5 new discoveries or developments significant for their scientific or applied value.

During FY 2014, ARS will

describe 5 new discoveries or developments significant for their scientific or applied value.

During FY 2015, ARS will

describe 5 new discoveries or developments significant for their scientific or applied value.

Measure 4.2.2 Develop and transfer tools to the agricultural community, commercial partners, and government agencies to control or eradicate domestic and exotic diseases and pests that affect animal and human health.

Baseline 2006
One technologies used by the commercial and government sectors relevant to the protection of humans, property, and domestic animals.
Target 2012
Cumulatively, transfer five technologies to the commercial and government sectors.

Indicator 1:

During FY 2012, ARS will form new partnerships and continue old partnerships with industry, universities, and other government agencies in order too promote production and marketing of new methods for detection and identification of animal pathogens, arthropods that transmit pathogens, and arthropods that destroy property; including genetic markers, new methods of detecting gene sequences or antibodies or proteins, and comprehensive guides to morphological identification.

FY 2012 Accomplishments:

HoBi like virus is a newly emerging type of virus distantly related to bovine viral diarrhea virus (BVDV) that has been isolated from cattle in South America, Southeast Asia and Europe. The clinical presentation following infection with this type of virus is very similar to that seen following infection with BVDV. Like BVDV, HoBi-like viruses cause immune suppression and can establish life-long persistent infection in cattle. HoBi like viruses have not yet been detected in the U.S. ARS scientists at the National Animal Disease Center (NADC), Ames, Iowa, have developed tests to provide diagnosticians and regulatory agencies with tools to screen imported animals and animal products to prevent introduction of HoBi like viruses into the U.S.

> ***Impact:*** These diagnostic tests provide the means for early detection should HoBi viruses enter the United States.

Pseudorabies virus (PRV), the cause of Aujeszky's disease, was eradicated from U.S domestic swine herds but continues to circulate in the feral swine population and thus continues to pose a threat for the commercial swine industry. A critical need for the current PRV surveillance program in the United States is the rapid detection of PRV. ARS scientists validated a real-time PCR assay for pseudorabies virus surveillance. Real-time polymerase chain reaction (real-time PCR) is a valuable diagnostic technique that can rapidly identify infectious agents in clinical specimens. Diagnostic performance of the real-time PCR assay developed as a testing method confirmed that it is a rapid, accurate assay that is adaptable to a variety of PCR platforms currently in use by diagnostic laboratories around the world and can provide reliable results on an array of clinical samples.

> ***Impact:*** This diagnostic test provides the means for detecting PRV circulating in feral swine and enables the implementation of a national PRV surveillance program.

The insidious reemergence of equine babesiosis or piroplasmosis in 2009 in Texas is a poignant reminder of the vigilance required to maintain an infection-free status in the U.S. Equine piroplasmosis has been considered a foreign animal disease in the United States since 1980's.Ticks native to the U.S. such as *Dermacentor variabilis* and *Riphicephalus microplus* are

known vectors *Babesia equi,* the causative agent of equine babesiosis. ARS scientists at Pullman, Washington in collaboration with APHIS-National Veterinary Service Laboratory, Ames, Iowa and APHIS-Western Regional Office, Fort Collins, Colorado identified the native U.S tick, *Amblyomma cajennense*, as the predominant tick species found on horses at the Texas outbreak and capable of transmitting *B. equi*. In addition, it has the potential to geographically expand within the U.S. due to acaricide resistance and distribution by infected horses and wildlife adding an additional risk factor. Persistently infected horses are the reservoirs for tick acquisition of *B.equi* and its transmission to susceptible horses.

> ***Impact:*** Understanding the competency of the U.S. native ticks is critical to designing an efficient control strategy to prevent the dissemination of equine.

Johne's disease (Paratuberculosis) is a chronic, progressive enteric disease of ruminants caused by infection with *Mycobacterium avium* subsp. *paratuberculosis* (MAP). Cattle become infected as calves, yet usually do not develop signs of diarrhea and weight loss until 2 to 5 years of age. During the subclinical phase of disease, animals may intermittently shed the organism in their feces, thereby contaminating the environment and infecting other animals within the herd. Current diagnostic tests are not able to identify these subclinically infected animals accurately. In order to prevent the further spread of this disease, improved diagnostic tools for the detection of infection and development of new vaccines to enhance control strategies are needed. ARS researchers at the National Animal Disease Center, Ames, Iowa, identified a new monoclonal antibody that selectively detects MAP and not other closely related bacterial strains. Further research identified the protein, termed MAP1025 that this specific antibody binds.

> ***Impact:*** This antibody is currently the only one in the world that has the capability of specifically identifying MAP. This antibody is the subject of a recently issued US patent. The identification of this unique protein and antibody for MAP will be helpful in developing new diagnostic tools to detect infected animals.

Indicator 2:

During 2012, ARS will form new partnerships and continue old partnerships with industry, universities, and other government agencies in order to promote production and marketing of mathematical models, evidence-based procedures, computerized spatial analysis systems, and other tools that measure risk of animal pathogens, arthropods that pathogens and arthropods that destroy property.

FY 2012 Accomplishments*:*

No accomplishments for this indicator

Indicator 3:

***During 2012, ARS will* form new partnerships and continue old partnerships with industry, universities, and other government agencies in order to promote production and marketing of new methods of management of arthropods that damage property or that transmit pathogens to humans and animals.**

FY 2012 Accomplishments*:*

No accomplishments for this indicator

Measure 4.2.2 Summary of Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported 4 new technologies developed, transferred, and used by the private sector and government agencies to protect animals, people, and property.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
Diagnostic tests to detect newly emerging HoBi viruses	These diagnostic tests have been transferred to APHIS	The beef and dairy cattle industries	These tests provide the means to detect and control an introduction of HoBi viruses if they were to be introduced in the U.S.
A Rapid Diagnostic Test for Pseudorabies Surveillance	This diagnostic test has been transferred to APHIS and State diagnostic laboratories	The pork industry and action and regulatory agencies	This diagnostic test provides the means for implementing a national PRV surveillance program.
Determination of a New Tick Vector for Equine Babesiosis	This information was communicated to APHIS and the equine industry and published in a peer-reviewed publication: Scoles, G.A., Hutcheson, H.J., Schlater, J.L., Hennager, S.G., Pelzel, A.M., Knowles Jr, D.P. 2011. Equine Piroplasmosis Associated with Amblyomma cajennense Ticks, Texas, USA. Emerging Infectious Diseases. 17(10)1903-1905.	APHIS and the equine industry.	Critical information on ticks for control of a disease considered to the U.S. equine industry.
Development of a Monoclonal Antibody Specific for a Johne's Protein	This information has been shared with the Johne's research community and a patent is pending for licensing as a diagnostic tool. It has been published in a peer-reviewed journal: Bannantine, J.P., Stabel, J.R., Lamont, E.A., Briggs, R.E., Sreevatsan, S. 2011. Monoclonal antibodies bind a SNP-sensitive epitope that is present uniquely in Mycobacterium avium subspecies paratuberculosis. Frontiers in Microbiology. 2(163):1-13.	The cattle industry and diagnostic companies	This monoclonal antibody has the potential to greatly increase the ability to diagnose Johne's disease at an early timepoint.

Measure 4.4.2.: Provide scientific information to protect animals, humans, and property from the negative effects of pests and infectious diseases. Develop and transfer tools to the agricultural community, commercial partners, and government agencies to control or eradicate domestic and exotic diseases and pests that affect animal and human health. (Formerly 4.2.2)

Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

form new partnerships and continue old partnerships with industry, universities, and other government agencies in order to promote production and marketing of new methods for detection and identification of animal pathogens, arthropods that transmit pathogens, and arthropods that destroy property; including genetic markers, new methods of detecting gene sequences or antibodies or proteins, and comprehensive guides to morphological identification.

form new partnerships and continue old partnerships with industry, universities, and other government agencies in order to promote production and marketing of inventions that protect animals from pathogens or manage arthropods that transmit pathogens or damage property.

During FY 2014, ARS will

form new partnerships and continue old partnerships with industry, universities, and other government agencies in order to promote production and marketing of new methods for detection and identification of animal pathogens, arthropods that transmit pathogens, and arthropods that destroy property; including genetic markers, new methods of detecting gene sequences or antibodies or proteins, and comprehensive guides to morphological identification.

form new partnerships and continue old partnerships with industry, universities, and other government agencies in order to promote production and marketing of inventions that protect animals from pathogens or manage arthropods that transmit pathogens or damage property.

During FY 2015, ARS will

form new partnerships and continue old partnerships with industry, universities, and other government agencies in order to promote production and marketing of new methods for detection and identification of animal pathogens, arthropods that transmit pathogens, and arthropods that destroy property; including genetic markers, new methods of detecting gene sequences or antibodies or proteins, and comprehensive guides to morphological identification.

form new partnerships and continue old partnerships with industry, universities, and other government agencies in order to promote production and marketing of inventions that protect animals from pathogens or manage arthropods that transmit pathogens or damage property.

Measure 4.2.3 Develop control strategies based on fundamental and applied research to reduce losses caused by plant diseases, nematodes, arthropods, and weeds that are effective and affordable while maintaining environmental quality. Develop technically and economically feasible alternatives to preplant and postharvest use of methyl bromide.

Baseline 2006
Developed eight new, environmentally sound management

Baseline 2006
practices that include crop resistance/tolerance through classical breeding and biotechnology, rapid and reliable diagnostics, pesticide development and use, and cultural and biological control. Biorationals have been studied and improvements explored that will provide additional protection for agriculturally important plants from pests and pathogens.
Target 2012
Specific information and technology using methods cited above will be made available to producers and the research community to exclude, control, and/or better manage disease and pest outbreaks as they occur. Strategies and approaches will be made available to producers to identify and control and/or effectively manage over 10 new and emerging crop diseases and pests.

Indicator 1:

During 2012, ARS will develop methods to reduce emissions of harmful gases from crop production systems and post-harvest/quarantine treatments.

FY 2012 Accomplishments*:*

Emission reduction with Totally Impermeable Film. Tarping fumigated fields with Totally Impermeable Film (TIF) can significantly reduce emissions, but it can also increase fumigant residence time in soil and require extended tarp-covering durations to reduce potential exposure of workers and bystanders to fumigants. In collaboration with university researchers, industry, and regulatory agencies, ARS scientists conducted a large field study and found a low emission flux, of a mixture of chloropicrin and 1,3-dichloropropene (Pic-Clor 60), throughout a tarp-covering period of 16 days; total emission loss was less than10 percent and loss at the tarp edges was less than 1 percent. Emission flux upon tarp-cutting increased, but was substantially lower than emissions when the tarp was cut 5 or 6 days after covering.

> ***Impact*:** This evaluation demonstrated the ability of TIF to significantly reduce fumigant peak flux and total emissions and also documented the need for a longer wait time before tarp-cutting time when using TIF.

Induction of nematode suppressive soil system. The tree fruit producer community needs effective non-chemical strategies for long-term control of plant parasitic nematodes because no nematicides are available for post-plant application. ARS scientists in Wenatchee, Washington, examined pre-plant application of *Brassicaceae* seed meal formulations used in conjunction with a virtually impermeable film for control of apple replant disease and suppression of lesion nematode in two organic orchard systems. Seed meal formulations provided multi-year suppression of lesion nematode densities in apple roots to levels significantly below the no treatment control. Nematode suppression in the seed meal treated soil was associated with significant changes in soil biology, including increased densities of nematode parasites and predators.

> ***Impact*:** This research indicates that a biologically viable alternative to chemical nematicides or soil fumigants can provide long-term suppression of plant parasitic nematodes in orchard production systems.

Methyl bromide alternatives for forest nurseries. ARS researchers surveyed forest nurseries of the Pacific Northwest for the presence of soilborne pathogens and found eight *Pythium spp*. pathogenic to Douglas-fir seedlings. Reduced-rate alternative fumigant treatments were identified that were as effective as methyl bromide at disease and weed control in forest nursery field studies. Aerated steam, irrigation management, and certain fungicides were also effective for the control of soilborne pathogens.

> ***Impact*:** These findings are significant because they provide economically viable alternatives to methyl bromide for disease control and their implementation can reduce emissions through lower rates of applied fumigants.

Management of red flour beetles in rice mills without methyl bromide. The red flour beetle is the most important insect pest infesting rice mills and management has historically relied on structural fumigation with methyl bromide. Because this use of methyl bromide is being phased out under the Montreal Protocol, there is a critical need to evaluate the efficacy of alternative treatments. ARS scientists in Manhattan, Kansas, and cooperators at Kansas State University determined that the average reduction in beetle capture in pheromone traps, after 25 sulfuryl fluoride fumigations in six rice mills, was 66 percent. Beetle captures inside these mills tended to follow a seasonal pattern of increased captures in warm months and decreased captures in cool months; these inside captures correlated with outside captures. The reduction in captures and the rate at which beetle captures returned to pre-treatment levels was strongly influenced by seasonal patterns of insect abundance, a pattern that contrasts with the non-seasonal nature of infestation in wheat mills.

> ***Impact*:** These data suggest that there are fundamental differences in red flour beetle populations in rice and wheat mills and that the timing of fumigation is critical for maximizing fumigation efficacy of alternatives to methyl bromide.

Tool to target stored products beetles. Knowing when and where to treat stored products for pests is important to limiting the use of fumigation and other pesticide treatments. Accurate surveillance can also increase the effectiveness of integrated pest management by enabling applicators to concentrate efforts where the problem is most severe. ARS scientists in Gainesville, Florida, have developed a new trapping system for stored product beetles. Studies of several beetle species that are pests of stored grains showed that all are preferentially attracted to light at a wavelength of 390 nanometers. Light at this optimum wavelength and a design that took advantage of beetles' tendency to orient towards edges were used to create a trap 20 times better than the current industry standard.

> ***Impact*:** Development of this new trapping system significantly improves the ability to monitor stored product pests even when pests are present at extremely low levels. The system promises to significantly reduce pesticide use for control of these pests because instead of fumigating a whole mill or warehouse only specific areas need to be treated.

Stored product pest management in grain mills. Grain mills have used fumigants extensively to treat areas where flour, grain parts, and other materials accumulate and support development of stored products pests such as the lesser grain borer and the rice weevil. ARS scientists in, Manhattan, Kansas, have systematically tested residuals spray treatments on the kinds of surfaces found in grain milling operations. They have discovered combinations of treatments that can greatly reduce the need for fumigation in the many parts of such facilities that provide good habitats for stored products pests. This work has shown that rice mills are considerably different from flour mills, with much more connection to insect populations outdoors.

> ***Impact*:** These findings provide practical guidance on how to minimize the populations of pests that might otherwise infest grain products.

Alternatives to methyl bromide for clean commodities in California. Finding alternatives to methyl bromide that are both effective and do not harm commodities is a priority. Experiments conducted by ARS researchers in Parlier, California, demonstrated the insecticidal efficacy of sulfuryl fluoride and phosphine, which were dispensed by a Horn generator. These fumigants appear to be the primary chemical alternatives to methyl bromide for postharvest disinfestations of perishable and durable commodities in California, but fumigants are not the only alternative to methyl bromide. In collaboration with Washington State University, ARS researchers in Parlier, California, have found that a low pressure-low temperature treatment kills codling moth in fresh fruit and results in a higher quality product than when the produce is treated with methyl bromide.

> ***Impact*:** This research provides new information on alternatives to methyl bromide while protecting American agricultural interests.

Oxygen and phosphine as an alternative to methyl bromide. Phosphine is commonly used as a fumigant and it does not degrade the ozone layer as methyl bromide does. The effectiveness of phosphine, whether generated from metallic phosphides or applied in pure form, is not as certain as for methyl bromide. Fumigation of leafy vegetables is a particular challenge because the tissues of the plants are easily damaged by fumigation and must be kept at cool temperatures to assure longevity of the product. ARS scientists in Salinas, California, have discovered that the addition of oxygen to phosphine fumigations greatly increases the effectiveness of this fumigant at low temperatures. Oxygenated phosphine fumigation was demonstrated to significantly reduce treatment time and phytotoxicity and achieve effective control of tolerant insects that cannot be controlled with regular phosphine fumigation.

> ***Impact*:** Oxygenated phosphine fumigation has the potential to make significant impact on the fumigation industry and replace the need for methyl bromide in some situations.

Indicator 2:

During 2012, ARS will continue to identify and characterize genes of insect resistance in crop plants, closely related non-crop species, and other species, to enhance opportunities for developing host plant resistance, and to incorporate such genes into commercially acceptable varieties.

FY 2012 Accomplishments:

New sources of resistance to fungal diseases in sorghum identified. Fungal molds and smuts reduce the yield and quality of sorghum worldwide. In 2012, ARS researchers in College Station, Texas, working with cooperators in Puerto Rico, Senegal, and Mexico, identified sorghum lines with resistance to anthracnose, downy mildew, grain mold, and long smut. Twenty sorghum accessions were evaluated for leaf spot and anthracnose resistance in González, Tamaulipas, Mexico, in collaboration with the Instituto Nacional de Investigaciones Forestales Agricolas y Pecuarias (INIFAP), and seven lines were found with protection for leaf spot and anthracnose.

> ***Impact*:** All the identified resistant lines will provide sorghum breeders new sources of genetic resistance to fungal diseases and contribute to international food security.

Refuting role of destruxins' importance in insect pathogenicity and virulence by Metarhizium fungi. The small peptide family known as destruxins has been thought to be critically important for virulence against insects, but conclusive proof as to their importance has been lacking. ARS researchers in Ithaca, New York, identified the gene cluster responsible for biosynthesis of these

peptides and generated knockout fungal strains of *Metarhizium* incapable of producing destruxins. The mutants had no significant changes in virulence levels against several different insect species and no changes in fungal morphology or development. That destruxins appear to be dispensable for virulence against insects casts serious doubt on their long-purported role in insect pathogenicity and virulence.

***Impact*:** This finding will inform efforts to exploit these fungi to target specific insect pests.

Indicator 3:

During 2012, ARS will continue to develop fundamental knowledge about insect biology and ecology that provides the foundation for strategies to exclude, detect, and mitigate pest infestations.

FY 2012 Accomplishments:

Effects of global change on insect pests of crops. Global change may include an overall increase in global temperatures, redistribution of rainfall patterns with overall increase in precipitation, increased incidence of weather events, and increased levels of ambient carbon dioxide in the atmosphere. ARS researchers in Sidney, Montana, summarized the literature on potential climate change effects on insect pests for the National Climate Assessment for Agriculture. Rising air temperatures affect all aspects of insect life cycles and generally result in larger insect populations, resulting from earlier emergence and more generations per year. Many pests currently limited by cooler temperatures at higher latitudes will be able to expand their ranges into these areas. Elevated carbon dioxide levels cause plants to shift their defenses from the production of defensive chemicals to the development of tougher, less digestible leaves. Beetles, aphids, and possibly other pests are favored by these changes. Plans to grow more suitable crops as conditions change will need to consider the redistribution of pests and their increasing severity. Better integrated pest management will need to be developed for those pests likely to cause the greatest losses in yield.

***Impact*:** These conclusions are being disseminated in a status report on the impacts of climate on agriculture in the United States for the U.S. Congress and the President of the United States to inform policy.

Localization of bacterial and fungal pathogens within the southern green stink bug. Southern green stink bugs (SGSBs) acquire several opportunistic plant pathogens from environmental sources as they feed. Some of these pathogens are transmitted to cotton bolls, resulting in boll rot, and subsequent yield losses. ARS scientists in College Station, Texas, identified the pathogens transmitted to cotton bolls by SGSBs that are responsible for boll rot. These researchers determined that only two of the many pathogens found in the mouthparts, alimentary canal, or head of the SGSB, are actually transmitted into cotton bolls through SGSB feeding.

***Impact*:** This work provides a much better understanding of the role of the SGSB in transmitting pathogens and will be used to develop control measures to improve U.S. cotton yields.

Key discovery for effective microbial control of insect pests. Without effective integrated pest management, overall crop production would likely decrease by 50 percent. Use of insect pathogens to control pests could have many advantages over other methods including a lower cost, elimination of the risk of environmental damage, and increased sustainability. ARS scientists in Manhattan, Kansas, worked with stored products pests to show that the normal gut

bacteria of most insects acts like a pro-biotic, protecting the insects from pathogenic microbes, and forms a barrier that hinders pathogen penetration of the gut wall.

> ***Impact*:** This discovery will lead to more effective microbial pesticides, a corresponding reduction in the amount of pesticides used, and lower crop production costs; as well as providing sustainable solutions for control of insect pests.

Indicator 4:

During 2012, ARS will continue to develop fundamental knowledge about weed biology and ecology that provides the foundation for strategies to exclude, detect, and mitigate weed infestations.

FY 2012 Accomplishments:

Root physiology for weed control and plant health. Herbicides are an essential part of American agriculture, not only to increase yields of major crops, but also to preserve soil and water through no-till strategies. Herbicide resistance threatens the usefulness of active ingredients, some of which are less damaging to the environment. Basic work on the physiology of root hairs by ARS scientists in Oxford, Mississippi revealed an entirely new mechanism of plant physiology that might be exploited for the development of herbicides. Using a library of the DNA sequences of root hair cells from sorghum, these scientists identified the genetic sequences responsible for production of a natural herbicide, sorgoleone, and for the control of that gene. DNA with those sequences inserted into rice or mustard stimulated production of sorgoleone, which is normally only produced by sorghum.

> ***Impact*:** This discovery could lead to the development of crops that protect themselves from weeds, modify the microbial community in soil, enhance plant nutrient acquisition, and bioremediate contaminated soils.

Multi-tactic approaches for effective management of glyphosate-resistant Palmer amaranth. ARS researchers found that winter cover crops rolled horizontally to form a thick mulch mat will help to hinder establishment of the small-seeded Palmer amaranth. Palmer amaranth populations in the southern United States have resistance to four different herbicide classes (with different mechanisms of action) and based on the genetic variability within the population, resistance to other herbicides is likely to exist within a population. Repeated use of a particular herbicide class will select for this resistance, by allowing plants to establish and reproduce. Successful stewardship of the current herbicide technologies depends on minimizing the number of plants that are under herbicide selection pressure. The physical barrier of the rolled cover crop mulches reduces the established Palmer amaranth plant density. However, the mulch will bind some herbicides, keeping them from reaching the soil surface, to reduce Palmer amaranth control. In addition, weeds that are able to emerge where the cover crop mulch was thin or moved during planting of the summer crop may have greater growth than those growing without the cover crop.

> ***Impact*:** This research contributes methods to maximize consistent ground coverage of the mulch to minimize Palmer amaranth establishment.

Indicator 5:

During 2012, ARS will continue to develop fundamental knowledge about plant disease biology and ecology that provides the foundation for strategies to exclude, detect, and mitigate disease outbreaks.

FY 2012 Accomplishments:

Soybean mosaic virus (SMV) genome regions required for aphid and seed transmission. *Soybean mosaic virus* (SMV) is transmitted by aphids and through seed, and can cause yield reductions as high as 35 percent in soybean. SMV-infected seeds serve as the primary source of inoculum for the virus in North America, and secondary spread occurs by aphids. ARS researchers in Urbana, Illinois, and scientists at the University of Illinois studied the role of virus-encoded proteins in aphid and seed transmission, severity of foliar symptoms, and induction of seed coat mottling. Two virus proteins previously associated with aphid transmission were shown to also be required for efficient seed transmission, and this discovery suggests that interactions of the two proteins are important for multiple functions in the virus life cycle. In addition, two other regions within the SMV genome were shown to affect transmission through seed and the presence of seed-coat mottling in virus-infected seeds.

> ***Impact*:** The information will help pathologists and virologists develop novel methods to disrupt this disease.

Soybean dwarf virus is limited by the aphid vector in the United States. *Soybean dwarf virus* (SbDV), which significantly affects soybean crops in Japan and other Asian countries, has been identified in multiple locations within the United States. Outbreaks of SbDV in the United States have always been limited, perhaps because the primary aphid colonizing soybean (*Aphis glycines)* is reported to be a poor vector of SbDV. An experimental analysis conducted by ARS researchers in Frederick, Maryland, identified soybean mutations that tend to prevent effective transmission of SbDV.

> ***Impact*:** This work provides new information on how to strengthen protection of U.S. soybeans from SbDV.

Measure 4.2.3 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported 5 new environmentally sound management practices that include crop resistance/tolerance through breeding and biotechnology, rapid and reliable diagnostics, pesticide and cultural and biological control developed and used to protect agriculturally important plants from pests and pathogens.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
ARS researchers found that their new grafting techniques, which used angled cuts at 70 degrees (rather than 20 or 45), increased the initial survival of tomatoes. Also, the greater the graft angle the greater the force necessary to separate the scion and the rootstock at the graft union because the he greater angle exposes more surface area to allow greater cell to cell contact.	These grafting techniques have been provided to growers/producers.	Tomato growers and the industry as a whole.	The increased survivability using this method will reduce the need for overplanting by as much as 30 percent.

ARS scientists collected data on tree growth and yield from 10 orchard replant trials, which demonstrated that broadcast, strip, and GPS-controlled spot fumigation treatments with 1,3-dichloropropene, chloropicrin, or mixtures of the two fumigants and found that they provided equal or superior control, relative to Methyl Bromide, of Prunus Replant Disease .	This information has been shared with growers and industry and one large commercial operation had adopted these new alternatives to methyl bromide.	Growers of almond, peach, and other trees whose crops are vulnerable to Prunus Replant Disease, as well as the associated industries.	Alternatives to Methyl Bromide were discovered and have been adopted by a large commercial operation and others have expressed interest. Additional research is being conducted to integrate this technology with GPS application software to make adoption easier.
ARS scientists' completed 4-years of research and demonstration trials on sweet potato hotbeds and found that combinations of 1,3-Dichloropropene, chloropicrin, and metam sodium with herbicides provide alternatives to Methyl Bromide.	These methyl bromide alternatives were provided to growers and many are adopting this technology.	Sweet potato growers and the industry as a whole.	Because of the cost and limited availability of methyl bromide that occurred after 2011, growers are rapidly adopting many of the alternatives tested.
ARS researchers found the postharvest irradiation treatment that controls light brown apple moth (LBAM); the radiation dose use resulted in zero tolerance (100 percent control) of the most tolerant LBAM stage.	These methyl bromide alternatives were provided to growers whose crops are affected by LBAM.	Exporters of crops affected by LBAM, and the countries that import them, especially those countries with a zero tolerance policy.	This information will facilitate international trade of commodities that are hosts of LBAM.
ARS researchers developed an effective biological control approach to reduce aflatoxin contamination in corn using non-aflatoxin-producing strains of *A. flavus*, via solid application of formulations with bioplastic and water dispersible granules. They also sequenced the genomes of three benign strains of *A. flavus* to enable comparison between benign and toxigenic strains.	This approach has been shared with growers.	U.S. corn growers , the industry as a whole, and International aid agencies that provide technical assistance to corn growers abroad.	A U.S. patent was granted on "granular bioplastic biocontrol composition."

4.3.2: Provide scientific information to increase our knowledge of plant genes, genomes and biological and molecular processes to protect crops and cropping systems from the negative effects of pests and infectious diseases. Develop sustainable control strategies for crop pests and pathogens based on fundamental and applied research that are effective and affordable, while maintaining food safety and environmental quality. (Formerly 4.2.3)

Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

continue to identify and characterize genes of insect, nematode, and plant pathogen resistance in crop plants, closely related non-crop species, and other species, to enhance opportunities for developing host plant resistance, and to incorporate such genes into commercially acceptable varieties.

continue to develop fundamental knowledge about biology and ecology that provides the foundation for strategies to exclude, accurately detect and identify, and mitigate arthropod and nematode pests, weeds, and plant pathogens.

perform applied research and development to provide new, useful and safe products to exclude, accurately detect and identify, and mitigate arthropod and nematode pests, weeds, and plant pathogens.

During FY 2014, ARS will

continue to identify and characterize genes of insect, nematode, and plant pathogen resistance in crop plants, closely related non-crop species, and other species, to enhance opportunities for developing host plant resistance, and to incorporate such genes into commercially acceptable varieties.

continue to develop fundamental knowledge about biology and ecology that provides the foundation for strategies to exclude, accurately detect and identify, and mitigate arthropod and nematode pests, weeds, and plant pathogens.

perform applied research and development to provide new, useful and safe products to exclude, accurately detect and identify, and mitigate arthropod and nematode pests, weeds, and plant pathogens.

During FY 2015, ARS will

continue to identify and characterize genes of insect, nematode, and plant pathogen resistance in crop plants, closely related non-crop species, and other species, to enhance opportunities for developing host plant resistance, and to incorporate such genes into commercially acceptable varieties.

continue to develop fundamental knowledge about biology and ecology that provides the foundation for strategies to exclude, accurately detect and identify, and mitigate arthropod and nematode pests, weeds, and plant pathogens.

perform applied research and development to provide new, useful and safe products to exclude, accurately detect and identify, and mitigate arthropod and nematode pests, weeds, and plant pathogens.

Measure 4.2.4 Provide needed scientific information and technology that is environmentally acceptable to producers of agriculturally important plants in support of exclusion, early detection and eradication, control, and monitoring of invasive arthropods, weeds, nematodes, and pathogens; enhanced sustainability; and restoration of affected areas. Conduct biologically-based integrated and area-wide management of key invasive species.

Baseline 2006
Developed and implemented strategies for management of key invasive pest species, such as the Asian longhorned beetle, leafy spurge, melaleuca, glassy-winged sharpshooter, whiteflies, and other species. Provided data in support of industry needs, APHIS and other action agencies. Conducted Areawide pest management programs for five insects and weeds. Increased systematic capabilities for fungal, bacterial and viral plant diseases and insect pests. Developed data for use in risk analyses of biological control agents, particularly with regard to modeling prediction of risk and protection of non-target species. NAL continued to operate www.invasivespeciesinfo.gov.
Target 2012
Improve knowledge and understanding of the ecology, physiology, epidemiology, and molecular biology and genomics of endemic and emerging diseases and pests. Incorporate this knowledge into at least 10 management strategies to minimize chemical inputs and increase production. Expand systematics of arthropods, fungi, and other biological collections' infrastructure.

Indicator 1:

During FY 2012, ARS will continue to develop and demonstrate technologies, including risk analysis, for excluding, detecting, and mitigating native and invasive insect pests, integrated pest management (IPM) and areawide approaches, and deliver IPM components and systems to ARS customers.

FY 2012 Accomplishments*:*

Monitoring Ambrosia beetle in ornamental tree nurseries. *Xylosandrus crassiusculus* and *X. germanus* are the most problematic ambrosia beetles in ornamental nurseries in the Northeastern, Midwestern, Atlantic, and Southeastern states. ARS scientists in Wooster, Ohio, determined that ethanol-injected trees can be used to monitor ambrosia beetle flight and attack activity in nurseries; such trees were found to be more attractive to ambrosia beetle than trees drenched with ethanol or traps baited with ethanol.

> ***Impact*:** This will help growers synchronize their control treatments with ambrosia beetle activity and improve management of these pests.

Managing emerald ash borer infestation. ARS researchers in Ithaca, New York, determined the extent of an emerald ash borer beetle infestation in western New York by using more than 100 individual (sentinel) girdled ash trees located up to 10 km away from the likely center of the infestation. Clusters of girdled ash trees were established near the center to act as sinks to

attract potentially dispersing beetles. Trees within clusters were more heavily infested (nine larvae per square meter of bark) than sentinel trees or ungirdled trees.

> ***Impact*:** This indicates that clusters of girdled trap trees that are destroyed prior to the following season can help lower local densities of emerald ash borer, a finding that will be assist land managers.

Models for predicting emergence and abundance of Asian longhorned beetle. Native to China, the Asian longhorned beetle (ALB), is considered to be among the world's most devastating invasive species of hardwood trees, especially maples, and could potentially kill over 30 percent of all trees in areas of the eastern United States; a threat of approximately $670 billion. Early detection of and rapid response to ALB infestations requires that the implementation of surveys and control methods be precisely timed. Paradoxically, the adaptation of ALB to the varying climatic conditions from southern Canada to the United States is significantly compromising researchers' ability to predict the optimal timing to implement surveys and control methods. In cooperation with the University of Delaware, ARS researchers in Newark, Delaware, developed degree day models for predicting adult ALB emergence from infested trees and estimates of how long these adult beetles survive.

> ***Impact*:** These models have resulted in earlier (by 2-3 weeks) survey and monitoring, are used in timing the deployment of attractants for early detection of adult beetles, and will be used to time the release of natural enemies for biological control of the beetle.

Control strategy mitigates the threat of the invasive Argentine cactus moth in North America. Subsequent to its detection in south Florida in 1989, the Argentine cactus moth had two incursions into Mexico, expanded its range along the Atlantic Coast and west along the Gulf Coast to the barrier islands of Mississippi and bayous of Louisiana, and became an imminent threat to many *Opuntia* cactus species. While eradication of these two pest incursions into Mexico was successful, with the invasive cactus moth located so nearby, re-infestation is bound to occur and continued action must be taken to control this pest. Following the eradication in Mexico and using control tactics including the sterile insect technique, ARS scientists in Tifton, Georgia, in collaboration with those in Tallahassee, Florida, and USDA, APHIS transferred mass-rearing technology to the Florida Department of Plant Industries Laboratory in Gainesville, Florida, and assisted in the establishment of an insectary supported by USDA, APHIS to supply sterile moths for the U.S.-Mexico bi-national cactus moth program. To insure moth quality, laboratory and field bioassays were developed and conducted on sterile moths and the data were used as feedback mechanisms to make protocol changes in both rearing and handling that improved moth quality and performance.

> ***Impact*:** USDA, APHIS and SAGARPA, Mexico continue to use these methods and tactics in their operational programs, which are part of an ongoing U.S.-Mexico bi-national campaign against this invasive pest to mitigate further westward expansion and population outbreaks.

Indicator 2:

During 2012, ARS will continue to develop and demonstrate technologies, including risk analysis, for excluding, detecting, and mitigating native and invasive weed pests, including IPM and areawide approaches, and deliver IPM components and systems to ARS customers.

FY 2012 Accomplishments:

Ecologically-based invasive plant management of invasive weeds in the western United States. In the United States, exotic invasive weeds not only cause an annual economic loss of about $35 billion, they also have environmental impacts ranging from the displacement of valued native species to the disruption of ecosystem functions. Cheat grass (CG) and medusahead rye (MHR) form an invasive species complex in the western United States that pushes out native vegetation, lowers the value of range for grazing, and creates a significant fire hazard. An areawide project conducted by ARS scientists in Burns, Oregon, has completed five years of effort to design ecologically-based invasive plant management (EIBM) against these species. These methods have been implemented throughout the western part of the United States and have served as a model for foreign countries with similar problems. The EIBM is a systems management approach that has classified the problem into separate, actionable problems. One of the considerations is repopulation of the landscape with native, desirable vegetation – a process that requires its own investment and techniques. The areawide project has also developed a "one pass" system that simultaneously removes the weeds with herbicides and seeds the area with native grasses. These methods have been communicated to those who can implement them. First, curricula were developed for professional students of rangeland management, working with university partners to develop online course segments. Second, a Website was designed, keeping in mind the needs of different user groups; the site has an average of 400 users per month. Finally, printed guides, calendars, and other communication tools have been distributed and made available for download.

> ***Impact*:** This areawide project has increased pasturage and wildlife habitat in a large area of the United States and is a model for management of other invasive species that threaten environmental balance. This approach also holds promise for biological control agents of MHR, when applied to the planned exploration of southern Europe, the home range of MHR, by ARS scientists in Montpellier, France.

Indicator 3:

During 2012, ARS will continue to develop and demonstrate technologies for excluding, detecting, and mitigating emerging and re-emerging plant disease pests, including IPM and areawide approaches, and deliver IPM components and systems to ARS customers.

FY 2012 Accomplishments:

Web-based mobile support for disease scouting and management. A web-based and mobile technology platform (known as AgScouter) was developed as a plant disease and insect scouting and management tool. It is currently being updated (v 2.0) to allow growers and scouts to enter GPS-labeled disease, insect, and production information directly into their mobile device (e.g., Smartphone) where it will be processed and used to develop field-specific, pest management recommendations. *Tomato yellow leaf curl virus* and whiteflies were initially used to validate this approach. Subsequently the adaptability of this approach has been demonstrated by expanding it to include the emerging *Squash vein yellowing virus* (cause of viral watermelon vine decline) and *Groundnut ringspot virus* and their vectors.

> ***Impact*:** Use of this system to promote real-time, regional pest management is being evaluated.

Extensive cereal disease evaluation protects U.S. wheat and barley from stripe rust losses. Cereal rust expertise provided by ARS researchers in Pullman, Washington, was applied in 2012 to protect the wheat and barley crop from new, emerging strains of the stripe rust fungus. During the 2012 growing season, ARS scientists in Pullman evaluated more than 18,000 wheat and 5,000 barley lines for resistance to stripe rust in the field, and hundreds were also tested in the

greenhouse with cultured stripe rust strains. This enabled U.S. wheat and barley breeders to select lines for advancing new varieties with resistance to new stripe rust strains.

> ***Impact*:** The results of the extensive evaluation combined with molecular marker analysis in fiscal year 2012 enabled the advancement and release of more than 10 new wheat and barley varieties with increased stripe rust protection.

High yielding soybean with resistance to multiple cyst nematode populations. In the United States, nearly a billion dollars are lost in annual soybean production due to a tiny root parasite, soybean cyst nematode. Cultivars with genetically controlled resistance will reduce these losses. ARS researchers at Jackson, Tennessee, in cooperation with the Tennessee Agricultural Experiment Station, released soybean germplasm line JTN-5203 with resistance to multiple pathogens endemic to the mid-southern United States, combined with high yield potential. Traditional breeding methods were combined with modern marker assisted biotechnology techniques for rapid advancements.

> ***Impact*:** Soybean JTN-5203 will be highly useful as parent material in breeding for more durable resistance, especially to soybean cyst nematode, while maintaining very high yield potential in new cultivars. It can also be adapted directly as an excellent soybean cultivar in the mid-southern United States.

Evaluation of beneficial yeasts to manage fire blight. Yeasts are being evaluated for use against fire blight of apple and pear at the point of infection in the flower nectar cup. Yeasts can complement bacterial agents that primarily suppress the disease on flower stigmas, the main source of cells invading the flower tissues. ARS researchers in Wenatchee, Washington, demonstrated in orchard trials that the yeast strain *Cryptococcus infirmo-miniatus* CIMyy6 reduces fire blight in apple trees.

> ***Impact*:** These yeasts are already approved or developed commercially, so they are readily available for biological control of fire blight.

Evaluation techniques for resistance to charcoal rot in soybean. Charcoal rot of soybean is caused by a fungal pathogen that is the leading soil-borne disease in many states and is especially destructive under dry soil conditions. Effective and reliable methods to evaluate soybean for resistance to this fungus are needed. ARS scientists in Urbana, Illinois, and researchers from the University of Illinois assessed a cut-stem inoculation technique to evaluate soybean genotypes for resistance to this fungal pathogen. The cut-stem inoculation technique distinguished differences in aggressiveness among isolates of the charcoal rot fungus and differences among soybean genotypes for resistance to the charcoal rot fungus comparable to results from field tests.

> ***Impact*:** This information will be used by soybean breeders and pathologists to evaluate soybean germplasm accessions for resistance to a disease for which there are no resistant soybean cultivars available for growers.

Preplant IPM strategy for managing root-knot nematode in peach. Peach growers in the Southeast often find it an economic hardship to apply fumigants to orchard sites. Finding a nonchemical alternative to preplant chemical control of nematode pests is warranted. ARS researchers in Byron, Georgia, and in Beltsville, Maryland, determined that a tall fescue grass cultivar can be used in preplant rotation for suppressing the Southern root-knot nematode.

> ***Impact*:** This work provided the essential baseline data to develop nonchemical preplant nematode control; this recommendation was communicated to peach growers in the *2012 Southeastern Peach, Nectarine, and Plum Pest Management and Culture Guide*.

Measure 4.2.4 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported improved knowledge and understanding of ecology, physiology, epidemiology, and molecular biology and genomics of endemic and emerging diseases and pests; incorporated this knowledge into at least 4 management strategies that were developed and implemented to minimize chemical inputs and increase production.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
ARS researchers (multiple locations) collaborated to isolate and identify a set of chemicals from the odors of wine and vinegar that can be used as lures for the critical invasive pest spotted wing drosophila (SWD); this work was done in collaboration with scientists from the Oregon State Department of Agriculture. ARS researchers also discovered a male-produced pheromone that causes the nymphs of another critical invasive pest, the brown marmorated stink bug (BMSB) to aggregate.	Growers are using these technologies to lure and trap both SWD and BMSB for pest monitoring. Growers may also be using these technologies to control the insects.	Growers whose crops are vulnerable to the invasives spotted wing drosophila (SWD), a pest of soft fruits, and the brown marmorated stink bug (BMSB), a pest of many fruits, vegetables, and field crops.	The SWD and BMSB lures are being combined with traps and will be used to monitor pest populations for treatment and evaluated to control the insects via trapping or insecticidal baits. A provisional patent has been filed for the stink bug lure.
ARS researchers found that treating pecan foliage with certain plant growth bioregulators lessens the chlorophyll degradation caused by black pecan aphids, thus improving canopy health. Some of the selected plant growth bioregulators, such as gibberellic acid, also increase season-long photosynthesis by encouraging longer foliage retainment into the autumn. Return bloom is not affected and there appears to be little to no negative effect on beneficial insects.	This technology was shared and is being adopted by many pecan growers.	Growers of both pecans and other crops vulnerable to pests that induce leaf chlorosis (the loss of photosynthetic chlorophyll pigment).	This new management tool is being adopted by pecan growers. Use of this bioregulator is also applicable to other crops with pests that elicit leaf chlorosis.
ARS researchers developed new methods to grow and commercially produce a bioinsecticidal fungus, *Metarhizium*, to kill root weevils, soil grubs, rootworms, wireworms, fruit flies, and root maggots. These insect pests affect a wide variety of agricultural crops, landscape plants, and turf. This fungus also kills lesser meal worm larvae and adults, which are pests in commercial poultry operations.	These technologies/methods have been shared with homeowners, farmers, and land managers to provide an effective, nonchemical way to control numerous soil-dwelling insect pests. An industry partner has adopted this technology.	This technology has wide use for growers, land managers, and industry for a variety of crops. Households can also use. this technology.	An industry partner has licensed the technology from ARS through a patent. ARS researchers also developed dried granular formulations of *Metarhizium*.
ARS researchers found that offspring production, body size, and female to male ratio of the parasitic wasp *T. planipennisi*,	These technologies/methods have been shared with managers of land	Land managers working to prevent EAB infection of North American ash trees. EAB spreads quickly and	The USDA, APHIS Emerald Ash Borer (EAB) Biocontrol Laboratory has applied this finding in the

an important biological control agent t of the invasive beetle best, emerald ash borer (EAB)—it attacks the larvae—can be significantly enhanced by using healthy EAB larvae reared with tropical ash logs.	affected by EAB and the USDA, APHIS Emerald Ash Borer (EAB) Biocontrol Laboratory has applied them.	without treatment infested trees will die. EAB has been found throughout the upper Midwest as far east as Maryland and New York and as far west as Minnesota and Iowa.	mass rearing of parasitic wasps for field releases against EAB in the United States, thus providing an important tool in the biological control effort against these devastating insects.

4.3.2: Provide scientific information to increase our knowledge of plant genes, genomes and biological and molecular processes to protect crops and cropping systems from the negative effects of pests and infectious diseases. Develop sustainable control strategies for crop pests and pathogens based on fundamental and applied research that are effective and affordable, while maintaining food safety and environmental quality. (Formerly 4.2.4)

Outyear Performance Plan (the future performance indicators for this Measure)

PLEASE SEE SECTION 4.2.3.

Measure 4.2.5 Provide environmentally sound fundamental and applied scientific information and technologies to action agencies, producers, exporters, and importers of commercially important plant and animal products in support of exclusion, early detection, and eradication of quarantine pests and pathogens that can impede foreign trade.

Baseline 2006
Developed and implemented five strategies for exclusion, detection, and eradication of quarantine pests and pathogens. Provided data in support of needs of industry, APHIS, and other action agencies. New technologies developed and implemented by action agencies that have opened new export markets.
Target 2012
Improved knowledge and understanding of quarantine pest and pathogen biology and epidemiology, leading to 30 new technologies implemented by industry, APHIS, or other action agencies to mitigate risk of pests and pathogens resulting in expanded export markets while protecting the safety and security of American agriculture.

Indicator 1:

During FY 2012, ARS will continue to develop diagnostic assays to detect and differentiate existing, new and/or emerging quarantine arthropod pests, weeds, nematodes, and pathogens.

FY 2012 Accomplishments:

Diagnostic test for the new boxwood blight pathogen. The recent rapid emergence and spread of boxwood blight disease in the United States places the nursery and landscape industry at substantial risk. Boxwood is a high value ornamental nursery crop valued at $103 million annually. Early and rapid detection of *Calonectria pseudonaviculata* in plants and soil is needed to prevent the spread of this emergent disease which threatens the health and production of U.S. boxwood. ARS scientists in Beltsville, Maryland, developed a DNA-based boxwood blight diagnostic assay capable of detecting the presence of the causal agent of boxwood blight disease.

> ***Impact*:** This diagnostic test can be exploited by plant scientists developing methods to halt the spread of boxwood blight and to develop control measures for the disease.

Grape Powdery Mildew Detection. ARS scientists in Corvallis, Oregon, developed and demonstrated that grower-performed Loop Mediated Isothermal Amplification assays can be used to detect grape powdery mildew. This new technology makes it much easier and less costly for growers to determine when to apply fungicides.

> ***Impact*:** This technology is currently being transferred to two commercial entities as well as being made directly available to grape growers in Oregon, Washington, and California. The reduction in fungicide use will have significant economic savings and enhance environmental quality by reducing impact on water shed, carbon footprint, and air quality.

Indicator 2:

During 2012, ARS will continue to expand interdisciplinary research to include means of excluding, managing and/or eradicating quarantine arthropod pests, weeds, nematodes and pathogens.

FY 2012 Accomplishments*:*

Disrupting insect diapause to control pest insects. A critical life function of numerous pest insects is the dormant state known as diapause, which allows insects to survive winter and other adverse conditions. Entering and exiting diapause is hormonally controlled by an insect's neuropeptides. ARS scientists in College Station, Texas, in collaboration with scientists at Ohio State University, developed stable versions of "Diapause Hormone" neuropeptides, which are much more active than the insect's neuropeptides. Unlike the native neuropeptide, two of these novel compounds can also prevent entry into pupal diapause or block its termination when administered at the preceding larval stage of the corn earworm, killing the insect.

> ***Impact*:** This discovery will be used to develop a novel, practical, and environmentally friendly strategy to control pest insects by disrupting diapause.

Making walnuts safe from codling moth for export. Codling moth larvae rest for long periods (diapause) in walnuts, an important export crop from California. ARS scientists have been working with the Controlled Atmosphere Temperature Treatment System (CATTS), which treats commodities with non-chemical changes in the physical environment. In this case, scientists found that an atmosphere of 98 percent carbon dioxide held at 43 degrees Celsius for eight hours was sufficient to kill 93 percent of the diapausing larvae. None of the rest of the larvae successfully completed development, essentially eliminating the infestation from the walnuts.

> ***Impact*:** The CATTS system will provide a safe and inexpensive method for treatment of an important export crop from California.

Indicator 3:

During 2012, ARS will apply essential taxonomy and systematics for organisms toward the correct identification and diagnosis and control of target arthropod pests, weeds, nematodes, and pathogens.

FY 2012 Accomplishments*:*

New genus and species of parasitic wasp and the first report of a true myrmecophilic (ant-loving) wasp species. Parasitic wasps help control populations of pest ants and have been evaluated for potential use as biological control agents of ants. Certain tropical ants form nests in the canopies of citrus and coffee trees and often contribute to leaf loss and protect plant-feeding insects that infest these crops. This can lead to losses in crop productivity costing millions of dollars annually. A new genus and species was taxonomically described, illustrated, and its host use was reported. Character diagnostics were discussed in the context of other species and groups of species in the same family and relative to more distantly related myrmecophilic (ant-loving) wasps.

> ***Impact*:** This taxonomic and diagnostic research is useful to other scientists conducting research on myrmecophilic wasps and their hosts as well as pest management and regulatory personnel responsible for controlling and limiting the spread of pest ants to reduce losses in crop productivity.

Mite and insect identification services. The Taxonomic Support Unit (TSU) of the ARS Systematic Entomology Laboratory in Beltsville, Maryland, provides identifications and information on important mite and insect invasive and adventive species. Requests for support come from many sources including the Animal and Plant Health Inspection Service (APHIS), State Departments of Agriculture, and U.S. universities. At the time of reporting on October 1, 2012, the mite section identified 387 lots with 2,395 mite specimens. For FY2012, the TSU identified 9,892 lots with 25,015 arthropod (insect and mite) specimens. It is reasonable to assume that the rate of identifications will remain constant for the rest of the 2012 fiscal year. If so, these numbers represent 75 percent of the total for the 2012 calendar year. These identifications are an essential to successful protection of our borders from invasion by mites and insects.

> ***Impact*:** These identifications are an essential to successful protection of our borders from invasion by mites and insects.

Indicator 4:

During 2012, ARS will expand new knowledge in epidemiology, host-parasite relationships and new means of developing host resistance toward exclusion, eradication, and management of quarantine arthropod pests, weeds, nematodes, and pathogens.

FY 2012 Accomplishments:

Evaluation of blueberry germplasm and grape rootstock nematode management. ARS researchers determined the host status of blueberry varieties to plant-parasitic nematodes and the impact of stubby root nematode on blueberry. Blueberry varieties with *Vaccinium* genetic backgrounds, including *V. corymbosum* and *V. angustifolium*, were excellent hosts for stubby root nematode, but *V. ashei* was a poor host. In field microplots, berry yield was reduced by at least 25 percent by stubby root nematode. Knowledge of a resistance mechanism to plant-parasitic nematodes can lead to the development of nematode-resistant blueberry cultivars. On grape, another plant-parasitic nematode, ring nematode, initially caused decreased root growth, but its above-ground impact on plant productivity was not apparent until the third year of a four-year study. The apparent ring nematode resistance of the rootstock 101-14 broke down in year three, with only the rootstock 420A remaining highly resistant to the nematode.

> ***Impact*:** Growers will use this information to select rootstocks for planting and to direct the timing of management practices to minimize the impact of ring nematode on vine establishment and productivity.

Optimizing disease management strategies for HLB (citrus greening) in the United States. ARS researchers finalized and validated an epidemiological model to predict the spatial and temporal dynamics of Huanglongbing (HLB), a.k.a. citrus greening, in infected areas of South Florida, which can be used to test various disease control strategies. A Web-based version of the model has also been developed for non-researcher use. For example, the model output suggests that controlling secondary infections by removing diseased trees and applying insecticides, plus controlling primary infection from new insect immigrations through areawide control strategies, can reduce the annual growth rate in the incidence of citrus greening disease to a manageable 2 to 5 percent, which appears to be economically sustainable.

> ***Impact*:** The State Departments of Agriculture from Florida, Texas, Arizona and California and USDA, APHIS are using the model described in their efforts to survey, deploy areawide management programs, delimit and eradicate the Asian citrus psyllid (the insect that transmits citrus greening), and for infected tree removal guidance.

Indicator 5:

During 2012, ARS will support interagency collaboration for tracking successful exclusion, eradication where possible, and management of quarantine arthropods, weeds, nematodes, and pathogens.

FY 2012 Accomplishments:

New genetic modifications yield "sexing strains" in fruit flies. Mass release of sterile, male fruit flies is used to control the insects, but sterile females released along with males do not contribute to fruit fly control and may distract the sterile males, thereby lowering control rates. Conditional-lethality, in which an insect's offspring dies when certain environmental conditions prevail, is a means of eliminating females early in their embryonic development. Females are not released and rearing costs are reduced. A conditional-lethal strain of the Caribbean fruit fly was created through genetic modification; females of this strain only survive when provided an antibiotic-(tetracycline) supplemented diet, therefore only male progeny are produced on an antibiotic-free diet. The genetic constructs involved in the production of conditional-lethal strains will serve to improve the efficacy of control programs that protect U.S. agriculture from fruit flies and other potentially invasive pests.

> ***Impact*:** The genetic constructs involved in the production of conditional-lethal strains will serve to improve the efficacy of control programs that protect U.S. agriculture from fruit flies and other potentially invasive pests.

Lower cost equipment for sterilizing insect pests. The “Sterile Insect Technique” (SIT) is an effective method of biocontrol for insect pests worldwide, but SIT research is limited by both the high price (>$250,000) of commercially-available x-ray units and their poor performance in insect sterilization. In addition, gamma-based sources are increasingly unavailable due to heightened control of radioisotopes. ARS researchers in Albany, California, designed and built an economical and effective irradiation device for SIT applications. Material costs for the x-ray unit developed by ARS are less than $50,000 and a patent application has been filed. The work was partially funded by USDA, APHIS.

> ***Impact*:** The effectiveness of this new design was validated by the sterilization of adult male navel orangeworm (pistachio pest).

Improvement of the sterile insect technique in fruit flies. ARS scientists in Tifton, Georgia, improved the efficacy of the Sterile Insect Technique (SIT) used to control tephritid fruit flies. They incorporated the juvenile hormone analog methoprene (which coordinates sexual signaling and reproductive development) and a protein supplement into the diets of adult sterile male flies. Flies fed the protein supplement became sexually mature 4–7 days earlier, thus mated earlier, and attracted more wild mates, thus increasing mating frequency. The International Atomic Energy Agency and the Food and Agricultural Organization are including this technology in a coordinated research program to improve the efficacy of SIT.

> ***Impact*:** The technology is now used in Mexico to improve the reproductive performance of sterile fruit flies that have been released to control invasive populations.

Sudden oak death fungus soil remediation. *Phytophthora ramorum* causes sudden oak death and seriously impacts the commercial nursery industry due to losses resulting from quarantine issues. The nursery industry badly needs new methods of control of *P. ramorum* so that infested nurseries can be removed from quarantine status and resume normal production. ARS researchers in Fort Detrick, Maryland, demonstrated for the first time in a nursery setting that the beneficial biocontrol fungus *Trichoderma asperellum,* grown on wheat bran and raked into

nursery test-plot soil, can reduce *P. ramorum* soil populations to non-detectable levels after six weeks.

> ***Impact*:** California regulatory personnel confirmed these results at a commercial nursery, and the nursery was lifted from quarantine status. The new method will have wide applicability in reducing losses to the nursery industry due to *P. ramorum*, and technology transfer is underway to facilitate development of a commercial formulation of the biocontrol fungus.

New tools to protect the U.S. food supply from pests.
Agricultural industries are facing, with increasing frequency, environmental and pest-related food safety requirements that are fundamentally difficult to balance. Failure to disinfest foodstuffs in trade and marketing channels can result in insect and microbial damage, which limits economic profitability, curtails market access, and, more importantly, vectors plant and animal diseases. ARS scientists in Parlier, California, developed three tools that address these food safety concerns. First, they developed a method to use methyl bromide to successfully fumigate strawberries against the spotted-wing drosophila, a pest that prevents the export of strawberries to Japan. Second, they developed a "host potential index" to prioritize the importance of postharvest treatment of various fruits, which will reduce the need for fumigation. Finally, they examined details of the life cycle of the spotted-wing drosophila to determine when it is and is not a problem in postharvest fruit commodities.

> ***Impact*:** These results will help reduce the impact of the spotted-wing drosophila, a new invasive species in the United States that threatens export and domestic markets.

Measure 4.2.5 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported improved knowledge and understanding of quarantine pest and pathogen biology and epidemiology, leading to 4 new technologies implemented by industry or other action agencies to mitigate risk of pests and pathogens resulting in expanded export markets while protecting the safety and security of American agriculture.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
ARS researchers developed a molecular method/ diagnostic assay for a recently discovered (in Oregon) nematode species that is related to the potato cyst nematode, and for which there was no reliable diagnostic method. This new method/ diagnostic assay provides highly reliable and rapid identification and will be used to monitor the potential spread of this new pest within Oregon and other potato producing states. ARS researchers, in collaboration with scientists at the University of Idaho, have also developed improved testing protocols that eliminate false positives and detect all variants of the tuber necrotic strain of Potato virus Y (PVY).	New molecular diagnostic assays/methods developed by ARS for emerging pathogens of potato have been shared with state and federal partners. These emerging pathogenic species include new nematode species and new necrotic strains of PVY that have the potential to become a major quality disease issue in U.S. potatoes.	The U.S. potato industry, regulators, and exporters.	Protocols have been transferred to state and federal partners that conduct product testing and regulate interstate and international commerce of potatoes.
ARS scientists tested the freezing tolerance of over 15,000 coffee berry borer insects at three different	The ARS cold treatment that stops coffee berry borer in green coffee, which is shipped around	Green coffee growers, producers of custom coffee roasts and blends ,	Hawaiian State regulators are using this information to implement a freezing

temperatures and determined the temperature and time at which they could control 100 percent of all life stages.	the world for custom blending and roasting, was shared with growers, industry, and regulators. Hawaiian State regulators have adopted this technology.	regulators, and the industry as a whole.	treatment protocol that allows coffee growers in the infested area to ship green coffee to other islands without the need for methyl bromide fumigation.
ARS researchers, along with Forest Service collaborators in Michigan, and Russia, developed a morphology-based taxonomy to identify the immature stages of the emerald ash borer (EAB). Prior to this study, the immature life stages were poorly known and had never been fully described and illustrated. EAB is a significant invasive beetle pest killing ash trees in the United States.	This technology was shared with land managers affected by EAB and the Forest Service has adopted it.	Land managers working to prevent EAB infection and subsequent death of North American ash trees; EAB spreads quickly and has already killed tens of millions of ash trees since it 's detection in the United States in 2002.	This morphology-based taxonomy is a valuable tool for the rapid identification of this (EAB) serious invasive pest beetle in the United States.
ARS scientists conducted a large-scale, commercial confirmatory test to control Hessian fly puparia in compressed bales of Timothy hay fumigated for 3-days with aluminum phosphide. This test resulted in 100 percent mortality of greater than 45,000 insects; part of Japanese requirements for a certified quarantine treatment for hay imports.	This methyl bromide alternative for baled hay has been shared with producers, exporters, and regulators.	Producers, exporters, importers, and regulators of baled hay.	This work supports USDA, APHIS efforts to maintain U.S. producers' ability to export hay to Japan.

4.3.2: Provide scientific information to increase our knowledge of plant genes, genomes and biological and molecular processes to protect crops and cropping systems from the negative effects of pests and infectious diseases. Develop sustainable control strategies for crop pests and pathogens based on fundamental and applied research that are effective and affordable, while maintaining food safety and environmental quality. (Formerly 4.2.5)

Outyear Performance Plan (the future performance indicators for this Measure)

PLEASE SEE SECTION 4.2.3.

Strategic Goal 5:
Improve the Nation's Nutrition and Health

Improving the Nation's health requires improving the quality of the American diet. The United States is experiencing an obesity epidemic resulting from multifaceted causes including sedentary lifestyles, selection of readily available high calorie foods, and increasing portion sizes. In addition, 4 of the top 10 causes of death in the United States—heart disease, cancer, stroke, and diabetes—are strongly associated with the quality of our diets—diets too high in calories, saturated fat, sodium, and added sugars, and too low in fiber rich foods such as fruits, vegetables, and whole grains. There is an increasing demand for foods that taste good, are convenient, economical, and yet offer nutrition and health benefits. Building a strong connection between agriculture and human health is an important step to providing a nutritionally enhanced food supply. Promoting healthier food choices and educating Americans to balance caloric intake with sufficient daily physical activity are vital steps to preventing obesity and decreasing risk for chronic diseases.

ARS conducts research to identify nutritive and health promoting components in foods, improve the understanding of human nutrient requirements at all stages of the life cycle, and better understand the relationships between diet and health. The Agency also determines the composition and bioavailability of beneficial components in foods, conducts the national "What We Eat in America" food consumption survey to track the nutritional quality of the American diet, and conducts research on dietary interventions and strategies for modifying diets, food choices, and physical activity behaviors. The outcomes of these combined research efforts provide a scientific knowledge base to evaluate the healthfulness of the American diet and food supply, and to establish sound dietary recommendations for Americans, such as the Dietary Reference Intakes and the USDA/HHS Dietary Guidelines. The information is widely used by policymakers, Government agencies, industry, and educators to promote better diets, reach children early, and enable people to make healthful food and lifestyle choices.

Objective 5.1: Ensure Access to Nutritious Food

Activities related to this objective are primarily carried out by other USDA agencies.

Objective 5.2: Promote Healthier Eating Habits and Lifestyles

The prevalence of obesity in the United States has doubled during the past two decades, making it a critical public health problem. High quality research is required to address this multifaceted problem. Good health is dependent on adequate physical activity combined with consumption of foods with the right balance of nutrients to meet an individual's needs within caloric requirements.

Building databases of food composition is critical to developing healthy diets. Also important is improving the health promoting value of foods through selection, biotechnology, processing, and other practices. ARS research will monitor food consumption patterns of Americans across time, define ways to prevent obesity (particularly in minority populations who are particularly susceptible to this condition) improve health through dietary manipulation, and help establish optimal levels of nutrients/foods to maximize health.

Performance Measures

Measure 5.2.1 Monitor food consumption/intake patterns of Americans, including those of different ages, ethnicity, regions, and income levels, and measure nutrients and other beneficial components in the food supply. Provide the information in databases to enable ARS customers to evaluate the healthfulness of the American food supply and the nutrient content of the American diet.

Baseline 2006
Three food intake and nutrient content databases released by ARS and used by ARS customers to establish Federal dietary policy guidelines, food assistance and feeding programs, and food labeling to safeguard the health of the American people. Also, NAL continued to operate nutrition.gov.
Target 2012
Cumulatively, 25 new databases developed and released to ARS customers.

Indicator 1:

During FY 2012, ARS will survey, release data on, and analyze national food consumption patterns of Americans.

FY 2012 Accomplishments:

ARS scientists released the 2009-2010 data from the What We Eat in America, NHANES survey conducted in partnership with CDC. This diet survey of 2 days' consumption by about 9,000 people is the only nationally representative nutrition survey conducted in the U.S.

> ***Impact*:** These data form the foundation for much of the data on nutritional intake and health status of Americans. It is used by researchers from other federal agencies, universities, and the private sector. Federal agencies dependent on the data include HHS/CDC, FDA, NIH, USDA/CNPP, FNS and EPA.

Indicator 2:

During 2012, ARS will develop new methods, conduct food composition analyses, and compile databases for known, emerging, and new classes of nutrients.

FY 2012 Accomplishments:

ARS scientists, in partnership with NIH/Office of Dietary Supplements compiled and released version 2.0 of the USDA Dietary Supplement Ingredients Database.

> ***Impact*:** This database enables researchers to better estimate nutrient intake since about half the American populations takes dietary supplements. For years this information was not collected in surveys because there was no database of ingredients. Other Federal agencies that make extensive use of this database include CDC, NIH, and the Department of Defense.

ARS scientists compiled and released the USDA National Nutrient Database for Standard Reference, Release 25.

> ***Impact*:** This database is the gold standard used by all commercial suppliers of nutrient data and many other countries. It is used by the public, researchers, clinicians, and other Federal agencies, including NIH, CDC, FDA, and USDA/FNS and CNPP, EPA, and the Department of Defense.

Measure 5.2.1 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported 5 new databases developed and released to ARS customers to establish Federal dietary policy guidelines, food assistance and feeding programs, and food labeling to safeguard the health of the American people.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
National Nutrient Database for Standard Reference, Release 25	Publicly released on the ARS Web site with free use and ability to download	Other federal agencies (including FDA, EPA, FNS, CNPP, DoD, NIH), researchers, food industry, clinicians, and consumers.	Updated information on changes in composition of the American food supply allows knowledge of nutrient intake and tracking of changes in food products.
USDA Tables of Cooking Yields for Meat and Poultry	Publicly released on the ARS Web site	Other federal agencies (including FDA, EPA, FNS, CNPP, DoD, NIH), researchers, food industry, and consumers.	This is the first time this publication, in print since 1975, has been released electronically, allowing researchers to more accurately estimate fat and water losses in these foods.
Dietary Supplement Ingredient Database, Release 2.0	Public Web site cosponsored by ARS and NIH	Other Federal agencies (including NIH, CDC, FDA, NIST) and researchers at universities.	This release includes, for the first time, national estimates of the vitamin and mineral content of children's multivitamin/mineral supplements.
What We Eat in America (WWEIA) diet survey of NHANES	Public release of diet data on the CDC Web site	Other federal agencies (including FDA, EPA, FNS, CNPP, DoD, NIH), researchers, food industry, and clinical nutritionists.	WWEIA is the only nationally representative diet survey. It is used by several federal agencies (CDC, FDA, NIH, EPA, DoD, USDA/FNS and CNPP) and hundreds of academic researchers

			studying the relation of foods or nutrients with health.
Food and Nutrient Database for Dietary Studies, Release 5.0	Public release of data on the ARS Web site	Researchers	This database allows researchers to calculate the nutrients in foods reported in the WWEIA/NHANES survey. This is used by academicians and Federal researchers at CDC, FDA, NIH, EPA, DoD, and USDA/FNS and CNPP.

Measure 4.1.1: Monitor nutrient composition of food supply and consumption by Americans while conducting research on life stage nutrition and metabolism. Strengthen the scientific basis for dietary guidance for health promotion and disease prevention and develop strategies for prevention of obesity and related diseases. (Formerly 5.2.1)
Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

survey, release data on, and analyze national food consumption patterns of Americans.

develop new methods, conduct food composition analyses, and compile databases for known, emerging, and new classes of nutrients.

identify dietary and lifestyle intervention strategies to prevent obesity and promote healthy food choices and eating behaviors.

determine the functions, bioavailability, interactions, and requirements for known, emerging, and new classes of nutrients across the lifecycle.

publish new findings on metabolic processes that are affected by nutrient intake.

discover genetic or epigenetic factors that influence physiologic responses to diet or changes in gene expression in response to dietary intake.

During FY 2014, ARS will

survey, release data on, and analyze national food consumption patterns of Americans.

develop new methods, conduct food composition analyses, and compile databases for known, emerging, and new classes of nutrients.

identify dietary and lifestyle intervention strategies to prevent obesity and promote healthy food choices and eating behaviors.

determine the functions, bioavailability, interactions, and requirements for known, emerging, and new classes of nutrients across the lifecycle.

publish new findings on metabolic processes that are affected by nutrient intake.

discover genetic or epigenetic factors that influence physiologic responses to diet or changes in gene expression in response to dietary intake.

During FY 2015, ARS will

survey, release data on, and analyze national food consumption patterns of Americans.

develop new methods, conduct food composition analyses, and compile databases for known, emerging, and new classes of nutrients.

identify dietary and lifestyle intervention strategies to prevent obesity and promote healthy food choices and eating behaviors.

determine the functions, bioavailability, interactions, and requirements for known, emerging, and new classes of nutrients across the lifecycle.

publish new findings on metabolic processes that are affected by nutrient intake.

discover genetic or epigenetic factors that influence physiologic responses to diet or changes in gene expression in response to dietary intake.

Measure 5.2.2 Define the role of nutrients, foods, and dietary patterns in growth, maintenance of health, and prevention of obesity and other chronic diseases. Assess bioavailability and health benefits of food components. Conduct research that forms the basis for and evaluates nutrition standards and Federal dietary recommendations.

Baseline 2006
Three Federal and Institute of Medicine reports used to establish Federal nutrition policy and regulations that employ ARS research results in formulating recommendations to safeguard the health of the American people.
Target 2012
Cumulatively, 23 new reports using ARS research to develop authoritative positions on nutrition and health issues.

Indicator 1:

During FY 2012, ARS will identify dietary and lifestyle intervention strategies to prevent obesity and promote healthy food choices and eating behaviors.

FY 2012 Accomplishments:

ARS scientists fed volunteers three doses of whole almonds in a highly controlled diet for 18 days and energy intake and excretion were carefully measured. Almonds provided one-third fewer calories than the value on the food label.

***Impact*:** Nuts are recommended in the USDA/HHS *Dietary Guidelines for Americans* as they provide a number of shortfall nutrients and are not associated with excess body weight. These data could assist the Food and Drug Administration in updating the calorie content on the food label.

Indicator 2:

During 2012, ARS will determine the functions, bioavailability, interactions, and requirements for known, emerging, and new classes of nutrients across the lifecycles.

FY 2012 Accomplishments:

ARS-supported scientists collaborated with scientists at the American Cancer Society on a study following 100,000 participants. Their diet was assessed and 7 years later, about 3,000 had died from CVD. Those with higher flavonoid intake were 18% less likely to die from total CVD and men were 37% less likely to die from stroke. Sophisticated statistical analyses of the intake and mortality data revealed that there was a threshold effect, rather than a linear dose-response which showed low intake was responsible for excess risk and higher intake was not beneficial for CVD mortality.

***Impact*:** This addresses one of the fundamental issues in interpreting observational studies on diet and health, namely is more intake better? That is often the standard interpretation and this study suggests it may be incorrect. Application of this approach should lead to more critical interpretation of data from epidemiological studies and more realistic dietary guidance on fruit and vegetable intake.

An ARS scientist, in collaboration with scientists at the University of California, Davis, modeled and quantified the kinetics, bioavailability, and metabolism of alpha-tocopherol in healthy adults by measuring tiny doses of the radioactively labeled vitamin excreted in urine or feces over 21 days and amounts in blood over 70 days. This allowed calculation of total body stores as well as daily requirements to remain in balance.

***Impact*:** The new data suggest the true vitamin E requirement is one-third of that set in 2000 by the Institute of Medicine and could form the basis for a revision of that recommendation. In addition to decreasing the perceived need for vitamin E supplements, school lunches paid for by USDA are required to provide one-third of the daily requirement, yet this has been impossible to meet. Lowering of the vitamin E requirement would help the USDA Food and Nutrition Service address this apparent shortfall nutrient.

Measure 5.2.2 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported 3 new reports using ARS research to develop authoritative positions on nutrition and health issues are used to establish Federal nutrition policy and regulations that employ ARS research results in formulating recommendations to safeguard the health of the American people.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
Institute of Medicine Consensus Report: Accelerating Progress in Obesity Prevention	Publication of a consensus report by IOM highlighting current situation and changes needed to reduce the prevalence of obesity	All Federal agencies concerned with health, including DoD which has identified obesity as a national security issue	Expert recommendations that will be studied and implemented to reduce obesity in the U.S.

	in the U.S.	since 1/3 are ineligible as a result of obesity.	
Institute of Medicine Consensus Report: Front-of-Package Nutrition Rating Systems and Symbols: Promoting Healthier Choices	Publication of a consensus report by IOM highlighting current situation and changes needed to affect consumer purchasing and consumption.	Report commissioned by CDC and FDA. Will be used by FDA and USDA/FSIS for decisions about food labeling and food industry.	Findings will influence food labels regulated by FDA and USDA/FSIS.
CDC Vital Signs Report: Food Categories Contributing the Most to Sodium Consumption in the United States, 2007-2008	Report published by CDC and freely available on their Web site.	Federal agencies concerned with health (CDC, FDA, USDA/FNS and CNPP, DoD) and researchers at universities.	This report established the baseline intake of sodium in the U.S. which had not been estimated for over 20 years. It will be used by customers identified and the food industry.

Measure 4.1.1: Monitor nutrient composition of food supply and comsumption by Americans while conducting research on life stage nutrition and metabolism. Strengthen the scientific basis for dietary guidance for health promotion and disease prevention and develop strategies for prevention of obesity and related diseases. (Formerly 5.2.2)
Outyear Performance Plan (the future performance indicators for this Measure)

Reported under Measure 5.2.1 above

Measure 5.2.3 Publish research findings not encompassed under the other performance measures for this objective likely to significantly advance the knowledge of human nutrition, extensively influence other researchers in the same or related field, or yield important new directions for research.

Baseline 2006
Six research studies published in peer reviewed biomedical literature with the potential to strongly influence the field of human nutrition or have demonstrated impact through high citation rates.
Target 2012
Cumulatively, 30 new scientific papers will be published that generate high impact among the research community.

Indicator 1:

During FY 2012, ARS will publish new findings on metabolic processes that are affected by nutrient intake.

FY 2012 Accomplishments:

ARS scientists studied 24 volunteers for metabolic responses to meals differing in calculated ability to elevate blood glucose over time; this is commonly called the glycemic index. Three distinct response groups were identified: the majority responded with changes in blood sugar as expected but one-quarter of the subjects had either higher or lower blood sugar changes than predicted.

> ***Impact*:** This approach identified definitive phenotypes that may help identify distinct subclinical metabolic dysfunction and also contribute to the debate about whether glycemic index of foods can be used to formulate dietary guidelines.

Premature infants often develop medical problems that require feeding via a tube in the intestine or through a vein. The medical costs associated with this, and complications that result from these types of feeding, are huge. A pair of new publications using neonatal pigs has provided clues on simple modifications to current feeding practices that should be tested in babies to reduce the adverse side effects of enteral or IV feeding. Simply changing from continuous feeding to an intermittent pattern enhanced protein formation in muscle, improved sensitivity to insulin, and decreased signs of poor metabolic function, such as fat deposition in the liver.

> ***Impact*:** All of the changes are seen in premature infants fed continuously, which is standard therapy. If the benefits seen in pigs are also found in humans, this will reduce suffering and medical costs significantly.

Almost 400 infants were evaluated four times during their first year of life by ARS-supported scientists in Little Rock, Arkansas for development of mental, motor, and language abilities. Breast-fed infants scored slightly but significantly higher on some of these measures and at some of the four time points. Both types of formula led to similar scores, which were within the normal range.

> ***Impact*:** Although the advantage was very small, these data support the recommendation to breast-feed during the first year of life but give reassurance to mothers who are not able to do so since formula feeding results in babies reaching normal developmental milestones.

Indicator 2:

During FY 2012, ARS will discover genetic or epigenetic factors that influence physiologic responses to diet or changes in gene expression in response to dietary intake.

FY 2012 Accomplishments:

ARS researchers in collaboration with an international consortium have used genetic technology to thoroughly analyze the strength of the association between high plasma HDL-cholesterol and heart attacks by analyzing gene variants in large numbers of cases and controls from 20 studies (20,913 cases, 95,407 controls). The findings clearly demonstrate that some genetic mechanisms that raise plasma HDL cholesterol do not lower risk of heart attack.

> ***Impact*:** These data challenge the long-held concept that interventions that raise plasma HDL-cholesterol will uniformly translate into reduction of risk. This finding will lead to more individualized dietary recommendations for health.

Homocysteine is an amino acid produced in the body that is not used to make protein; it is also a marker of folic acid status and a possible risk factor for a variety of diseases including heart

disease and cognitive decline. ARS scientists, in collaboration with University of California researchers, found that variants in six genes significantly affect homocysteine blood levels in healthy people who take in adequate folic acid.

> ***Impact*:** These results contribute to understanding of homocysteine metabolism as modified in different subgroups based on normal variants of genes distributed throughout the population. Many studies have investigated the role of homocysteine as a risk factor for a variety of chronic diseases, with divergent results which may be explained by these data.

Measure 5.2.3 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported 5 new scientific papers published that generate high impact among the research community with the potential to strongly influence the field of human nutrition or have demonstrated impact through high citation rates.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
Controlled feeding study of glycemic index responses based revealed three distinct phenotypes.	Peer-reviewed publication	Researchers	The findings indicate that general advice for following a low glycemic index diet is not appropriate for a substantial minority of the population and, therefore, should not
Neonatal piglets are a model for premature human infants and both develop fatty liver when fed on a continuous basis. Intermittent feeding prevented fatty liver.	Peer-reviewed publication	Researchers	This important result will need to be tested in human babies, but it a breakthrough in providing nutrition for premature infants who have a high rate of liver problems.
There is controversy over safety of soy formula and growth effects of cow's milk formula. A longitudinal study of 400 infants fed these formulas or breast milk found no differences in developmental status at one year between the formulas but slightly better development among breast-fed babies.	Peer-reviewed publication	Researchers	These data support the recommendation to breast-feed during the first year of life but give reassurance to mothers who are not able to do so since formula feeding results in babies reaching normal developmental milestones. This information will be used to develop dietary guidelines for the birth – 24 month age range that will be added to the Dietary Guidelines for Americans in the year 2020.
Study of gene variants in >100,000 people revealed that the serum level of HDL-cholesterol is not always associated with reduced risk of heart attack, depending on the particular gene variant that was present.	Peer-reviewed publication	Researchers	These data challenge the common belief that raising HDL-cholesterol in the blood would uniformly reduce risk of cardiovascular disease. It may also lead to more individualized dietary advice for heart disease.

Normal gene variants were found that significantly affect blood levels of the amino acid, homocysteine; this amino acid has been linked to heart disease and dementia.	Peer-reviewed publication	Researchers	Homocysteine levels are associated with serious health problems and these genetic variations will help identify subgroups of the population that may need different levels of vitamins that can lower concentrations of this amino acid.

Measure 4.1.1: Monitor nutrient composition of food supply and consumption by Americans while conducting research on life stage nutrition and metabolism. Strengthen the scientific basis for dietary guidance for health promotion and disease prevention and develop strategies for prevention of obesity and related diseases. (Formerly 5.2.3)
Outyear Performance Plan (the future performance indicators for this Measure)

Reported under Measure 5.2.1 above

OBJECTIVE 5.3: IMPROVE NUTRITION ASSISTANCE PROGRAM MANAGEMENT AND CUSTOMER SERVICE

Activities related to this objective are primarily carried out by other USDA agencies.

Strategic Goal 6:

Protect and Enhance the Nation's Natural Resource Base and Environment

There is no substitute for fresh water, high quality soils, and clean air in productive agricultural ecosystems. Reliable supplies of food, fiber, feed, forages, and energy feedstock are essential for a productive agricultural sector and the maintenance of goods and services derived from the Nation's crop, pasture, and range lands. Agriculture relies on a healthy natural resource base whose sustainability depends on sound, science-based agricultural practices.

ARS research activities are designed to help ensure that the Nation's natural resources meet the long term needs of a vibrant society with its increasing population while enhancing the quality of life for producers, rural communities, and the Nation. To achieve these goals, ARS conducts multidisciplinary research to solve problems arising from the interaction between agriculture and the environment, and develops new practices and technologies to conserve the Nation's natural resource base and balance production efficiency with environmental quality. Since environmental quality is a global problem, ARS is expanding collaboration with international research institutions with the aim to produce technologies and practices that mitigate the adverse impacts of climate on agriculture and agriculture on the environment.

OBJECTIVE 6.1: ENHANCE WATERSHEDS' CAPACITIES TO DELIVER SAFE AND RELIABLE FRESH WATER

Water is fundamental to life and is a basic requirement for virtually all of our agricultural, industrial, urban, and recreational activities, as well as the sustained health of watersheds. ARS conducts fundamental and applied research on the processes that control water availability and quality for the health and economic growth of the American people. The Agency is working to develop and transfer to producers, action agencies, local communities, and resource advisors new knowledge, improved technologies, conservation practices, and decision support systems that will enable them to reuse degraded waters, improve water conservation, and increase water use efficiency in agriculture. This research will provide the tools to reduce the transport of agricultural pollutants and the associated degradation of terrestrial and aquatic ecosystems. The overall goal is to provide knowledge and tools to enhance water availability and quality, mitigate the adverse impact of droughts and floods on rural and urban communities, and improve the health of our Nation's watersheds.

Performance Measure

Measure 6.1.1 Develop technology and practices to reduce the delivery of agricultural pollutants by water on farms and ranches and quantify the environmental benefit of conservation practices in watersheds.

Baseline 2006
Four agricultural practices and technologies developed and used by customers to enhance water quality and availability.
Target 2012
Cumulatively, 10 agricultural practices and technologies will have been developed and used by customers to enhance water quality and availability.

Indicator 1:

During FY 2012, ARS will develop guidelines for irrigating in urban and agricultural settings with degraded waters.

FY 2012 Accomplishments:

Agricultural Research Service (ARS) scientists in Riverside, California, used results from new field and laboratory experiments to revise earlier water quality criteria that now relate infiltration hazard to pH as well as SAR (sodium adsorption ratio) and salinity. These new criteria replace earlier Food and Agricultural Organization (FAO) criteria that did not consider pH, and that underestimated the adverse impacts of low SAR on water infiltration. New guidelines are also included for assessing infiltration hazard in environments where rainfall contributes to the water budget.

> ***Impact*:** Results from this work provide water quality specialists, water planners, regulatory agencies, and producers with the improved ability to evaluate the infiltration hazards associated with the application of irrigation waters based on their chemical composition. These improved guidelines ensure safer use of saline waters for irrigation, and thus extend the supply of water resources available for agriculture.

Because low quality waters, including treated recycled waste water, are increasingly used for irrigation, there is a need to develop appropriate guidelines for their use. In cooperation with researchers at the University of California, Davis, Agricultural Research Service (ARS) scientists in Riverside, California, developed a Salt Management Guide. The guide and accompanying CD include an extensive list of plant species suitable for water reuse systems, ranging from relatively non-saline settings to salt-affected problem sites.

> ***Impact*:** The guide helps landscape professionals, growers, and home gardeners manage salinity in recycled irrigation waters, particularly in matching appropriate plant species with specific water reuse systems and situations.

Declining water supplies have reduced production in irrigated agriculture in the western U.S. Agricultural Research Service (ARS) scientists at Parlier, California, identified plant species (e.g., mustard, poplar-tree clones, *opuntia* cactus) adapted to high saline drainage or ground waters. These plants can be used to produce new bio-based products that have economic value for the grower (e.g., biofuel, Se-enriched feed-products, and biofumigants).

> ***Impact*:** These findings improve our ability to develop a sustainable, agronomic-based system on drainage-impacted soils to support drainage water reuse or the use of poor quality waters. By reducing the grower's need for higher quality water, water availabilty to support agriculture in the western U.S. is enhanced.

The accumulation of pharmaceuticals in environments receiving treated municipal wastewater is a growing concern. Agricultural Research Service scientists at Maricopa, Arizona, investigated the accumulation of four pharmaceutically active compounds (PhAC's) found in treated effluent at a local groundwater recharge facility. Two PhAC's, ibuprofen and the antibiotic, lincomycin, were found not to accumulate over a three year period, but over the same three year period, caffeine and carbamazepine, an anti-seizure medication, did accumulate, although total accumulated carbamazepine and caffeine concentrations were low (1 and 4 parts per billion, respectively). The distribution and accumulation of PhAC's were related to specific chemical properties of the pharmaceutical, as well as soil chemical and physical properties such as texture and organic carbon content.

> ***Impact*:** The results of this research are helping the Town of Gilbert, Arizona, evaluate the sustainability of their groundwater recharge facility, while developing strategies to reduce the potential adverse effects of using treated wastewaters to support groundwater recharge in arid environments.

Indicator 2:

During FY 2012, ARS will develop guidelines for management practices that optimize soil, water, and economic benefits associated with drainage water management (DWM) systems in humid areas.

FY 2012 Accomplishments:

Drainage ditches surrounding agricultural fields are conduits for stormwater and irrigation runoff, linking production landscapes to aquatic systems such as rivers, lakes, and other water bodies. In collaboration with scientists from Mississippi State University, an ARS scientist at Oxford, Mississippi, analyzed seasonal sediment and water samples from eight ditches throughout the Lower Mississippi Alluvial Valley. Pesticide concentrations in ditch sediments were an order of magnitude higher (150-300 ug kg-1) than those in water samples (6-14 ug L-1). Additionally, out of all collected samples, approximately 87% were below detection limits for the 17 current and past-use pesticides examined.

> ***Impact*:** The lack of pesticide prevalence in water samples highlights the importance of drainage water management for improving habitat conditions in aquatic systems adjacent to agricultural fields, as well the potential for decreased pesticide toxicity in the aquatic ecosystems that are important components of agricultural landscapes in the Lower Mississippi Alluvial Valley.

In the young glacial till landscapes of the upper midwestern U. S., closed depressions – known locally as potholes – are widely pervasive. Even when using standard subsurface tile drains in the field, water from surface drainage collects at the lowest spot in the pothole, keeping the area too wet for farming. Most farmed potholes are drained using subsurface tiles, but some also have supplemental drainage from a tile riser (a pipe with holes drilled in its sides) that extends vertically above the soil surface. Agricultural Research Service scientists in West Lafayette, Indiana, found that the extent of potholes within a watershed was directly related to concentrations or loads of nutrients lost from that watershed. Research showed that an alternate practice, called a blind inlet, provided greater filtration of surface water from potholes. As compared to a tile riser, when drained with a blind inlet, watershed-scale phosphorus losses decreased by approximately 78 percent, and nitrogen losses decreased by more than 50 percent.

***Impact*:** Decreased nutrient losses in runoff waters improve water quality, but also save farmers money, increasing their bottom line. In 2012, ARS scientists in West Lafayette worked with the USDA Natural Resources Conservation Service (NRCS) to develop a conservation practice standard. The NRCS in Indiana now offers blind inlets as a cost-sharable practice through their Environmental Quality Incentives Program (EQIP). Overall application of this research in tile-drained agricultural landscapes in the humid pothole region has the potential to both strengthen the rural economy as well as improve water quality in the Mississippi River Basin and the Gulf of Mexico.

To meet the needs of a growing global population and improve human nutrition, agricultural production must continue to increase. At the same time, it is necessary to improve the environmental footprint of agriculture, particularly losses of sediment, nitrogen, and phosphorus. Agricultural Research Service scientists in St. Paul, Minnesota, showed that in the U.S. Corn Belt, these goals can be met simultaneously by combining increased landscape water storage with supplemental irrigation. This combination reduces flooding and associated nutrient losses while stabilizing yields and permitting the adoption of alternative cropping practices (e.g., cover crops; living mulches) that provide environmental benefits but can increase the risk of soil moisture depletion. Annual precipitation and stream flow have increased substantially over the past 50 years, so there is water available to supply supplemental irrigation if it can be stored during periods of excess. Restoration of wetlands and construction of ponds could provide that storage, with the added benefits of creating new wildlife habitat, serving as buffers to reduce downstream losses of sediment and nutrients, and providing additional crop biomass for forages or renewable fuels.

***Impact*:** Producers benefit economically from the additional productivity as well as the reduced financial risk associated with irrigation-stabilized yields. The broader public receives additional benefits in terms of increased wildlife habitat, improved water quality, and the increased production of forages and/or biofuel feedstocks.

Agricultural Research Service (ARS) scientists from Tucson, Arizona, Ames, Iowa, and Fort Collins, Colorado, demonstrated an approach linking production and water quality monitoring data, the Root Zone Water Quality Model (RZWQM) simulation model, the DevTreks economic budgeting tool, and the Facilitator decision support tool, to rank management systems in northeastern Iowa. In ranking management systems, they considered the effects of tillage, crop rotation, cover crops, and Nitrogen (N) (i.e., application method, timing, and amount) on net returns and N loading, for 30 long term simulations. From both an onsite and an offsite perspective, rankings from simulated results were very similar to those from observed results.

***Impact*:** By linking field data with physically based simulation models and budgeting tools, this research demonstrates a systematic and integrated approach that can be used to address water quality problems in tile-drained agricultural landscapes.

Indicator 3:

During FY 2012, ARS will develop predictive equations, procedures, and databases that will allow improved estimation of concentrated flow erosion on agricultural fields and construction sites.

FY 2012 Accomplishments:

Laterally migrating, meandering streams erode large quantities of fine-grained bank soils, adversely affecting downstream aquatic resources. Previously, tools used to predict future migration patterns relied on migrations observed in historical aerial photographs, an approach

that introduces great uncertainty. With collaborators at the Universities of Illinois and Pittsburgh, ARS scientists in Oxford, Mississippi, co-developed a new computer model that uses the resistance-to-erosion properties of floodplain soils, in combination with a meandering channel flow model, to predict channel migration rates.

> ***Impact*:** This new technology improves our ability to predict both stream channel migration rates and the patterns of meandering streams. The U.S. Army Corps of Engineers and natural resource agencies in various states have adopted the model to design, locate, and prioritize bank protection and stream restoration works, resulting in an overall reduction in stream bank erosion and improved stream restoration efforts.

Although dams have an excellent safety record across the U.S., dams do fail, and when they fail, life and property downstream are at risk. Along with cooperators from Kansas State University and the Natural Resources Conservation Service (NRCS), Agricultural Research Service (ARS) scientists at Stillwater, Oklahoma, continue to enhance WinDAM (Windows Dam Analysis Modules) software to provide an improved tool for predicting the processes and impacts associated with earthen embankment erosion and failure. Newly developed algorithms were incorporated into a pre-alpha version of WinDAM C, an enhanced version of WinDAM that includes a process-based internal erosion breach module. This enhanced version of WinDAM predicts the internal erosion and embankment failure that occurs during an internal erosion event.

> ***Impact*:** Increased knowledge of embankment breach erosion and failure processes due to overtopping and internal erosion results in enhanced predictive tools and capabilities, improving risk assessment, the prioritization of systems for rehabilitation, and the development of emergency action plans, inundation maps, and flood warning systems. This ensures that the excellent safety record of earthen dams in the U.S. continues.

Because soil deposited in streams results in impaired aquatic habitats and the build up of sediment in lakes and reservoirs, stream water contamination by sediment remains a major environmental concern in the U.S. In collaboration with researchers at the University of Missouri and Iowa State University, Agricultural Research Service (ARS) scientists at Columbia, Missouri, compared the streambank erosion rates of streams in two claypan watersheds in northeastern Missouri—the Crooked and Otter Creek watersheds. Streambank erosion was the dominant source of sediment in these streams, and contributed significantly to N transport, accounting for an average of 88% of the annual in-stream sediment, and 23% of the total nitrogen (N), exported from these watersheds.

> ***Impact*:** These findings will help to improve the management of riparian areas in watersheds dominated by claypan (restricted drainage) soils. Resulting decreases in streambank erosion will significantly improve water quality in streams of the Central Claypan region, helping to decrease N loadings in the Mississippi River Basin, thereby decreasing hypoxia in the Gulf of Mexico.

The Water Erosion Prediction Project (WEPP) model is a widely available and widely used method for predicting soil erosion by water. Although the model is process based, it does not explicitly model the effects of wind driven rain (WDR) on erosion. In collaboration with researchers from Turkey and Belgium, Agricultural Research Service (ARS) scientists at West Lafayette, Indiana, evaluated the magnitude of this effect under various wind speeds and two wind directions—slope facing into the wind or slope facing down wind. Results showed that the interrill erosion process in WEPP could be modified to better describe effective rainfall intensity by using three simple terms--the angle of rain incidence, the effective energy of the rain hitting the surface falling vertically, and the effective angle on the slope. Because it was already accounted for by the angle of rain incidence, the direction of the slope did not improve predictions.

***Impact*:** By providing a mechanistic description of wind-driven rain to account for the effects of wind on interill erosion, this research improves the predictive capabilities and accuracy of a widely used erosion prediction model, leading to the more efficient and effective management of soil loss in agricultural landscapes.

In collaboration with researchers from Ohio State University, Agricultural Research Service scientists at Columbus, Ohio, identified the frequency and extent of floodplain interaction, using a tributary of the Upper Big Walnut Creek (UBWC) Conservation Effects Assessment Project (CEAP) watershed as a model system. Floodplain interaction has been shown to be important for both nutrient retention and ecological diversity. A tributary of the UBWC was surveyed and monitored for one year to determine the frequency and extent of floodplain interaction. Findings were used to populate a computer model to project the number of out of bank flows, supporting the development of design parameters for a two-stage ditch conservation practice.

***Impact*:** The results of this research will help the Natural Resources Conservation Service (NRCS) and other environmental organizations develop innovative technologies and practices for improving stream water quality in agricultural landscapes, with the ultimate benefit of improved water quality in the Mississippi River Basin, thereby helping to reduce the extent of the hypoxic zone in the Gulf of Mexico.

Measure 6.1.1 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported 2 agricultural practices and technologies developed and used by customers to enhance water quality and availability.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
A new conservation practice standard for the blind inlet, a new conservation practice.	The NRCS in Indiana now offers blind inlets as a cost-sharable practice through the Environmental Quality Incentives Program (EQIP).	The Natural Resources Conservation Service (NRCS).	Significant decreases in nitrogen and phosphorus losses in runoff waters from agricultural fields, improving water quality and saving farmers money in terms of fertilizer costs, thereby increasing their bottom line.
A new computer model that uses the resistance-to-erosion properties of floodplain soils, in combination with a meandering channel flow model, to predict channel migration rates.	Made available to a variety of users in the U.S.	The U.S. Army Corps of Engineers and natural resource agencies in various states have adopted the model to design, locate, and prioritize bank protection and stream restoration works.	Improved prediction of stream channel migration rates and meandering stream patterns, resulting in an overall reduction in stream bank erosion and improved stream restoration efforts.

Measure 2.2.1: Develop technology and practices to promote improvement of integrated, effective and safe water resource management. (Formerly 6.1.1)
Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

develop new or improved guidelines, technologies, and/or knowledge to increase the effectiveness of agricultural water management.

develop new or improved guidelines, technologies, and/or knowledge to reduce erosion and sedimentation from agricultural lands and/or improve water quality.

develop new or improved knowledge, tools, technologies, guidelines, and/or conservation practices to better protect water resources, improve the overall effectiveness of USDA conservation programs, and/or improve watershed management and ecosystem services in agricultural landscapes.

During FY 2014, ARS will

develop new or improved guidelines, technologies, and/or knowledge to increase the effectiveness of agricultural water management.

develop new or improved guidelines, technologies, and/or knowledge to reduce erosion and sedimentation from agricultural lands and/or improve water quality.

develop new or improved knowledge, tools, technologies, guidelines, and/or conservation practices to better protect water resources, improve the overall effectiveness of USDA conservation programs, and/or improve watershed management and ecosystem services in agricultural landscapes.

During FY 2015, ARS will

develop new or improved guidelines, technologies, and/or knowledge to increase the effectiveness of agricultural water management.

develop new or improved guidelines, technologies, and/or knowledge to reduce erosion and sedimentation from agricultural lands and/or improve water quality.

develop new or improved knowledge, tools, technologies, guidelines, and/or conservation practices to better protect water resources, improve the overall effectiveness of USDA conservation programs, and/or improve watershed management and ecosystem services in agricultural landscapes.

OBJECTIVE 6.2: IMPROVE SOIL AND AIR QUALITY TO ENHANCE CROP PRODUCTION AND ENVIRONMENTAL QUALITY

High quality soil and air resources are essential for enhanced crop production and environmental stewardship. Productive soils enable efficient cycling of nutrients, help sequester atmospheric carbon, contribute to improved water and air quality, and foster other ecosystem services such as wildlife habitat. However, soils are vulnerable to degradation and damage through natural processes and human activities.

Air quality and atmospheric gas composition also have an impact on, and are in turn impacted by, agricultural production. Research is needed to control gaseous and particulate matter emissions from agricultural operations to protect air quality and mitigate impacts on climate.

ARS provides agricultural producers and land managers with strategies and technologies to enhance soil and air quality, and provides Federal and State agencies with science-based information to establish policy and regulatory decisions. For example, ARS research develops remedies for soil conditions limiting crop production and adversely affecting environmental quality. The Agency also works toward further developing safe and productive applications of animal manure and selected industrial and municipal byproducts as a low cost means of enhancing soil properties and improving crop production. Additionally, ARS is developing new measurement and prediction tools to determine the effects of agricultural land management practices on soil quality. In addressing its research objectives, ARS works to balance the stewardship of air and soil resources with the attainment of profitable and sustainable agricultural yields.

Performance Measure

Measure 6.2.1 Develop practices and technologies to enhance soil resources and reduce emissions of particulate matter and gases from crop production lands, agricultural processing operations, and animal production systems.

Baseline 2006
Six agricultural practices and technologies to enhance soil and air natural resources developed and used by customers and partners.
Target 2012
Cumulatively, 18 agricultural practices and technologies to enhance soil and air natural resources will be developed and used by customers and partners.

Indicator 1:

During FY 2012, ARS will assess the potential risks and benefits to agricultural systems that may arise from global change, and develop agricultural management practices and

decision support strategies that enable producers to take advantage of beneficial effects and mitigate adverse impacts.

FY 2012 Accomplishments*:*

Elevated atmospheric CO_2 selectively affects the vigor of non-native plants. For some plants, greater atmospheric CO_2 promotes larger and more vigorous growth, and while this can increase crop yield, it can also foster an undesired, aggressive spread of non-native plants. Lantana and Vinca, non-native species introduced to the U.S. as ornamentals, were grown in Auburn, AL under elevated CO_2 by ARS researchers. However, Lantana was more responsive to elevated CO_2 than Vinca. Thus, Vinca is less likely to aggressively spread as atmospheric CO_2 increases, whereas Lantana will likely respond to additional atmospheric CO_2 and may require greater effort to control. This study illustrates how non-native species, previously cultivated as non- invasive, have the potential to become invasive as atmospheric CO_2 continues to rise.

> ***Impact*:** Identification of plants that may create management problems under future climate provides a climate change adaptation tool for avoiding unintended consequences of using and/or importing non-native species.

Indicator 2:

During FY 2012, ARS will identify the processes that control the rate at which agricultural systems release and absorb greenhouse gases, and develop agricultural management practices that contribute to reductions in the Nation's net greenhouse gas emissions.

FY 2012 Accomplishments*:*

Greenhouse gas (GHG) emissions data base for agriculture developed. GRACEnet project developed a GHG emissions data management system and continued GHG model development. Basic data on GHG emissions acquired from different agricultural systems at 33 locations across the U.S over the past five years was organized into a data base. The data provides basic information on the effects of management practices on GHG emissions and C sequestration.

> ***Impact:*** The data and analyses from GRACEnet provide the science basis for policy decisions on GHG management which will reduce GHG emissions and reduce the economic loss of nitrogen as nitrous oxide from farming systems. Public access to the data is planned for 2013.

Indicator 3:

During FY 2012, ARS will develop practices which remediate degraded soils.

FY 2012 Accomplishments*:*

Narrow-row planting reduces sediment and herbicide losses from cotton production systems. Changing production practices can reduce runoff containing sediment and agrochemicals. ARS scientists at Stoneville, MS, evaluated sediment and herbicide losses from 4- to 6-leaf cotton planted in narrow and wide rows to determine if a change of row spacing could maintain yields while reducing cultivation impacts on water quality. Planting cotton on flat beds with rows spaced 15-inches apart reduced sediment loss by 38% relative to the losses from cotton planted on raised beds spaced 38-inches apart. Planting cotton in narrow rows also reduced herbicide loss relative to that of wide-row systems given similar factors affecting pesticide movement and runoff.

***Impact*:** Converting from wide-to narrow-row cotton cultivation provides a simple means of reducing sediment losses from fields without a reduction of yields, and thus positively impacting Mid-South water quality.

Indicator 4:

During FY 2012, ARS will develop methods to reduce emissions of harmful gases from crop and animal production systems.

FY 2012 Accomplishments:

Sensitivity of herbicide volatilization to soil moisture. Efficient herbicide application has been hampered by a lack of understanding of fate and transport mechanisms. Field investigations over the past 14 years by ARS scientists from Beltsville, Maryland, Ames, Iowa and Riverside, California have determined that volatilization (vapor loss to the atmosphere) appears to be the most critical pathway for herbicide loss from production fields into neighboring ecosystems. Herbicide volatilization experiments conducted in Beltsville, Maryland, the longest record of herbicide vapor loss observations worldwide, demonstrated that herbicide volatilization is greatest under warm, wet soil moisture conditions during the day when air near the soil has a tendency to rise as the soil warms.

Impact: All herbicide volatilization models must be revised to account for atmospheric stability and soil moisture conditions. The addition of these terms significantly improves herbicide volatilization models used to help guide herbicide applications on crop fields world-wide. These model improvements have uses in herbicide application practices, as well as USDA and U.S. Environmental Protection Agency policy development, and they show ways to reduce environmental and economic losses incurred with volatilization.

Indicator 5:

During FY 2012, ARS will develop practices and approaches which mitigate the detrimental effects of tropospheric ozone on agricultural crops.

FY 2012 Accomplishments:

Atmospheric vapor pressure deficit is a key factor in plant response to ozone stress. Accurate prediction of impacts of global climate change and atmospheric pollutants on plant growth is complicated due to interactions with environmental variables such as atmospheric vapour pressure deficit (vpd). ARS researchers at Raleigh, North Carolina showed that ozone-induced reductions in snap bean growth and yield under low vpd (high humidity) did not occur under high vpd (low humidity), although overall yield potential was also limited by high vpd conditions. These results suggest that efforts to model climate change impacts on vegetation must consider interacting environmental factors and that vpd is a critical factor to consider when predicting the effects of ozone air pollution.

Impact: The results provide information needed for models to be incorporated into decision support systems from agriculture.

Indicator 6:

During FY 2012, ARS will develop management practices and decision tools to improve soil quality and protect the environment.

FY 2012 Accomplishments*:*

Guidelines developed for corn stover harvest that maintain soil sustainability. Corn stover (crop residue left on fields following harvest), has been identified as a potential feedstock for producing bioenergy and/or other bioproducts. However, excessive harvest of corn stover may also rob the soil of nutrients and carbon need to maintain healthy, sustainable soil, and thus guidelines for sustainable corn stover harvest are needed. Four years of cooperative field research among ARS scientists in Ames, IA, the advanced fuels commercial partnership POET-DSM, and Iowa State University showed that to sustain soil carbon levels and other critical soil functions, corn stover should not be harvested from a field if the average grain yields of the field are less than 11 Mg/ha (175 bu/acre). This is a key development of ARS Renewable Energy Assessment Project (REAP) team studies

> ***Impact:*** This provides guidelines for enabling the U.S. to reach goals for increased bioenergy and bioproduct production from corn stover, while sustaining soil health for future harvests.

Indicator 7:

During FY 2012, ARS will document the effectiveness of management practices and control technologies to reduce the emission of harmful gases from crop and animal production systems.

FY 2012 Accomplishments*:*

Corn processing and distiller's grain effects on production of odors from feedlot manure. The compositon of diets fed to finishing cattle can have significant effects on odors emitted from feedlits. The effects of feeding steam-flaked corn and wet distiller's grains, a byproduct of the grain-based bioethanol industry, on odor production from beef cattle fed high-concentrate finishing diets is not known. ARS scientists at the Conservation and Production Research Laboratory, Bushland, Texas, collected feces and urine from steers fed varying diets, and ARS scientists at the Meat Animal Research Center, Clay Center, Nebraska, incubated the feces and urine in chambers in order to measure the production of volatile fatty acids, methane, total gas, and other volatile organic compounds that contribute to feedlot odor. Cattle fed diets containing dry rolled corn excreted more starch than cattle fed steam-flaked corn based diets. Production of odors, volatile fatty acids, and other gases increased as the starch content of the feces increased. Production of sulfur-containing odorous compounds was greater from feces of cattle fed diets containing distiller's grains.

> ***Impact*:** These results indicate that odors from feedyards may be decreased by steam flaking corn and by limiting the quantity of distiller's grain in the diet.

Indicator 8:

During FY 2012, ARS will demonstrate the effectiveness of management practices and control technologies that will reduce nutrient losses, reduce emissions, and control pathogens from animal production operations.

FY 2012 Accomplishments:

Injecting liquid manure improves ammonia retention but increases other nitrogen losses. Incorporation of liquid manure into the soil is often recommended to reduce ammonia losses, odor, and nutrient runoff in surface water. However, incorporation with tillage is not compatible with high-residue conservation practices, such as no-till, and is not possible with pasture or perennial forages. Manure injection technologies allow incorporation with limited disruption of the soil surface or plant residue cover. ARS scientists at Beltsville, Maryland conducted a critical review and analysis of the literature and found many publications that show injection of liquid manures can reduce ammonia N emissions by 40-90%, compared to surface application. However, injection can create anaerobic soil conditions leading to losses of other gaseous forms of nitrogen (N). Up to half of the N that is conserved by reducing ammonia emissions can later be lost as N2 (a chemically inert gas that makes up 78% of earth's atmosphere) or as nitrous oxide (a potent greenhouse gas). Improved crop utilization of the N conserved by reducing ammonia emissions is the most common observation following injection, but this benefit can be minimal.

> ***Impact:*** These results provide scientists, nutrient managers, and policy makers with improved estimates of the effects of manure injection on the fate and transport of manure N that can be used to improve economic return and minimize adverse affects of manure N.

Managing manure to reduce runoff phosphorus (P) losses. Manure application to cropland can contribute to runoff losses of P, which can lead to excessive algae growth in lakes and streams. ARS researchers in Marshfield, Wisconsin, conducted a series of rainfall simulation experiments to assess how the amount of dissolved P in runoff would be affected by: 1) P supplementation of dairy heifer diets; 2) manure application method and rate; and 3) the amount of available P already in the soil. Phosphorus supplementation in the diet resulted in more P in manure, which led to 2 to 3 times more dissolved P in runoff. Incorporation of manure into the soil reduced runoff P concentrations by 85 to 90% compared to surface application.

> ***Impact:*** These results show that large reductions in P runoff losses can be achieved by avoiding unnecessary dietary P supplementation, by incorporation of manure, by limiting application rate when applying to cropland, and by avoiding soils with excessive P. By adopting these practices, farmers can greatly reduce the amount of P leaving their farms, which subsequently will reduce algae growth and eutrophication in surface waters.

Indicator 9:

During FY 2012, ARS will deliver a Nitrogen Index (N Index) relative risk assessment tool that provides field guidance for potential movement of nitrogen via runoff, leachate, or gas emission from various landscapes and cropping systems.

FY 2012 Accomplishments:

The first Nitrogen Index app was released in 2012. Nitrogen losses from agricultural systems negatively impact ecosystems. The new smartphone app can be run at a given farm and can even email the results, helping users assess and improve nitrogen use efficiency.

Impact: The Index has been downloaded hundreds of times by national and international users. An invited Soil & Water Conservation Society workshop was conducted and the tool was covered in an Agronomy Society of American online nitrogen course.

Indicator 10:

During FY 2012, ARS will develop instrumentation and models to measure and predict emission and dispersion of particulate matter and gases from animal production operations.

FY 2012 Accomplishments:

Models predict nitrogen excretion by beef cattle. Reliable estimates of nitrogen excretion in the urine and feces of beef cattle are important to determine how much nitrogen is lost from feedyards as ammonia gas. Researchers in Bushland, Texas, analyzed 50 different beef cattle diets to determine the relationships between nitrogen intake, the amount of protein in the diet, and nitrogen excretion in the urine and feces of beef cattle. Then, statistical models were developed that predict excretion of urinary and fecal nitrogen by beef cattle.

Impact: These simple and robust statistical models were very accurate and provide a simple tool to predict nitrogen excretion for a wide range of dietary and animal characteristics. They could be incorporated into more complicated process-based models, which track ammonia production based on numerous animal management and environmental factors, to improve their accuracy for predicting feedyard ammonia loss.

Measure 6.2.1 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported 2 agricultural practices and technologies to enhance soil and air natural resources will be developed and used by customers and partners. ARS also reported 1 new technologies or strategies provided to manure and byproduct producers and users to improve profitability while meeting environmental objectives.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
Non-point source pollution of fresh waters by agricultural phosphorus (P) can limit water use for drinking, recreation, and industry. The Annual P Loss Estimator (APLE) is a user-friendly spreadsheet model that estimates annual sediment bound and dissolved P loss in surface runoff, and long-term changes in soil P concentrations. Access to the model is free of charge to the public.	APLE is available at http://ars.usda.gov/Services/docs.htm?docid=21763	Domestic and international phosphorus runoff research, extension, and policy community.	Provides a user-friendly model and supporting documentation to evaluate the effect of management practices on phosphorus loss in runoff and accumulation in soil. Model is being used by ARS researchers in KY to develop methods to improve P Indexes and by consultants in the Chesapeake Bay watershed to develop soil

			P drawdown estimates for high P soils.
USDA-ARS scientists involved in GRACEnet (Greenhouse Gas through Agricultural Carbon Enhancement Network) published a book documenting recent research accomplishments addressing strategies to mitigate and adapt to climate change.	A commercially (Elsevier Sci. Pubs) published book, entitled Managing Agricultural Greenhouse Gases: Coordinated Agricultural Research through GRACEnet to Address our Changing Climate, includes regional syntheses of soil organic carbon and greenhouse gas (GHG) dynamics for broad portfolio of agricultural land uses.	Domestic & international researchers; extension agents. Serves as a scientific reference for policy-makers addressing GHG management options.	Provides knowledge and information on soil carbon sequestration, GHG emissions, and environmental benefits to better measure and implement scientifically-based agricultural management practices from field to national policy scales.
Synthesis of the options for greenhouse gas mitigation by agriculture.	Report published by the Council for Agricultural Science and Technology Report (CAST report number 142) entitled, Carbon Sequestration and Greenhouse Gas Fluxes in Agriculture: Challenges and Opportunities.	Domestic & international researchers and policy makers	Provides a state-of-the art reference document on greenhouse gas emissions and emissions management by agriculture.

Measure 2.2.1: Improve quality of atmosphere and soil resources, understand effects of climate change through development of knowledge and technologies. (Formerly 6.2.1) Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, *ARS will*

effectively and safely manage and use manure and other agricultural and industrial byproducts in ways that maximize their potential benefits while protecting the environment and human and animal health.

assess the potential risks and benefits to agricultural systems from climate change, and develop agricultural management practices and decision support strategies that enable producers to take advantage of the beneficial effects, and adapt to the adverse effects of climate change.

develop management practices and decision tools to improve soil quality, protect the environment, and contribute to the sustainability of agricultural systems.

assess the greenhouse gas emissions from agricultural systems and develop methods for reducing the emissions.

During FY 2014, *ARS will*

effectively and safely manage and use manure and other agricultural and industrial byproducts in ways that maximize their potential benefits while protecting the environment and human and animal health.

assess the potential risks and benefits to agricultural systems from climate change, and develop agricultural management practices and decision support strategies that enable producers to take advantage of the beneficial effects, and adapt to the adverse effects of climate change.

develop management practices and decision tools to improve soil quality, protect the environment, and contribute to the sustainability of agricultural systems.

assess the greenhouse gas emissions from agricultural systems and develop methods for reducing the emissions.

During FY 2015, *ARS will*

effectively and safely manage and use manure and other agricultural and industrial byproducts in ways that maximize their potential benefits while protecting the environment and human and animal health.

assess the potential risks and benefits to agricultural systems from climate change, and develop agricultural management practices and decision support strategies that enable producers to take advantage of the beneficial effects, and adapt to the adverse effects of climate change.

develop management practices and decision tools to improve soil quality, protect the environment, and contribute to the sustainability of agricultural systems.

assess the greenhouse gas emissions from agricultural systems and develop methods for reducing the emissions.

Objective 6.3: Conserve and Use Pasture and Range lands Efficiently

Healthy, vigorous plant communities on diverse lands protect soil quality, prevent soil erosion, and provide sustainable forage and cover for livestock and wildlife. They also provide fiber and a diverse habitat for wildlife, improve water quality and sequester atmospheric carbon dioxide. The four serious threats that pose an increasing risk to the values, goods, and services provided by public and private pasture and range lands are wildfire, invasive species, loss of open space, and reduced profitability.

ARS works with public and private land stewards to maintain/enhance watersheds and landscapes and their environmental services. The Agency produces the scientific knowledge needed to actively manage pasture and range lands and maintain the health, diversity, and resilience of these ecosystems.

Key Outcomes: Pasture and range land management systems that enhance economic viability and environmental services.

Performance Measure

Measure 6.3.1. Improved management practices and technologies for managing pasture and rangelands to improve economic profitability and enhance environmental values.

Baseline 2006
Fifteen new technologies or strategies provided to pasture, forage, and range land managers to conserve and restore natural resources while supporting profitable production.
Target 2012
Cumulatively, 39 new technologies or strategies will be provided to pasture, forage and range land managers to conserve and restore natural resources while supporting profitable production.

Indicator 1:

During FY 2012, ARS will provide increased understanding of genetic resources, genomics, and molecular processes of grasses, legumes, and other herbaceous plants that affect establishment, persistence, production and use so that improved germplasm and cultivars can be released for pasture, harvested forages, turf, biofuels, rangeland restoration, and conservation.

FY 2012 Accomplishments*:*

ARS releases new Siberian wheatgrass cultivar for revegetation of dry-harsh disturbed rangelands. ARS scientists in Logan, Utah released 'Stabilizer' Siberian wheatgrass cultivar as a rapid-establishing grass for use on arid and semiarid rangelands, roadsides, and as a grass component in fire strip plantings in the western U.S. Intermountain, Great Basin, and Northern Great Plains regions. Due to its rapid establishment and persistence, Stabilizer can successfully compete against troublesome weeds such as cheatgrass and medusahead that frequently occupy much of the disturbed rangelands and roadsides in the western U.S. As rangeland ecosystems experience changing climate conditions that may result in reduced precipitation, Stabilizer Siberian wheat grass meets the need for a low-growing grass that is easily established, and that persist under increased drought, weed completion, and wildfire conditions.

> ***Impact*:** Commercial sales of previous improved cultivar releases such as this make up a majority of the seed purchased by BLM for reclamation purposes. It is anticipated Stabilizer Siberian wheatgrass will be extensively utilized by public land management agencies and private landusers.

Improved winter-hardy switchgrass with high biomass yields developed. ARS researchers at Lincoln, NE have developed a lowland-type switchgrass with improved winter hardiness similar to

highland types, but with high biomass yield characteristic of lowland types. The improved lowland-type strain was obtained by crossing upland and lowland plants followed by three generations of selection and breeding, and has excellent winter survival in Nebraska, Wisconsin, and Illinois. In eastern Nebraska, average yields were 2.4 tons per acre per year greater than the best available released upland cultivar.

> ***Impact*:** This improved winter-hardy switchgrass type demonstrates the feasibility of improving the winter hardiness of switchgrass by breeding. The lowland experimental strain is in the seed increase phase for potential release as a cultivar and commercialization.

Indicator 2:

During FY 2012, ARS will provide forage and pasture management technologies and strategies that reduce inputs while improving livestock performance and sustaining the environment.

FY 2012 Accomplishment:

Eastern gamagrass in dairy heifer feed limits excessive weight gain. ARS researchers at Madison, Wisconsin showed gamagrass can easily be ensiled and blended into mixed forage diets replacing purchased straw. Dairy heifer diets typically contain high proportions of corn silage or other high-energy forages that often cause excessive weight gains and negatively affects future milk production performance. Consequently, dairy farmers will add straw and other high-fiber feeds to feed rations to limit the amounts of feed eaten and reduce caloric density. Gamagrass use provides an effective alternative management strategy to manage replacement dairy heifer weight gains, especially when facilities are overcrowded.

> ***Impact*:** Feeding gamagrass grown on the dairy farm is a low-cost replacement to purchased straw can save farmer $150/ton in straw costs.

Indicator 3:

During FY 2012, ARS will provide rangeland management technologies and strategies that reduce inputs while improving livestock performance and sustaining the environment, including reducing the risks of wildfires, invasive weeds, and other threats, by stabilizing, restoring, and monitoring degraded rangeland in an affordable and sustainable manner.

FY 2012 Accomplishments:

Online weather-based recommendations developed for rangeland vegetation restoration. ARS scientists in Boise, Idaho created a microclimatic index of favorable seedbed conditions and developed a management framework for using historical weather data for planning and managing rangeland restoration projects. This framework includes analysis of site-specific historical weather data, evaluation and ranking of annual, seasonal and monthly precipitation and temperature patterns, and assessment of seedbed microclimatic conditions relative to the growth stage of seeded plant materials that could be used for rangeland restoration.

> ***Impact*:** The tool is available on the Web for land managers to adapt their restoration efforts to fit site-specific weather conditions to help ensure more dependable restoration success and save costs of restoration.

Rangeland Hydrology and Erosion Model tool implemented. ARS scientists in Reno, Nevada, in collaboration with ARS in Boise, Idaho, and Tucson, Arizona, estimated runoff and erosion rates on non-federal rangelands in the 17 western states and provided maps of where targeted place-based conservation practices to reduce soil loss would be most cost-effective. The *Rangeland Hydrology and Erosion Model* (RHEM) developed by ARS allows rapid identification of where conservation programs can be utilized most cost-effectively. This same approach can be used to target specific locations for conservation practices to meet specific goals set by landowners, federal land managers, and policy makers in cost-effective ways.

***Impact*:** The results from the 17-state analysis were reported in USDA's National Conservation Program report to Congress.

Measure 6.3.1 Summary of the Major Technologies Developed, Transferred, and Used in FY 2012:

During FY 2012, ARS reported 4 new technologies or strategies provided to managers of pasture, forage and range lands to improve conservation, restore natural resources, and increase profitability.

Describe the Technology	Describe the Transfer	Identify the Customer	Impact
New Siberian wheatgrass cultivar	Public release to private seed companies for increase and sale to customers.	Federal and state land management agencies including the Bureau of Land Management (BLM), USDA Natural Resources Conservation Service, state road departments, ranchers, and seed companies.	Anticipated extensive use by public land management agencies and private land users
Winter-hardy switchgrass with high biomass yield	Public release to University Nebraska Foundation Seed for certified seed companies for increase and sale to customers.	Private landowners and energy companies that produce dedicated forage and energy crops in Nebraska, Wisconsin, and Illinois.	This new cultivar will yield 20-25% more than existing varieties under the same conditions.
Eastern gamagrass for dairy heifer diets	Publication and technical notes released to university extension and dairy industry.	Dairy operators that presently blend straw into dairy cattle diets.	Reduced feedstocks by substitution of on-farm produced gamagrass and improved dairy heifer nutrition and feed accessibility.
Online recommendations for rangeland vegetation restoration	Worldwide Web access to the decision tool at: web http://www.ebipm.org/	Private land owners, DOE Bureau of Land Management and other public land managers.	

Measure 2.2.5: Develop and transfer economically viable and environmentally sustainable production and conservation practices, technologies, plant materials and integrated management strategies, based on fundamental knowledge of ecological processes, that conserve and enhance the Nation's diverse natural resources found on its range, pasture, hay and turf lands. (Formerly 6.3.1)

Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, ARS will

provide improved germplasm and cultivars can be released for pasture, harvested forages, turf, biofuels, rangeland restoration, and conservation.

provide forage, pasture, and rangeland management technologies and strategies that reduce inputs while improving livestock performance and sustaining the environment.

During FY 2014, ARS will

provide improved germplasm and cultivars can be released for pasture, harvested forages, turf, biofuels, rangeland restoration, and conservation.

provide forage, pasture, and rangeland management technologies and strategies that reduce inputs while improving livestock performance and sustaining the environment.

During FY 2015, ARS will

provide improved germplasm and cultivars can be released for pasture, harvested forages, turf, biofuels, rangeland restoration, and conservation.

provide forage, pasture, and rangeland management technologies and strategies that reduce inputs while improving livestock performance and sustaining the environment.

ARS Management Initiatives

ARS is continually assessing the relevance, quality, and performance of its research, providing agricultural information to the public through the National Agricultural Library and print and electronic media, ensuring adequate facilities to support Agency research, and ensuring a workplace conducive to personal and professional development.

MANAGEMENT INITIATIVE 1: ENSURING THE QUALITY, RELEVANCE, AND PERFORMANCE OF ARS RESEARCH (COVERS ALL RESEARCH OBJECTIVES)

The Office of Management and Budget (OMB) has established Governmentwide R&D Investment Criteria that are designed to assess the relevance, quality, and performance of Federally funded research, and ARS adopted the R&D Investment Criteria as a tool to measure its research. To establish the relevancy of the Agency's research programs, ARS relies on organized interactions with customers, stakeholders, and partners. Peer reviews conducted by the Office of Scientific Quality Review (OSQR) and the Research Position Evaluation System (RPES) ensure the quality of the Agency's research and scientific workforce. All research projects are assessed annually to determine the number of currently approved milestones that were met/not met during the preceding fiscal year. Near the end of the 5-year program cycle, National Programs are subject to retrospective reviews, which verify the scientific impact and programmatic relevance of the work conducted under each National Program Action Plan.

Performance Measure

MI 1.1 Relevance: ARS' basic, applied, and developmental research programs are well conceived, have specific programmatic goals, address high priority national needs, and have direct relevancy in achieving ARS' long-term goals.

Baseline 2004
As assessed against the Program Action Plans, the Agency's long-term goals, and the priority needs of U.S. agriculture, 97.1% of ARS' projects were conducting highly relevant research.
Target 2011
100% of ARS' projects will be conducting highly relevant research.

MI 1.2 Quality: ARS' research projects are reviewed for quality by National Program using independent external peer review panels at the beginning of the 5-year National Program cycle.

Baseline 2005
Using an average based on cumulative scores for the past five years, 76.1% of projects received scores of No, Minor, Moderate revision needed upon initial review and, overall, 97% received such scores by the completion of the review.
Target 2011
Using a cumulative five-year average, 80% of the projects reviewed will receive initial scores of No, Minor, or Moderate revision needed and 98% receive such scores by completion of review.

Baseline 2005
RPES conducted 392 scientific peer reviews of ARS scientists: 181 (46.2%) were upgraded, 203 (51.8%) remained in grade or were referred to the Super Grade Panel, 3 (0.8%) could not be graded because of insufficient information, and 5 (1.3%) had a grade/category problem.
Target 2011
RPES will conduct 400 scientific peer reviews of ARS scientists.

MI 1.3 Performance: ARS will monitor the percentage of annual research project milestones met.

Baseline 2004
85.3% of ARS project milestones were fully or substantially met.
Target 2011
89% of ARS' project milestones will be fully or substantially met.

Baseline 2004
NPS completed three National Program Reviews.
Target 2011
NPS will complete National Program Reviews for all Programs in the first 5-year cycle and will begin reviews for the programs currently in the second 5-year cycle.

FY 2012 Accomplishments are reported under the USDA Performance Accountability Report and OMB PART requirements.

MANAGEMENT INITIATIVE 2: ENSURE PROVISION AND PERMANENT ACCESS OF QUALITY AGRICULTURAL INFORMATION FOR USDA, THE NATION, AND THE GLOBAL AGRICULTURAL COMMUNITY VIA THE NATIONAL AGRICULTURAL LIBRARY

The National Agricultural Library (NAL) has statutory mandates to identify, collect, preserve in perpetuity, and provide access to quality information relevant to agriculture; serve as one of four national libraries; serve as USDA's library; provide leadership in developing and operating a comprehensive agricultural library and information network; and provide specialized information services through such NAL information centers and programs as the Animal Welfare Information Center (AWIC), the Rural Information Center (RIC), the Food Safety Research Information Office, and the Agriculture Network Information Center (AgNIC). The library serves a large and broad customer base, including such audiences as policymakers, researchers, agricultural specialists, farmers, members of the library, educational and agribusiness sectors, food stamp recipients, and the general public. Recently, the library, with partners in the land-grant university and agricultural information service communities, has initiated development of the National Digital Library for Agriculture (NDLA).

Performance Measures

MI 2.1 The services and collections of the National Agricultural Library continue to meet the needs of its customers.

Baseline 2005
The National Agricultural Library total annual volume of customer service transactions exceeded 82 million.
Target 2011
The National Agricultural Library total annual volume of customer service transactions exceeds 145 million.

Indicator 1:

During FY 2012, NAL will continue to expand and improve services based on customer usage and satisfaction data.

FY 2012 Accomplishments*:*

The National Agricultural Library (NAL) is the largest and most accessible agricultural research library in the world. It provides service directly to the staff of USDA and to the public, primarily via the NAL Web site, http://www.nal.usda.gov. NAL was created with the U.S. Department of Agriculture (USDA) in 1862 and was named a national library in 1962 by Congress (7USC§3125a), as "the primary agricultural information resource of the United States." NAL is the premier library for collecting, managing, and disseminating agricultural knowledge. The Library is the repository of our Nation's agricultural heritage, the provider of world-class information, and the wellspring for generating new fundamental knowledge and advancing scientific discovery. It is a priceless national resource that, through its services, programs, information products, and Web-based tools and technologies, serves anyone who needs agricultural information. The Library's vision is "advancing access to global information for agriculture."

Progress Continues Toward a Transformation to a Digital Library
After decades of providing *some* services and content digitally, NAL has begun a transformation to deliver information about *all* NAL programs and services digitally and to deliver as much content and as many services digitally as are permitted by law, technology, and funding. Because NAL's resources are limited, its customer needs and expectations are broad, and the digital information landscape is constantly changing, practical steps have been identified to advance the development of "Digital NAL." The Library's information technology infrastructure is being reinforced and brought up to date. An automated indexing application was installed, integrated into existing IT systems, and passed quality testing. The indexers began development of the semantic tools that fine tune and drive the quality control process so that the goal of increasing annual production to more than 250,000 articles in the next two years with acceptable quality will be realized. The NAL collection development policy was revised to exclude the purchase of print monographs and increase the acquisition of commercially available digital content and ramp up the digitization of items in the library's collection, beginning with USDA publications.

Delivering Information and Research Services.
NAL provides free access to agricultural information, primarily through its core Web site, http://www.nal.usda.gov/. NAL's FY2012 total volume of direct customer transactions exceeded 107 million. Services delivered digitally continued to grow while services based entirely on physical materials continued to decline. Examples of accomplishments and progress include:

- DigiTop usage stayed strong and online document delivery services increased. USDA staff executed more than 1,200,000 full-text downloads from NAL's DigiTop (Digital Desktop for USDA) service, level with usage in FY2011.
  Online document delivery requests received by NAL increased by 27 percent to 24,225 items. 100% of document delivery requests by USDA staff and non-USDA were received electronically and 78% were delivered electronically. Reference transactions decreased 29.4% to 7,871 as more information is available on our Web site.
- NAL and AFSIC, with the support of Sustainable Agriculture Research and Education (SARE) and USDA's National Organic Program (NOP), digitized the Organic Roots Collection, which was added to the NAL Digital Collections and is accessible at http://organicroots.nal.usda.gov/. Organic Roots is a collection of historic documents published prior to 1942, before synthetic chemicals were widely used. The data contained in these documents is still very relevant for current organic and sustainable agricultural practices.

• NAL's AFSIC/RIC Start2Farm Web site http://www.start2farm.gov/, funded through a grant from NIFA as part of the Beginning Farming and Ranching Development Program Curriculum and Training Clearinghouse, was launched as an online accessible "one-stop" source of information for beginning farmers and ranchers. Associated with this clearinghouse is a database organized into four main topic areas: educational programs, financing, service providers, and networking. Additionally, a "New to Farming" tutorial, events calendar, BFRDP & USDA program information are featured. The site had over 430,000 pageviews in FY 2012.
• NAL's Food and Nutrition Information Center (FNIC)/Nutrition.gov specialists provided advice and digital content including:

- **WIC Calculators App** The WIC Works Resource System released the WIC Calculators App for iPhone and Android platforms. The app allows WIC nutritionists to accurately and quickly calculate the amount of infant formula that can be provided to WIC participants. It also allows staff to determine if a bread or cereal is whole grain eligible as defined in the WIC food package regulations.
- **Nutrition.gov: Web site Statistics** Pageviews increased 136%, from 1,995,922 in FY2011 to 4,716,666 in FY2012 (+ 2,720,744).
- **Nutrition.gov Releases Videos**
  Farmers Markets: Fresh, Nutritious and Local. The FNIC Web and Reference Team (WRT) launched a video and supporting Web page (http://www.nutrition.gov/shopping-cooking-meal-planning/food-shopping-and-meal-planning/farmers-markets) they developed to educate consumers about the benefits of shopping at farmers markets. The video was produced in conjunction with the USDA Office of Communications, featured on the USDA Blog, Let's Move Blog and USDA and NAL You Tube channels, where the video has more than 5,000 views.
  Kids Rock Nutrition in the Kitchen. WRT developed and launched a video and supporting Web page (http://www.nutrition.gov/life-stages/children/kids-kitchen) for parents and teachers to help kids learn to create fun and healthy meals and snacks. The WRT worked with the USDA Office of Communications to produce the video, which features children learning to create a healthy, tasty meal. The video was featured on the USDA Blog, and is also available on the USDA and NAL You Tube channels, with more than 3,000 views.
- **SNAP-Ed Connection Releases Build a Cookbook Feature.** In conjunction with the release of an updated, Drupal-based Recipe Finder database, SNAP-Ed Connection launched a "Build a Cookbook" feature in June 2012. The new feature allows users to create a personalized cookbook by selecting any of the nearly 600 low-cost, healthy recipes in the Recipe Finder. Pre-selected recipes, grouped by categories such as children's favorites, older adults, and fruits and vegetables, are also available. Completed cookbooks can be saved as a PDF file for viewing and printing.
- **Improved USDA Food Composition Database Interface Launched.** FNIC's Web and Reference Team worked with NAL Information Services Division and the Nutrient Data Laboratory (NDL) staff to create a hybrid search page and navigation scheme to support ISD's restructured and improved database interface. The new search page allows users greater access to related information resources from both the FNIC and NDL Web sites and can be accessed at http://ndb.nal.usda.gov/. The USDA National Nutrient Database for

Standard Reference is used in many government databases and studies, as well as commercial applications. It now has nearly 8,000 food items listed.

- **Food Safety Research Publications Automated Feed.** The Food Safety Research Information Office provides a feed to an automatically updated list of research articles from several peer-reviewed journals, including: Journal of Food Safety, Journal of Food Protection, Food Control, Journal of Food Science, Food Microbiology, Annual Review of Food Science and Technology, International Journal of Food Microbiology and Applied and Environmental Microbiology. Some articles may be early view or ahead of print. The feed can be viewed at http://fsrio.nal.usda.gov/research-projects-and-publications/research-publications-peer-reviewed-journals.

***Impact*:** Services were expanded and improved.

Developing Decision Support Tools for Science-Based Sustainability Practices.
Consumers' interest in how agricultural products are grown and made is on the rise along with concern for the environment. Researchers and members of the food industry are gathering data about these products and processes using the Life Cycle Assessment. This widely used tool assesses potential environmental impacts for a given product, process, or activity throughout its entire life span. But few information resources exist to share these assessments. In response, NAL launched the LCA Digital Commons. This Web site offers the public access to a broad inventory of peer-reviewed, standard-formatted United States Life Cycle Assessment data. In 2012, the project was featured as a U.S. government contribution to the Rio+20 Convention for the UNEP Sustainable Public Procurement Initiative. Data for 536 U.S. commodity crop unit processes including corn, wheat, soybeans, cotton, oats, peanuts, and rice have been uploaded and are fully searchable at http://www.lcacommons.gov. The LCA Digital Commons will expand to encompass data from other industries, including dairy and cotton. NAL is coordinating with other Federal agencies to link database development efforts, and working with NIFA to require the uploading of research data as part of its bioenergy grants.

***Impact*:** Services were expanded and improved.

Digital Collections
The NAL Digital Collections (NALDC) http://naldc.nal.usda.gov/ provides unified and simplified access to the full-text of USDA-funded research, data and publications as well as digital reproductions of images. Currently, the NALDC provides access to more than 1 million pages of documents, and, during FY2012, added 42,342 full-text articles and approximately 2,328 ARS-generated publications. Also in 2012, the NALDC added the Organic Roots Collection of pre-1942 USDA publications related to organic agriculture http://organicroots.nal.usda.gov/.

***Impact*:** Services were expanded and improved.

Developing Public Awareness and Partnerships

• *AgNIC*: NAL serves as the secretariat for the Agriculture Network Information Center (AgNIC) Alliance, a voluntary, collaborative partnership that hosts an international distributed network of discipline-specific agricultural information Web sites (http://www.agnic.org). AgNIC utilizes Open Source technologies which are all freely available. AgNIC provides access to high-quality agricultural information selected by its 48 AgNIC partners, including land-grant universities, NAL, and other institutions around the world. AgNIC incorporates 2/3 of the AGRICOLA database and 1.5 million PubMed records which include links to local libraries owning the items, in case people would like

to borrow them locally. AgNIC harvests more than 30 relevant full-text digital repositories from institutions worldwide, in multiple languages. The AgNIC partners identified more than 150 additional digital repositories to harvest. The AgNIC search now provides access to more than 5 million sources.

• *VIVO:* NAL collaborated with ARS, other REE Agencies, and the Forest Service to establish a semantic web application, VIVO, which enables the discovery of research and scholarship across the USDA science agencies. NAL hosts VIVO for USDA at http://vivo.usda.gov/. The USDA VIVO ingests public data from systems of record such as ARS, ARIS, the NIFA Current Research Information System (CRIS), and the U.S. Forest Service Research Information Tracking System (RITS) databases. Additional agencies and information will be added. The open source application, developed and implemented at Cornell University, will allow improved discovery for networking, collaboration and research. VIVO will also allow citizens to better discover USDA research.

• *Interagency partnerships*: NAL continued to be very active in developing and maintaining partnerships to provide digital information services. Nutrition.gov, invasivespeciesinfo.gov, science.gov, and worldwidescience.org are multi-agency and multi-national Web portals to which NAL contributes digital content and leadership. ARS and NAL are working closely with the National Renewable Energy Laboratory (NREL), Department of Energy (DOE) and Environmental Protection Agency (EPA) toward the development of a Federal LCA Digital Commons. In 2012, NAL assisted with updating the software platform for the U.S. LCI Database and currently hosts the database for NREL and DOE. NAL also continued to participate actively in other interagency groups such as PHPartners (Public Health) and CENDI (scientific and technical information management) to promote and leverage NAL's work.

***Impact*:** Services were expanded and improved.

Measure MI 2.1 Outyear Performance Plan (the future performance indicators for this Measure)

During FY 2013, NAL will continue to expand and improve services based on customer usage and satisfaction data.

During FY 2014, NAL will continue to expand and improve services based on customer usage and satisfaction data.

During FY 2015, NAL will continue to expand and improve services based on customer usage and satisfaction data.

Management Initiative 3: Develop a model Equal Employment Opportunity (EEO) program that will provide infrastructure necessary to create and maintain a diversified workplace free from discrimination, harassment, or retaliation, and characterized by an atmosphere of inclusion and career development opportunities.

Performance Measure

MI 3.1 Take proactive steps to increase representation of minorities, women, and employees with targeted disabilities in the workforce; improve retention; increase career development opportunities; and increase diversity in award recognition programs.

Baseline 2005
The FY 2005 Area Management Directive 715 (MD-715), Annual EEO Program Report was used as a management tool to identify potential barriers to creating and maintaining a diversified and qualified workplace, and to develop action plans to reduce/eliminate the barriers.
Target 2011
Reduce/eliminate barriers identified in the MD-715, Annual EEO Program Report.

Actionable Strategies/Activities for Management Initiative 3

- **Expand outreach activities in K-12 schools (long-term goal), universities/colleges, and minority serving institutions and organizations to educate students and faculty about scientific research and diversify the workforce.**
- **Review and assess the utilization of the student programs [Student Temporary Employment Program (STEP), Student Career Experience Program (SCEP), and postdoctoral research associate programs]. Encourage managers to convert students who have previously participated in the program from the STEP to the SCEP.**
- **Ensure that all employees complete mandatory USDA and recommended training.**
- **Introduce Multigenerational Training and sponsor a Multigenerational Diversity Day.**
- **Determine if there is a need to create and maintain a formal pilot mentoring program to develop ARS' human capital to its fullest extent.**

- **Maintain and increase involvement in knowledge management and mentoring activities to strengthen our workforce.**

- **Create, implement, and maintain a secure and confidential electronic exit interview process to determine why employees choose to leave ARS. Develop a plan to overcome any obstacles in the workforce.**

- **Encourage employees to utilize the ARS programs such as career development, mentoring, and Special Emphasis Programs, and to serve on EEO/Diversity Advisory Committees.**

- **Promote consistency in new employee, Research Leader, and scientist orientation programs throughout ARS regarding all components of the EEO Program.**

- **Identify barriers to parity among minorities and women in Agency award recognition programs; increase award recognition parity among minorities and women.**

- **Ensure that civil rights personnel are more visible to all employees, i.e., Area Civil Rights Managers, EEO/Diversity Committees, Civil Rights Staff participating in the CARE (Consolidated Assistance, Review, and Evaluation) Program and the Human Capital Management Assessments.**

Management Initiative 4: Develop Outreach activities that will enable ARS to better support the USDA Initiative to increase services to limited resource, socially disadvantaged, and/or historically underserved farmers and ranchers.

USDA has identified a number of issues related to how it serves or fails to serve that segment of the U.S. agricultural community that has been historically underserved by many Government programs. These studies did not identify specific issues or problems in the USDA research programs, but in 2000, ARS decided to take a more active approach to see how the knowledge and technologies developed through its intramural research activities could be made available to Outreach target populations (historically underserved, limited resource, and/or socially disadvantaged).

Performance Measures

MI 4.1 Bring the benefits of ARS research to underserved populations and organizations serving these target populations by providing them with access to ARS-generated knowledge and technology that enables them to increase their productivity and profitability.

Baseline 2005
ARS has an Agency Outreach Coordinator and an Outreach Coordinator in every Area. The Agency Outreach Coordinator will answer directly to the Associate Administrator of NPS. The Outreach Coordinators are responsible for actively seeking ways to reduce/eliminate internal barriers that prevent target populations from accessing ARS research products.
Target 2011
Area Outreach Coordinators will identify organizations and individuals that serve the underserved populations who are potential users of ARS research and work to reduce/eliminate barriers to their participation.

MI 4.2 Identify significant Outreach activities and report them annually to the USDA Office of Outreach.

Baseline 2005
ARS identified 20 significant Outreach activities and reported them to the Departmental Office of Outreach as requested.
Target 2011
ARS will cumulatively report 100 significant Outreach Activities to the USDA Office of Outreach and through the GPRA Annual Performance Report.

Actionable Strategies/Activities for Management Initiative 4

- Provide leadership to forge interagency efforts to better serve underserved populations (partnerships within USDA, and with other Federal agencies, State agencies, universities, and private organizations)
- Increase extramural agreements with organizations that serve underserved populations.
- Increase the number of invitations extended to representatives of underserved populations to participate in program workshops, symposia, project/program reviews, and site/location reviews.
- Increase the number of research collaborations and technology transfer activities focused on meeting the special needs of this target population.
- Identify good examples of recent research that can or will be useful to target populations and ways to help them access this information.
- Ensure that appropriate employees are aware of the outreach initiative and their responsibilities in it.
- Promote knowledge of the outreach initiative to new employees, as appropriate.

ARS Administrative and Financial Management (AFM) Initiatives

OVERVIEW OF AFM INITIATIVES

ARS' Administrative and Financial Management (AFM) initiatives link with USDA's management initiatives to support more efficient program operations and deliver scientific excellence and public service.

AFM expects to:

- Ensure an efficient, high performing, high quality, diverse workforce to fully accomplish the ARS mission and work cooperatively with partners and the private sector.
- Ensure ARS sustains a clean annual audit opinion and provides access to quality financial information through financial systems that meet the needs of their users.
- Enhance ARS effectiveness through effective and automated services for acquisition, personal property, and administrative management.
- Link budget decisions and program priorities more closely with program performance and consider the full cost of programs.
- Reduce improper payments by establishing targets and corrective actions.
- Efficiently and effectively manage real property through good stewardship (*i.e.*, acquisition, maintenance, and disposal) of ARS' real property assets.
- Award extramural agreements in an efficient and timely manner, and ensure they are legally and fiscally sound and in full compliance with established policies and procedures.
- Ensure systems fully meet needs for AFM information and guidance in support of the President's Management Agenda and E-Gov initiatives.

FY 2012 Accomplishments:

AFM Goal 1: **Improved Human Capital Management**

Objective: Research, Education, and Economics Agencies have a highly qualified diverse workforce to fully accomplish the REE mission.

Accomplishments

- **Restructured AFM into Business Service Centers.** In response to continuing budget challenges, ARS leadership developed and implemented a new structure to deliver administrative and financial management services more effectively and efficiently. Centered around three geographically dispersed Business Service Centers (BSC), the new structure places services closer to the research mission, takes advantage of lower facilities costs and reduced competition

for talent in these areas, and incorporates hiring and retention flexibilities inherent to a mobile and virtual workforce.

- **Identified staffing gaps for REE Mission Critical Occupations (MCOs).** AFM participated in this USDA-level project. It involved gathering workforce data to identify critical staffing gaps for MCOs in the REE mission area. Based on the data, action plans were developed for five of these MCOs. REE agencies hire into all five of these USDA-identified MCOs. Portions of these plans will be implemented in FY13 and FY14 as appropriate for REE agency situations. These plans will be used to work with REE managers to develop effective recruitment and marketing strategies. It is anticipated that this project will serve as a model to develop action plans for additional REE-specific MCOs as well as other types of REE positions.
- **Rebuilt capacity in human capital management skill set in Human Resources Division**. The HR Specialist (0201) occupation is one of USDA's MCOs. Critical human capital talent in this MCO was lost during FY11 early out/buy out offerings just as the Human Resources Division (HRD) was tasked with facilitating updates to the REE human capital and workforce plans. In FY12, HRD trained key HR staff in fundamental human capital concepts using both formal training and developmental assignments to rebuild this capacity. The human capital skill sets will be critical to developing REE human capital and workforce plans in FY13.
- **Consistently met OPM's 80-day hiring goal for most REE hires**. HRD reports monthly to the Departmental Office of Human Resources Management OHRM. Recruitment action plans included strategies to meet this goal. In FY12, REE met this goal for more than 90% of all new REE hires into positions advertised on USA Jobs.
- **Increased efforts to recruit students, veterans and employees with disabilities in REE.** AFM HRD launched a multi-pronged approach to raise awareness and outreach in order to increase the numbers of new hires who are students, veterans and/or employees with disabilities. AFM hired one new HRD employee dedicated full-time to these efforts. Working with another HRD staffing expert, these two employees accomplished the following to help meet REE targeted recruitment goals:
- Created a new recruitment brochure to be used at career fairs and other recruitment venues targeted towards students, veterans, and people with disabilities and purchased new recruitment aids (display, table coverings, and brochure holders) to present a professional image at recruitment fairs;
- Developed a recruitment website for applicants and hiring managers focused on students, veterans and people with disabilities. The website will include information on the Schedule A Hiring Authority, videotaped success stories of people with disabilities, a PowerPoint presentation for hiring managers on hiring people with disabilities, laws and Executive Orders, FAQ's and links to useful resources for people with disabilities and hiring managers. Projected completion date for the website is March 2013;
- Initiated development of a recruitment database for Veterans and People with Disabilities to allow Hiring Managers and HR Specialists the flexibility to quickly access resumes from Veterans and People with disabilities to fill time-sensitive positions. Projected completion date for the database is April 2013;
- Conducted outreach through meetings and webinars to the ARS managers and employees to explain the various programs for veterans and persons with disabilities and responded to questions regarding specific hiring goals them for persons with disabilities and techniques to meet the goals.
- Attended at least 14 separate recruitment events nationwide targeted at one or more of these specific groups.
- These efforts resulted in making direct contact with more than 800 potential recruits in one or more of these targeted groups and in laying the foundations for future targeted recruitment initiatives. AFM will assess the progress made in terms of actual hires in these groups in FY13.
- **Developed and conducted Individual Development Plan training for supervisors and employees.** AFM HRD Employee Leadership and Development Staff developed and delivered 8 face-to-face IDP training sessions to a total of 165 managers and employees in ARS's

Kearneysville, West Virginia location at the request of location leadership. These efforts dovetailed with USDA goals to have IDPs in place for all employees promulgated later in FY12. As a result, the IDP training will be modified based on feedback and offerings will be expanded to include both face-to-face and webinar formats during FY13. This is expected to help embed a culture of continuous learning and development in ARS.

- **Implemented two knowledge management pilots in HRD.** HRD developed a SharePoint site for human capital resources and collaboration. A separate project was undertaken to scan employee relations files into a secure site to facilitate employee mobility and collaboration.
- The human capital SharePoint site was linked to the strategy to rebuild human capital capacity in HRD. This project also incorporated lessons learned from the loss of key staff in this area, as well as consideration of the movement toward a more virtual workforce with implementation of the BSCs. The site was developed and populated with key resources. It was also designed to facilitate collaboration on creation of human capital documents and reporting of human capital data.
- HRD also began scanning employee relations case files into a secure site. Creating electronic versions of these files allows for more efficient and effective implementation of the telework program for Employee Relations Specialist because they will have electronic access to files that may not be transported out of the building. This change in business process has improved Specialists' capability to serve their customers and accomplish work effectively from alternative worksites.
- Both these projects also have an underlying goal of knowledge management for the organization. Centralized repositories in these functional areas allow for faster and more effective transference of knowledge to new staff when previous incumbents leave the organization or move into different functional areas.
- **Fully implemented the REE Onboarding Program.** In response to data gleaned from the FY2012 Federal Employees Viewpoint Survey (FEVS), USDA published a new directive requiring agencies to develop and implement onboarding programs. Simultaneously, ARS identified related issues from FEVS 2012 and other employee feedback sources. In FY2011, ARS developed and piloted a REE Onboarding Program to enhance the acclimation, engagement, and retention of new employees, as well as to comply with the new Departmental onboarding regulation. Using feedback from the pilot, AFM fully implemented the REE Onboarding Program in FY12. The REE onboarding program includes the following key elements.
- Enhanced supervisory outreach and involvement with new hires at the point of selection through the first 90 days;
- Use of a peer "sponsor" to assist new employees in their acculturation process with sponsor roles clearly defined and training provided to sponsors on their roles;
- Development of new web-based tools to supplement USDA's New Employee Onboarding Portal to assist administrative staff in conducting first-day orientation processes and in providing standard information about benefits and agency overviews;
- Creation of a web-based tool to assist new employees throughout their first year to find information about basic employee terms and processes, missions, and other information critical to their early employment;
- Development of an AgLearn-based training module titled "Managing Your Federal Career" to cover basic information necessary for the employee to understand and succeed in his/her current position and additional career guidance. This will be required training for all REE new employees.
- Provision of additional web-based and other organizational tools to assist new employees with fully integrating into their REE organization.
- Feedback from both supervisory and new employee participants has been very favorable. The program was not implemented soon enough in FY2012 to expect results to show up in FEVS survey results. However, REE anticipates results from the FY13 Federal Employee Viewpoint Surveys to reflect results of the onboarding process and program.

- **Improvements to ARS performance management and awards systems.** As a result of employee feedback from ARS's *Your Two Cents* employee engagement website, FEVS 2011 survey results, an ARS annual program review, and Departmental changes to the performance management program, ARS undertook two critical initiatives to improve and better integrate performance management and awards. These initiatives included:
- Updating and consolidating REE performance management policy and procedures to include all four REE agencies; and
- Developing a pilot awards program to increase perceptions of fairness and better integrate awards for research, service, and support scientists in ARS.
- Updating and consolidating the performance management policy is expected to reinforce the requirement for supervisors to adhere to anti-discrimination laws and regulations and to administer the system in a fair and equitable manner in order that all employees may be successful. ARS partnered with Departmental staff to ensure strategic alignment and consistency throughout all four REE agencies. Implementation will occur in FY13.
- During ARS's annual review of the employee recognition program, it was noted that the Scientist of the Year Award addressed only the accomplishments of ARS's research scientists. Employee feedback from Your Two Cents reinforced that there were perceptions of unfairness in the awards system in that some of ARS's service and support scientists felt their contributions were not adequately recognized. ARS's Administrator directed that modifications be made to this awards program to include the service and support scientists. The program was piloted during FY12. As a result of the pilot, ARS received nominations for the Scientist of the Year nominating personnel in the research and support scientist fields. In additions, the nomination pool for the Presidential Early Career Award for Scientist and Engineers was much more diverse in FY12 than in previous years. Consequently, ARS was able to identify its most premier research more globally within the agency and market it throughout the Federal government. This pilot will be evaluated in FY13 to determine whether changes need to be made prior to full implementation.
- **Established foundations for a robust REE telework program.** In response to a new Departmental directive published in January 2011. AFM HR staff facilitated an ARS telework committee comprised of representatives from throughout ARS's HQ and field structures. In addition, AFM HR staff collaborated with the other REE agency leadership staff to gain their input and buy-in to an updated REE telework policy. The new policy was published in March 2012. Numerous presentations, delivered in both face-to-face and webinar formats, were given to educate managers and employees on the new policy and procedures. The number of approved telework agreements in place has increased from approximately 125 in 2011, mostly in HQ and AFM, to more than 2,200 agreements at the end of 2012. More than 400 of those agreements are for employees who are teleworking on a regular and recurring basis (i.e., core telework). In FY13, AFM will continue education, marketing and outreach efforts to promote telework participation.
- At the same time, AFM undertook collaborative efforts with ARS's Office of the Chief Information Officer to develop and implement a new database to track key telework metrics to reduce the time needed to provide monthly reports to the Department. The database was fully implemented in June 2012 and has reduced monthly reporting time needed from approximately 3 full days to about 30 minutes.
- **Began phased implementation of ARS supervisory training program.** In FY11, ARS proposed a comprehensive supervisory training program for approval by management. Due to budget constraints, leadership approved a phased implementation of the program. Course implementation was accomplished through both face-to-face and virtual delivery methods to accommodate ARS's burgeoning virtual workforce. The following chart shows the delivery methods, number of sessions offered, and the numbers of participants trained in each course piloted in FY12.

Course	Length	Total Offerings	Total Attendees

Leading Virtual Teams - Webinar	3 Hours	2	24
Leading Virtual Teams - Classroom	3 Hours	5	76
Intro to Crucial Conversations – Classroom	3 Hours	8	124
Crucial Conversations - Classroom	2 Days	7	147
MBTI – Classroom	6 Hours	7	228
NRLTP Leadership Lab Seminar	4.5 Days	1	16
NRLTP Orientation Seminar	2 Days	1	20
NRLTP HRM Workshop	2 Days	1	18
NRLTP Prerequisites – Webinars	1.5 Hours	11	60
Totals	NA	43	713

- **HRD Subject Matter Experts participated in NIFA day-long supervisory training sessions.** HRD supported NIFA's efforts to conduct regular supervisory training across key management topics. NIFA held two day-long supervisory training meetings in which HRD SMEs delivered presentations in several HR functional areas. Topics included performance management, staffing and recruitment, position classification, employee relations, individual development plans, and the REE telework program. With AFM's support, NIFA's training initiative has contributed to creating a well-trained, efficient, and productive workforce to meet the needs of NIFA's employees, customers and partners.

Performance Measure 1.1: Fill critical positions and hire people with agency-desired skill sets into positions as they are approved to be filled. In FY12, REE accomplished the following towards this Performance Measure.

Indicators:

By FY 2013, AFM will:

Identify current and future staffing gaps within each REE agency
Work with hiring managers to identify desired skill sets in critical positions
Develop an integrated marketing and recruitment strategy to attract diverse candidates with top skill sets from sources that provide maximum opportunity for all
Develop an evaluation plan, including appropriate metrics, to guide improvement in the hiring process.

By FY 2014, AFM will:

Identify current and future skills gaps within each REE agency
Develop metrics to guide improvement in the hiring process
Evaluate and refine marketing and recruitment strategy to attract diverse candidates with top skill sets from sources that provide maximum opportunity for all
Implement evaluation plan to guide improvement in the hiring process.

By FY 2015, AFM will:

Re-evaluate marketing and recruitment strategies to ensure they are producing desired candidates and agency results, and revise/refine as needed.

Continue to identify current and future staffing and skills gaps
Adjust hiring process as indicated from evaluation and continue to monitor for effectiveness and potential improvements.

Performance Measure 1.2 Emphasize employees' continuous development.

Indicators:

By FY 2013, AFM will:

Develop career development templates for targeted critical occupations to assist employees to grow in the agency.
Develop and implement an employee continuous education requirement.
Retain and share corporate knowledge by defining/developing and implementing Knowledge Management strategies.

By FY 2014, AFM will:

Implement career development templates for targeted critical occupations and continue to develop additional templates to assist employees to grow in the agency.
Develop and implement tools for managers to use at local levels to facilitate meeting employees' continuous education requirements.
Continue to develop and implement effective corporate knowledge management strategies

By FY 2015, AFM will:

Evaluate career development templates in use and refine as needed; continue to develop additional templates as needed based on proven models.
Evaluate and refine effectiveness and efficiency of process/tools to foster employees' continuous education requirements.
Evaluate and refine corporate knowledge management strategies.

Performance Measure 1.3 REE Agencies work toward achieving/retaining top ranking in USDA as "Best Places to Work" as reported in the Federal Human Capital Survey.

Indicators:

By FY2013, AFM will:

Monitor retention rates and develop additional metrics for REE Onboarding program/process to ensure effectiveness and efficiency of assimilation and support for new employees.
Continue implementation of the Performance Appraisal Assessment Tool (PAAT) in order to improve performance management and reward processes and actions.
Expand/implement maxiflex, telework, and other programs and flexibilities to assist employees in balancing work and personal responsibilities.

By FY 2014, AFM will:

Evaluate and refine REE Onboarding program/process and metrics to ensure effective assimilation and support for new employees to increase retention.

Develop metrics and monitor the Performance Appraisal Assessment Tool (PAAT) in order to determine whether performance management and reward processes and actions have improved.
Expand/implement maxiflex, telework, and other programs and flexibilities to assist employees in balancing work and personal responsibilities.

By FY 2015, AFM will:

Evaluate and refine REE Onboarding program/process and metrics to ensure effective assimilation and support for new employees to increase retention.
Evaluate and refine the Performance Appraisal Assessment Tool (PAAT) as needed to ensure the tool is improving management and reward processes and actions.
Evaluate and refine workplace flexibility programs designed to assist employees in balancing work and personal responsibilities.

Performance Measure 1.4 Improve “Leading People” skills of all leaders, supervisors, and managers.

Indicators:

By FY 2013, AFM will:

Develop Succession Plans in REE
Fully implement a supervisory training program.

By FY 2014, AFM will:

Implement Succession Plans in REE.
Complete implementation of and develop an evaluation plan for a supervisory training program.

By FY 2015, AFM will:

Evaluate REE Succession Plans for continued relevance and adjust as needed.
Evaluate supervisory training program and adjust/adapt as needed.

AFM Goal 2: Improved Financial Management

Objective: REE Agencies sustain a clean audit opinion and have access to quality financial information through financial systems that meet their management needs.

Accomplishment:

- USDA received an unqualified "clean" audit opinion for the FY 2012 consolidated statements.
- During FY 2012 the Travel Policy & Systems branch coordinated the process of submitting conference data to the department, and coordinated the process of providing travel data in response to Congressional inquiries. These were significant accomplishments based on the challenges in providing the data.
- ARS has implemented the use of CATS to track the Agency 4% R&M requirement and ensure R&M charges are appropriate.
- A Lean Six Sigma team was organized to review the ARMP system. The team meets weekly and has identified several opportunities to be implemented in 2013.

Performance Measure 2.1 REE meets all monthly, quarterly, and annual appropriation level accounting and reporting requirements. Appropriated fund (obligation) and cash reports continue to evidence an accurate financial picture.

Indicators:

By FY 2013, AFM will:

Support the quarterly financial statements process, and actively respond to annual OIG audit of REE-wide financial statements and resolve relevant audit concerns.

By FY 2014, AFM will:

Support the quarterly financial statements process, and actively respond to annual OIG audit of REE-wide financial statements and resolve relevant audit concerns.

By FY 2015, AFM will:

Support the quarterly financial statements process, and actively respond to annual OIG audit of REE-wide financial statements and resolve relevant audit concerns.

Performance Measure 2.2 All REE travelers are supported by a professional, customer oriented Travel and Transportation staff and Web-based systems are operational.

Indicators:

By FY 2013, AFM will:

Implement new eTravel system(Concur) under the GSA ETS2 contract as required.

By FY 2014, AFM will:

Continue to support new Concur eTravel system.

By FY 2015, AFM will:

Continue to support new Concur eTravel system.

Performance Measure 2.3 ARMPS and CATS are fully implemented on ARIS/ORACLE platform, meets needs of ARS users, and maximizes opportunities for financial data integration.

Indicators:

By FY 2013, AFM will:

Begin updating the ARMPS system to implement the data exchange opportunities that have been identified to ensure the system is up to date and utilizing current technology to increase efficiency. Continue to identify multiple data exchange opportunities between SAMS, ARMPS, CATS, ARIS and other non-financial ORACLE-based applications to reduce the need for duplicate data entry and increase operating efficiency.

By FY 2014, AFM will:

Continue updating the ARMPS system to implement the data exchange opportunities that have been identified to ensure the system is up to date and utilizing current technology to increase efficiency. Continue to identify multiple data exchange opportunities between SAMS, ARMPS, CATS, ARIS and other non-financial ORACLE-based applications to reduce the need for duplicate data entry and increase operating efficiency.

By FY 2015, AFM will:

Identify multiple data exchange opportunities between SAMS, ARMPS, CATS, ARIS and other non-financial ORACLE-based applications to reduce the need for duplicate data entry and increase operating efficiency.

AFM Goal 3: Improved Real and Personal Property Management

Objective: Agencies receive effective and automated services for acquisition and personal property management.

Accomplishments

- *APD implemented new Business Service Structure for Purchase Cards, consolidating the eight part-time Area Agency Program Coordinators (AAPCs) into three full-time AAPCs located at the BSC.*
- *APD reviewed, updated, and reinstituted the reporting and review requirements for LAPC to monitor cardholder transactions per the Department's Coordinator's Purchase Card Program Guide to comply with Departmental OIG audit of Purchase Card Program.*
- *APD continued to serve as an Agency subject matter expert to assist USDA's Office of Procurement and Property Management address CPAIS-Personal Property development issues. USDA has rescheduled implementation until FY2014.*
- *APD issued guidance (APD Alert 2012-17) regarding Sustainable Acquisition, which contains the Federal Acquisition Regulation (FAR) requirement for contractors with service or construction contracts to report biobased products used by utilizing the tool at http://www.biopreferred.gov/FARReporting/FARReporting.xhtml.*

- *FD continued to work with NFC, WBSC and locations to develop FMS to electronically track, synthesize and report utility consumption data.*
- *FD continued to work with NFC and FS to develop a replacement utility payment system for TUMS.*
- *FD continued to hold monthly energy awareness teleconferences to virtually showcase energy efficient, sustainable procurement, products and suppliers to ARS engineers, facility managers, and location procurement decision makers.*
- *FD continued to contact utilities to review tariffs and obtain energy services. ARS obtained free energy audits and is implementing UESCs.*
- *FD and APD developed policy for use of GSA Areawide Contracts for purchasing utilities. GSA was contacted to negotiate more Areawide contracts on ARS' behalf.*
- *FD worked with GSA and DLA Energy (DoD) to procure electricity and natural gas from 3rd parties in deregulated states on behalf of ARS. New 3rd party contracts were awarded and existing contracts were re-competed for electricity and natural gas.*
- *FD is working with NFC and FS on a replacement system for TUMS. Policy was issued requiring the use of TUMS or its successor system.*
- *FD reviewed all utility accounts for sales tax, contacted utilities, corrected tax exempt status and requested refunds of overpaid taxes. This resulted in a reduction of $100,000 in utility costs per year.*
- *FD continued to work with NFC to resolve errors in utility billing.*
- *FD issued policy and continued to facilitate applicatiuon for and collection of utility incentives for energy improvements.*
- *FD worked with FS to establish BOCs for additional utilities to improve data quality.*
- *FD continued to act as subject matter expert for utility and energy matters.*
- *Established written vehicle allocation methodology (VAM) that addressed a standard approach to determine vehicle need, size, and replacement. It also contained USDA minimum use guidelines and greenhouse gas thresholds for light duty vehicles. Monitored vehicle requisitions and ensured fleet managers maintained justifications for functional needs for vehicles that did not meet the minimum greenhouse gas score. Of the 69 replacement vehicles acquired, 53 percent were alternative fueled vehicle, including hybrids e85 flex fuel and bio-diesel.*
- *Reviewed VAMs to ensure detailed justifications supported the functional needs for light duty vehicles that did not meet minimum greenhouse gas threshold.*
- *Manually collected E85 fuel use to ensure proper credit for alternative fuel use. Manually data collection needed to offset the problems with data received from the fleet card. Problems include E85 fuel incorrectly coded as regular gasoline or no data available. Increase of 10% alternative fuel from FY2011.*
- *Reviewed and monitored fleet card purchases, analyzed data, and updated data to the Personal Property System (PROP). This allowed for all fleet costs to reside in a single system and allowed BSC fleet managers to use existing fleet reports in PROP to monitor fleet costs and vehicle use.*
- *Continued to provide guidance and assistance to LFPCs in using U.S. Bank's electronic fleet card system.*
- *Continued to work with OPPM to identify and resolve issues with the interface between Property Management Information System (PMIS/PROP) and FMMI, assisted in identifying problems between the FMMI to PROP interface to capture vehicle requisitions through Interagency Payments and Collection (IPAC).*
- *Continued to serve as the Agency fleet subject matter expert to work with OPPM to identify and resolve issues relating to the fleet card and fleet system, redesigned fleet reports to obtain enhanced fleet data, increase of level III data, and monitor fleet transactions from VISA/US Bank.*
- *Assisted in identifying fleet issues that were unresolved after implementation of SmartPay2 contract. Worked to develop procedures to resolve tag receipt problems that identified USDA vehicle tags as "missing". Continued to work with OPPM to address fleet reporting, system functionality, procedures, and policy.*

- *APD provided guidance and training to improve the accuracy of the data reported in the Federal Procurement Data System – Next Generation (FPDS-NG).*
- *APD's oversight and guidance resulted in ARS increasing its FPDS-NG Verification and Validation (V&V) reporting from 92.8% in FY 2011 to 98% in FY 2012. This was accomplished by mandating all transactions, including purchase card buys are processed in IAS.*
- *Provided guidance and assisted the acquisition workforce reporting past performance contract* information in the Contractor Performance Assessment Reporting System (CPARS).
- *APD initiated monitoring the reporting status of: contracts registered in CPARS; contracts identified to be registered in the CPARS; and ARRA contracts; and provided the reports to the Business Service Centers (BSCs) and the Office of Procurement and Property Management (OPPM). The BSC's increased the number of Focal Points (FP) to register contracts in CPARS and all FPs and Agency Points of Contacts were trained in CPARS.*

Performance Measure 3.1 Acquisition & Property Division, Facilities Division, Area, Locations, and REE agencies partner to effectively implement and administer E-commerce initiatives and custom electronic information exchange.

Indicators:

By FY 2013, AFM will:

Implement new purchase card; Reevaluate the use of the purchase card in ARS (Field); review and determine appropriate number and users of purchase cards.
Develop and conduct Purchase Card refresher training for all Coordinators, Cardholders and Approving Officials
Development and implement the ability to track purchases using the purchase card in the Acqusition Tracking System (ATS) and reporting queries in ATS.
Implement the Green Purchase Pilot Program for Cardholders, including Sustainable acquisition training for all LAPCs, AAPCs, Cardholders and Approving Officials
Continue to serve as an Agency subject matter expert to assist USDA's Office of Procurement and Property Management address CPAIS-Personal Property development issues.
Implement USDA CPAIS for personal property in REE. Upon USDA's confirmed implementation date and schedule, develop REE implementation plan and training plan.

By FY 2014, AFM will:

Reevaluate the use of the purchase card in ARS (Field); review and determine appropriate number and users of purchase cards.
Develop and implement database for tracking Purchase Card training for LAPCs, AAPCs, Cardholders and Approving Officials.
Continue to develop and conduct Purchase Card refresher training for all Coordinators, Cardholders and Approving Official.
Continue to serve as an Agency subject matter expert to assist USDA's Office of Procurement and Property Management address CPAIS-Personal Property issues post-implementation.
Complete REE CPAIS implementation plan based on USDA's confirmed implementation date and schedule.
Conduct CPAIS training for Business Service Centers
Develop CPAIS quick guides to support personal property training.

By FY 2015, AFM will:

Reevaluate the use of the purchase card in ARS (Field); review and determine appropriate number and users of purchase cards.
Continue to develop and conduct Purchase Card refresher training for all Coordinators, Cardholders and Approving Official.
Continue to serve as an Agency subject matter expert to assist USDA's Office of Procurement and Property Management address CPAIS-Personal Property issues.
Continue to develop and conduct CPAIS-Personal Property refresher training for Business Service Centers.
Continue to develop CPAIS quick guide training materials for Business Service Centers(BSC) and assist in BSC training.

Performance Measure 3.2 REE Agencies realize cost savings and receive best value through leveraging their energy buying power.

Indicators:

By FY 2013, AFM will:

Coordinate between APD and FD to develop and implement a comprehensive energy buying plan.
APD and FD will continue to work with the General Services Administration (GSA) to expand existing GSA area-wide contracts for utilities to include regions in which ARS is located.
APD will continue to work with OPPM on the Strategic Sustainable Performance Plan (SSPP) by participating in the Green Purchasing Workgroup.
Continue to work with APD and FD to provide policy and guidance to the acquisition workforce on methods to achieve energy savings.

By FY 2014, AFM will:

Coordinate between APD and FD to develop and implement a comprehensive energy buying plan.
APD and FD will continue to work with the General Services Administration (GSA) to expand existing GSA area-wide contracts for utilities to include regions in which ARS is located.
APD will continue to work with OPPM on the Strategic Sustainable Performance Plan (SSPP) by participating in the Green Purchasing Workgroup.

By FY 2015, AFM will:

Coordinate between APD and FD to develop and implement a comprehensive energy buying plan.
APD and FD will continue to work with the General Services Administration (GSA) to expand existing GSA area-wide contracts for utilities to include regions in which ARS is located.
APD will continue to work with OPPM on the Strategic Sustainable Performance Plan (SSPP) by participating in the Green Purchasing Workgroup.

Performance Measure 3.3 REE agencies realize cost savings and receive best value through effective fleet management.

Indicators:

By FY 2013, AFM will:

Review vehicle procurements for minimum size needed for mission. Maximize use of alternative fuels and alternative fuel vehicles. Monitor fleet fuel use for methods for overall fuel savings.
Update VAM to include revisions to greenhouse gas emissions threshold, include list of vehicles available from GSA that emit low greenhouse gas.
Conduct a vehicle use survey to help identify under-utilized vehicles that could be removed from the fleet, reducing overall fleet fuel/maintenance costs; reassign vehicles as needed within the agency.
Serve on USDA's Technical Review Panel to review proposals for USDA's new fleet card.
Implement new fleet card for ARS and NASS.
Implement USDA's new fleet management system (FedFMS) that will provide enhanced inventory and fuel and maintenance costs.
Conduct training for LFPCs (BSC fleet managers), location AOs (for reporting) on fleet card system and fleet management system.
Develop standard reports to share with BSC fleet managers and location AOs to help monitor fleet charges.
Update REE fleet guides to address USDA's new fleet card program and fleet management system.
Monitor E85 fuel use through quarterly data calls for vehicles that do not have a waiver from refueling with E85 as the primary fuel source (due to local merchant within 5-mile radius or 15-minute drive)

By FY 2014, AFM will:

Update VAM as appropriate to include FY2014 revisions to vehicle availability and greenhouse gas emissions threshold limits.
Conduct annual vehicle use survey to identify under-utilized vehicles that could be removed from the fleet, reducing overall fleet fuel/maintenance costs; reassign vehicles as needed within the agency.
Continue to develop and conduct refresher training for LFPCs (BSC fleet managers) on managing fleet card system
Continue to develop and conduct refresher training for BSC fleet managers and location property officers on USDA's FedFMS.
Continue to monitor E85 fuel use through quarterly data calls for vehicles that do not have a waiver from refueling with E85 as the primary fuel source (due to local merchant within 5-mile radius or 15-minute drive)

By FY 2015, AFM will:

Update VAM as appropriate to include FY2015 revisions to vehicle availability and greenhouse gas emissions threshold limits.
Conduct annual vehicle use survey to identify under-utilized vehicles that could be removed from the fleet, reducing overall fleet fuel/maintenance costs; reassign vehicles as needed within the agency.

Continue to develop and conduct refresher training for LFPCs (BSC fleet managers) on managing fleet card system
Continue to develop and conduct refresher training for BSC fleet managers and location property officers on USDA's FedFMS.
Continue to monitor E85 fuel use through quarterly data calls for vehicles that do not have a waiver from refueling with E85 as the primary fuel source (due to local merchant within 5-mile radius or 15-minute drive)

Performance Measure 3.4 Develop metrics for REE acquisitions.

Indicators:

By FY 2013, AFM will:

Provide guidance and training to improve the accuracy of the data reported in the Federal Procurement Data System – Next Generation (FPDS-NG).
Provide guidance and oversight to assist ARS' Acquisition Workforce to report past performance contract information in the Contractor Performance Assessment Reporting System (CPARS).
Provide guidance and oversight to assist ARS' Acquisition Workforce to ensure all GS-1102's complete the necessary training to achieve or maintain their required Federal Acquisition Certification in Contracting (FAC-C) level.
Assist the ARS Acquisition Workforce to ensure all Contracting Officer's Representatives complete the necessary training to achieve or maintain their required Federal Acquisition Certification for Contracting Officer's Representative (FAC-COR) level.

By FY 2014, AFM will:

Provide guidance to assist ARS' Acquisition Workforce to report past performance contract information in the Contractor Performance Assessment Reporting System (CPARS).
Provide guidance to assist the acquisition workforce on contract closeout.
Assist the ARS Acquisition Workforce to ensure all GS-1102's complete the necessary training to achieve or maintain their required Federal Acquisition Certification in Contracting (FAC-C) level.
Assist the ARS Acquisition Workforce to ensure all Contracting Officer's Representatives complete the necessary training to achieve or maintain their required Federal Acquisition Certification for Contracting Officer's Representative (FAC-COR) level.

By FY 2015, AFM will:

Provide guidance to assist ARS' Acquisition Workforce to report past performance contract information in the Contractor Performance Assessment Reporting System (CPARS).
Provide guidance to assist the acquisition workforce on contract closeout.
Assist the ARS Acquisition Workforce to ensure all GS-1102's complete the necessary training to achieve or maintain their required Federal Acquisition Certification in Contracting (FAC-C) level.
Assist the ARS Acquisition Workforce to ensure all Contracting Officer's Representatives complete the necessary training to achieve or maintain their required Federal Acquisition Certification for Contracting Officer's Representative (FAC-COR) level.

AFM Goal 4: Improved Accountability and Program Stewardship of the ARS Asset Management Program.

Objective: Stewardship (acquisition, operation, and disposal) of REE Real Property assets effectively supports and enhances the REE Mission Area.

Accomplishments:

- Developed the ARS Capital Investment Strategy to prioritize ARS modernization and new construction needs based on facility condition and research program priority.
- Developed a standard Operation and Maintenance (O&M) Plan at an ARS facility to use as a standard guide for implementation of a facility O&M Program at other ARS facilities to address general maintenance, preventive maintenance, and repair of facilities to minimize the life cycle cost of the facility.
- Utilized the facility plan developed by the Agency and Area Asset Management Review Boards to prioritize the allocation of R&M funds to meet mission requirements.
- FD continued funding and performing energy audits and re-/retro-commissioning of 25% of covered facilities annually to meet EISA requirements. Compliance status was entered into the DOE CTS tracking system and Energy Star Portfolio Manager
- FD continued to improve data quality for the annual GHG report
- FD revised and reissued Design Manual 242.1which includes the requirements of EPACT 2005, EISA, EO 13423 and EO 13514.
- FD updated policy on capturing operation and maintenance costs.
- FD continued to identify and facilitate ESPCS and UECS to identify, implement and finance energy and water improvements.
- Revised P&P 134.2 - Energy Water and Sustainability. It establishes roles and responsibilities commensurate with the new ARS structure and incorporates EPACT 2005, EISA, EO 13423 and EO 13514.
- FD completed installation of advanced electric meters and is networking them as required by EPACT 2005. FD is continuing to install advanced steam and natural gas meters. As required by EISA.
- FD issued policy, guidance and training on replacement of inefficient lighting as required by EISA.
- FD worked with OCIO to reissue policy on ElectronicsStewardship.
- Established a single point of contact in each Business Service Center (BSC) to coordinate the BSC asset management program.
- Completed 6 Security Site Assessments.
- Completed 4 ePAC Migrations
- Established plans for 13 Security Site assessments for FY 2013.
- Established plan for 11 ePAC migrations for FY 2013.
- Conducted seventeen Environmental Site Assessment to ensure properties being transferred and received do not have environmental liabilities associated with them prior to the transfer.
- Ensure each location maintains environmental compliance by having an Environmental Management System that meets or exceeds the International Organization for Standardization (ISO) 14001 standard.
- Prepared an information paper for ARS management outlining major regulatory changes regarding the Globally Harmonizing System of Classification & Labeling; briefed safety community personnel; and ensured over 80 employees where provided “train the trainer” training.
- Secured a suite of over 125 AgLearn SkillSoft safety, health and environmental training courses for all ARS employees in which over 1000 courses were taken Agency-wide in FY2012.
- Prepared the Annual Occupational Safety and Health Report analyzing Agency trends and identifying several corrective actions.

- In accordance with the Hazard Communication Standard required by OSHA, ensured each location developed a chemical inventory for inclusion on Area SharePoint sites.
- Sponsor two monthly teleconferences to bring together, telephonically, the Agency's safety, health and environmental professionals. The purposes of the teleconferences are to disseminate information, solicit the exchange of ideas including lessons learned, enhance participation and involvement, and serve as a means for assessing the overall effectiveness of the Agency's program.

Performance Measure 4.1 Enhance the protection and well being of the work force and REE assets.

Indicators:

By FY 2013, AFM will:

Identify and protect ARS infrastructure and real property assets.
Work with Office of Homeland Security to establish protocols for validating high priority physical security needs.
Analyze trends regarding employee safety and wellbeing with the goal of reducing worker injuries and OMSP exposures to workplace hazards, and implement corrective action.

By FY 2014, AFM will:

Identify and protect ARS infrastructure and real property assets.
Work with Office of Homeland Security to establish protocols for physical security needs.
Analyze trends regarding employee safety and wellbeing with the goal of reducing worker injuries and OMSP exposures to workplace hazards, and implement corrective action.

By FY 2015, AFM will:

Identify and protect ARS infrastructure and real property assets.
Work with Office of Homeland Security to establish protocols for validating high priority physical security needs.
Analyze trends regarding employee safety and wellbeing with the goal of reducing worker injuries and OMSP exposures to workplace hazards, and implement corrective action. validating high priority

Performance Measure 4.2 Maintain a robust Real Property Asset Management program.

Indicators:

By FY 2013, AFM will:

Implement a facility Operation and Maintenance Program to address general maintenance, preventive maintenance, and repair of facilities to minimize the life cycle cost of the facility
Develop a program to implement the Federal Buildings Personnel Training Act (FBPTA) to insure federal managers are properly trained to maintain federal buildings to achieve the highest possible return on investment over the building's operating life.
Exercise proper stewardship of environment, natural, and energy and water resources as defined by EO 13423 – Strengthening Federal Environmental, Energy & Transportation Management and EO 13514 - Federal Leadership in Environmental, Energy, and

Economic Performance.
Utilize the facility plan developed by the Agency and Area Asset Management Review Boards in determining the allocation of R&M funds to meet mission requirements.
Establish a single point of contact in each Area to coordinate the Area's asset management program.
Coordinate with Business Service Center Asset Managers on asset management issues in O&M, CIS, FBPTA, and R&M programs.
Comply with OMB Memo M-12-12 – Freeze the Footprint – no "net new" square footage as it applies to office and warehouse space.
Continue to exercise Real Property Cost Savings and Innovation Plans, disposing of unneeded Federal Real Estate, President's June 10, 2010 Memorandum.

By FY 2014, AFM will:

Continue to implement a facility Operation and Maintenance Program to address general maintenance, preventive maintenance, and repair of facilities to minimize the life cycle cost of the facility
Implement a program to implement the Federal Buildings Personnel Training Act (FBPTA) to insure federal managers are properly trained to maintain federal buildings to achieve the highest possible return on investment over the building's operating life.
Exercise proper stewardship of environment, natural, and energy and water resources as defined by EO 13423 – Strengthening Federal Environmental, Energy & Transportation Management and EO 13514 - Federal Leadership in Environmental, Energy, and Economic Performance.
Utilize the facility plan developed by the Agency and Area Asset Management Review Boards in determining the allocation of R&M funds to meet mission requirements. Fund energy audits, re-/retro-commissioning and identified deficiencies of 25% of covered facilities annually to meet EISA requirements.
Utilize the Capital Investment Strategy in determining the modernization priority of ARS facilities and continue to update the CIS to reflect changing Agency priorities.
Establish a single point of contact in each Area to coordinate the Area's asset management program.
Coordinate with Business Service Center Asset Managers on asset management issues in O&M, CIS, FBPTA, and R&M programs.
Comply with OMB Memo M-12-12 – Freeze the Footprint – no "net new" square footage as it applies to office and warehouse space.
Continue to exercise Real Property Cost Savings and Innovation Plans, disposing of unneeded Federal Real Estate, President's June 10, 2010 Memorandum.

By FY 2015, AFM will:

Continue to implement a facility Operation and Maintenance Program to address general maintenance, preventive maintenance, and repair of facilities to minimize the life cycle cost of the facility
Continue to implement a program to implement the Federal Buildings Personnel Training Act (FBPTA) to insure federal managers are properly trained to maintain federal buildings to achieve the highest possible return on investment over the building's operating life.
Exercise proper stewardship of environment, natural, and energy and water resources as defined by EO 13423 – Strengthening Federal Environmental, Energy & Transportation Management and EO 13514 - Federal Leadership in Environmental, Energy, and Economic Performance.
Utilize the facility plan developed by the Agency and Area Asset Management Review

Boards in determining the allocation of R&M funds to meet mission requirements. Fund energy audits, re-/retro-commissioning and identified deficiencies of 25% of covered facilities annually to meet EISA requirements.
Utilize the Capital Investment Strategy in determining the modernization priority of ARS facilities and continue to update the CIS to reflect changing Agency priorities.
Establish a single point of contact in each Area to coordinate the Area's asset management program.
Coordinate with Business Service Center Asset Managers on asset management issues in O&M, CIS, FBPTA, and R&M programs.
Comply with OMB Memo M-12-12 – Freeze the Footprint – no "net new" square footage as it applies to office and warehouse space.
Continue to exercise Real Property Cost Savings and Innovation Plans, disposing of unneeded Federal Real Estate, President's June 10, 2010 Memorandum.

Performance Measure 4.3 Implement Energy Policy Act (EPACT) 2005 and the Energy Independence and Security Act of 2007

Indicators:

By FY 2013, AFM will:

Establish roles and responsibilities of AFM/Areas/Locations/State Offices in implementing EPACT 2005 and the Energy Independence and Security Act of 2007 goals.
Maximize the use of no cost/low cost energy management programs.
Evaluate how to allocate energy reduction/renewable energy initiatives across ARS in a manner that maximizes progress in meeting Agency EPACT 2005 and the Energy Independence and Security Act of 2007 goals.

By FY 2014, AFM will:

Establish roles and responsibilities of AFM/Areas/Locations/State Offices in implementing EPACT 2005 and the Energy Independence and Security Act of 2007 goals.
Maximize the use of no cost/low cost energy management programs.
Evaluate how to allocate energy reduction/renewable energy initiatives across ARS in a manner that maximizes progress in meeting Agency EPACT 2005 and the Energy Independence and Security Act of 2007 goals.

By FY 2015, AFM will:

Establish roles and responsibilities of AFM/Areas/Locations/State Offices in implementing EPACT 2005 and the Energy Independence and Security Act of 2007 goals.
Maximize the use of no cost/low cost energy management programs.
Evaluate how to allocate energy reduction/renewable energy initiatives across ARS in a manner that maximizes progress in meeting Agency EPACT 2005 and the Energy Independence and Security Act of 2007 goals.

AFM Goal 5: Improved Accountability and Program Stewardship of the ARS Extramural Agreements Program.

Objective: Extramural agreements are awarded and administered in an efficient and timely manner to ensure accomplishment of mission and program goals and objectives. All agreements are legally and fiscally sound and are in full compliance with established extramural policies and procedures.

Accomplishments:

- Implemented Phase 1 improvements as identified by the Business Process Review Team (BPRT) for Extramural Agreements. Modified ARIS/AIMS to incorporate new or revised business practices identified by the BPRT.
- Established the e-Green module in ARIS/AIMS as the official repository for ARS agreements
- Developed and implemented an automated tracking and notification system for ARS-PIs to submit conflict of interest certifications electronically via ARIS/AIMS.
- Mapped the Interagency Agreement (IA) Process, modified ARIS/AIMS to facilitate tracking of outgoing IAs, developed and delivered training on new process and data entry requirements.
- Published ARS Bulletin 12-702, Conflict of Interest Certification
- Published ARS Bulletin 12-708, Use of the Federal Financial Report, SF-425 for Grants and Assistance Type Cooperative Agreements.

Performance Measure 5.1 Ensure effective use and administration of extramural agreements including fiscal and programmatic responsibility for ARS-PIs, Authorized Departmental Officers (ADOs) and Grant Management Specialists (GMS)

Indicators:

By FY 2013, AFM will:

Continue training programs on authorized uses of Extramural Agreements for ARS-PIs and deploy on AgLearn.

By FY 2014, AFM will:

Continue AgLearn training programs on authorized uses of Extramural Agreements for ARS-PIs.
Develop Levels 1 and 2 ADO training program and deploy on AgLearn.

By FY 2015, AFM will:

Continue AgLearn training programs on authorized uses of Extramural Agreements for ARS-PIs and Levels 1 and 2 ADOs.
Develop ARS specific training for GMS (Levels 3 and 4 ADOs) and deploy on AgLearn.

Performance Measure 5.2 Ensure fiscal and financial systems are fully integrated into the agreement process.

Indicators:

By FY 2013, AFM will:

Implement best business practices for post-award administration and closeout of extramural agreements as identified by the ARS Business Process Review team.
Develop an implementation plan for transition to Treasury ASAP for ARS extramural agreement payments.
Continue oversight of extramural agreements close out activities and account reconciliation

By FY 2014, AFM will:

Continue Implementation of best business practices for post-award administration and closeout of extramural agreements as identified by the ARS Business Process Review team.
Implement Treasury ASAP for all ARS agreement payments. (Phase out HHS-PMS).
Continue oversight of extramural agreements close out activities and account reconciliation.

By FY 2015, AFM will:

Finalize Implementation of best business practices for post-award administration and closeout of extramural agreements as identified by the ARS Business Process Review team.
Continue oversight of extramural agreements close out activities and account reconciliation.

Performance Measure 5.3 Ensure ARS Extramural Agreements Regulations; Policies and Procedures (P&Ps) comply with applicable Government-wide standards as prescribed by OMB.

Indicators:

By FY 2013, AFM will:

Conduct comprehensive review of Extramural Agreements P&Ps, update and publish as necessary.
Initiate revision of 7 CFR 550, General Administrative Requirements for Non-Assistance Cooperative Agreements, and finalize clearance process for Federal Register publication.

By FY 2014, AFM will:

Conduct comprehensive review of Extramural Agreements P&Ps, update and publish as necessary.
Publish revision to 7 CFR 550 as a final rule in the Federal Register.
Codify General Provisions for Research Support Agreements.

By FY 2015, AFM will:

Conduct comprehensive review of Extramural Agreements P&Ps, update and publish as necessary.
Continue codification of RSA General Provisions and clear through Departmental offices for Federal Register publication.

AFM Goal 6: Improved Electronic Access to AFM Information and Business Applications.

Objective: AFM applications fully meet REE needs for administrative and financial management information and guidance in support of improved productivity, service, and reduced costs.

Accomplishments:

- Initiated planning for the development of an automated Position Management System to be developed in FY 13. Also, planned and designed a Vacancy Status System to provide customers with an easy method of determining where their vacancy is in processing. This will be implemented in FY 13.
- Continued development and refinement of the automated action tracking "Portal" and began testing. Established limited use/access to customers.
- Developed and implemented an automated tracking and notification system for COR's and ARS PI's to submit ethic approvals in a timely manner.
- Developed and implemented a standardized spreadsheet to track performance appraisals and awards in order to streamline review and processing functions.
- Implemented changes identified through a Lean Six Sigma exercise to the extramural agreements functions and the automated systems supporting those functions.
- Implemented automated On-Boarding.
- Began planning for the development of an Intranet
- Pilot tested a new check scanning process to allow more efficient and timely depositing of incoming funds while mitigating the possibility of lost checks.
- Continued the development of a Facility Management System that allows users to see utility costs by building in order to manage more efficiently.
- Developed a system to track Telework data (users, types of agreements, etc.) which saved hundreds of hours of labor each year.
- Researched and purchased smaller, more mobile laptops and piloted the purchase of smart phones which allowed us to eliminate land lines and limit the number of devices per person while enhancing the possibility of Telework.
- Developed and implemented an automated Budget Allocation Module.
- Standardized the use of the Integrated Acquisition System and deployed the use of the Acquisition Tracking System.
- Developed and deployed a new Emergency Preparedness website.
- Developed an automated tracking system for the Performance and Labor Solutions staff to track and manage workload.

Performance Measure 6.1 Ensure employees have access to personal and professional resources.

Indicators:

By FY 2013, AFM will:

Develop an electronic Portal which allows customers to submit work requests, and track status and timeliness. This Portal will provide customers with management data points. Develop an employee service and information site with career data, personal data, calendars, chat rooms, etc. Develop a Position Management System. Develop a Vacancy Status System.

By FY 2014, AFM will:

Continue to add enhancements to the electronic Portal which allows customers to submit work requests, and track status and timeliness. This Portal will provide customers with management data points.
Develop an employee service and information site with career data, personal data, calendars, chat rooms, etc.

By FY 2015, AFM will:

Continue to add enhancements to the electronic Portal which allows customers to submit work requests, and track status and timeliness. This Portal will provide customers with management data points.
Develop an employee service and information site with career data, personal data, calendars, chat rooms, etc.

Performance Measure 6.2 Ensure that new or modified administrative processes or information systems effect measurable, qualitative improvements.

Indicators:

By FY 2013, AFM will:

Develop electronic workflows for several administrative processes.
Improve the public AFM Web site ensuring that the information provided is commensurate with agency identified priorities and that access to administrative and financial (AFM) information is clear and user friendly.

By FY 2014, AFM will:

Develop electronic workflows for several administrative processes.
Improve the public AFM Web site ensuring that the information provided is commensurate with agency identified priorities and that access to administrative and financial (AFM) information is clear and user friendly.

By FY 2015, AFM will:

Develop electronic workflows for several administrative processes.
Improve the public AFM Web site ensuring that the information provided is commensurate with agency identified priorities and that access to administrative and financial (AFM) information is clear and user friendly.

ARS Office of the Chief Information Officer (OCIO) Management Initiatives

Overview of Management Initiatives

ARS works through its Office of the Chief Information Officer (OCIO) to enable more effective and efficient research mission delivery through a strengthened information and technology management program. The premise of this program is based on the following vision statement:

> *ARS information systems are mission driven and responsive to customer needs; they are reliable, secure, user friendly, relevant, innovative, well planned, and managed effectively.*

Effective information systems flow from mission requirements. This relationship dictates a structured, comprehensive, and ongoing review of information systems and the technology needed to support ARS mission and internal and external customer needs. Because ARS is the government entity uniquely responsible for creating new knowledge and the data, information, and technology necessary for a sustainable and globally competitive American agriculture, the Agency's information technology program must provide a safe and reliable environment to support the creation, storage, and dissemination of this knowledge.

The ARS OCIO works in consultation with the ARS Executive Information Technology (IT) Steering Committee to define the strategic direction of the Agency's information technology program in the ARS IT Strategic Plan, which defines ARS' IT strategic goals, objectives, and strategies. The plan identifies key information management issues and provides the framework for developing integrated information systems and technology through further definition and specification of architecture components and information elements. OCIO then works in coordination with the Agency's IT specialists to implement these IT strategies with broad Agencywide impact.

Expand Electronic Government

OCIO facilitates the Agency's implementation of broad Federally and USDA-mandated IT programs focused on expanding electronic government. OCIO will continue to work with the USDA Office of the Chief Information Officer (USDA-OCIO) to achieve this goal. Specifically, OCIO will work with the USDA-OCIO on key areas for effective IT management, such as Enterprise Architecture, Federal Information Security Management Act (FISMA), and Capital Planning and Investment Control, as well as on network efficiency, reliability, and capacity to ensure support of E-Government projects.

Actionable Strategies/Activities for OCIO Management Initiatives

- Ensure that the ARS mission drives its information systems and the deployment of information technology.
- Ensure that ARS information systems are reliable, secure, relevant, innovative, well planned, and managed effectively.
- Invest in appropriate human resources and infrastructure to ensure effective management of high quality information and state-of-the-art technology.
- Ensure information systems support research and technology transfer through development and dissemination of ARS advanced knowledge-based systems, decision tools, and databases.
- Ensure that researchers, educators, and the public have an awareness of and access to research accomplishments and agriculturally related information.