



United States Department of Agriculture

RESEARCH, EDUCATION, AND ECONOMICS ACTION PLAN PROGRESS REPORT

2014

Progress and
Achievements







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PREFACE

Farmers and ranchers in America and across the world rely on U.S. Department of Agriculture's (USDA) powerful and historic investments in agricultural science and research to meet the ever-growing global demands for food, fuel, and fiber. Science performed and supported by USDA's Research, Education, and Economics (REE) Mission Area underpins the critical advancements needed for increased sustainable and safe food production. It also informs efforts to ensure vulnerable populations receive adequate nutrition. As climate change creates difficult and unpredictable conditions for farmers, research performed by this Mission Area must continue to inform natural resource conservation and the environment while providing economic opportunities for rural citizens and communities.

The purpose of the REE Action Plan (http://www.ree.usda.gov/ree/news/USDA_REE_Action_Plan_03-2014.pdf) is to identify and focus research efforts in mission-critical core areas. It lays out seven Strategic Goals that draw attention to our need for a healthy and secure food supply, clean and sustainable energy sources, good nutrition and healthy diets, education, and farm-to-city interdependence for the well-being of all people. Each year we track our progress toward the goals and produce a progress report.

This FY2014 REE Action Plan Progress Report highlights some of the many research and education accomplishments under the goals and strategies of the REE Action Plan. The report is not intended to provide an exhaustive list of all the work accomplished in FY2014. Rather, it highlights some of the most relevant and interesting advancements related to research, education, and extension programs within the Mission Area.

Some accomplishments in 2014 that align with the REE Action Plan include:

- USDA scientists performed foundational research to determine the right amount of food to provide in school lunches and supported research to help high school students eat more fruits and vegetables, leading to reduced obesity and improved nutrition in youth.
- USDA released new varieties of fruits and vegetables, including apples, sweet potatoes, blueberries, and sweet orange, which can be produced at lower cost and in greater abundance.
- USDA research contributed to greater protection of bee colony health, which is critical to global food security.
- Scientists developed new sources of biofuels converted from waste (including urban forest wood waste, rural and urban solid waste, and food processing waste), and researchers cultivated grasses that can supplement or replace traditional sources of fuel while augmenting the rural economy.



Additionally, the REE Mission Area contributed to basic and applied research in the areas of crop and animal breeding, molecular biology, statistical analysis, and agricultural engineering, among others, which provided successful and marketable strategies that boosted the rural economy and sustainably increased production with fewer inputs and less land. REE support for social science research strengthened efforts to increase nutrition and prevent obesity, and it enabled more efficient delivery of resources to low-income families.

Through the Office of Technology Transfer (OTT), REE actively promotes the adoption and use of USDA science and research outcomes by external stakeholders to support marketable products. Technology transfer is critical to accelerating the utility of research and development (R&D) investments, catalyzing economic activity, and creating jobs and sustainable economic development. Two key examples of technology transfer in 2014 include the discovery and transfer of new platforms for the protection of animals from priority diseases and new technologies for the protection of humans and animals from biting arthropods, such as ticks and mosquitos. A second example involves the development of an innovative process to pasteurize shelled eggs using radio frequency energy. This process will eliminate 99.999 percent of Salmonella that may be present in eggs. An industry partner is currently scaling-up this technology for commercialization. These examples fulfill Goal 1b: Crop and Animal Health and Goal 5: Food Safety. To further support the accessibility of USDA research, the Agricultural Technology Innovation Partnership Network was redesigned. It re-emerged as the Agricultural Research Partnerships Network and now extends the impact of USDA research by facilitating more efficient delivery of USDA research outcomes, providing mentoring in business and manufacturing problem solving, and providing networking opportunities to facilitate collaborations and public-private partnerships. This should also facilitate the advancement of commercialization of new technologies.

As America continues to face economic, health-related, and environmental issues, REE continues its commitment to develop answers to fundamental agricultural questions. It supports advances in technological methodologies and techniques that contribute to America's agricultural economy. REE research is helping to create sustainable food production, provide clean and abundant water, respond to climatic variability, develop renewable energy, improve human health, and strengthen food safety.

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INTRODUCTION

Food production must increase by 70 percent or more to feed a global population that may exceed 9.5 billion by 2050. Today, about 14 percent of U.S. households are food insecure and do not have enough to eat on a daily basis; meanwhile, about one-third of U.S. adults (more than 72 million people) and 17 percent of children are obese. Nutritional deficiencies exist even when food is abundant and available.

The REE Mission Area works to address the challenges that exist today and those that will confront the country in the future. Through the combined efforts of all REE Mission Area agency scientists, researchers, and partners, USDA has created a robust infrastructure to perform world-class science and to deliver classroom and community education and transfer technologies from the labs to the private sector for commercialization. Each component plays a pivotal and complementary role.

Agricultural Research Service (ARS): ARS is the principal in-house research agency of the USDA. Its mission is to conduct research to develop and transfer solutions to agricultural problems of high national priority and to 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. ARS is committed to addressing the Department's priorities, including assisting rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving; ensuring that the national forests and private working lands are conserved, restored, and made more resilient to climate change; promoting agricultural production and biotechnology exports; increasing food security; ensuring America's children have access to safe, nutritious, and balanced meals; and creating a USDA for the 21st century that is high performing, efficient, and adaptable.

Economic Research Service (ERS): ERS's research spans a number of USDA mission areas and provides the information for improved decisionmaking across USDA, and so its program supports all of the USDA Strategic Goals. ERS's long-term performance goal is the successful execution of economic research and analysis to provide policymakers, regulators, program managers, and those shaping the public debate on agricultural economic issues with timely, relevant, and high-quality economic research, analysis, and data to enhance their understanding of economic issues affecting food and agriculture. The key outcome of the ERS program is improved decisionmaking by policymakers, regulators, program managers, and those shaping the public debate on socioeconomic issues affecting agriculture, food, the environment, and rural development.

National Institute of Food and Agriculture (NIFA): NIFA integrates USDA's research, education, and extension functions. It ensures that science makes its way into the hands of those who need it most, such as producers, families, State and local governments, and decision-makers. This integration leads to true innovations in agriculture. For example, three large NIFA-funded Coordinated Agriculture Projects in California and Minnesota led research on developing new varieties of wheat and barley that are resistant to some effects of climate change, such as drought. Through integrating education and extension, these new varieties account for 20 percent of the harvested wheat acreage—worth approximately \$3.5 billion—and 4 percent of the harvested barley acreage in the United States. These projects are resulting in training some 269 students, many of whom will become the next generation of plant breeders in the United States.

National Agricultural Statistics Service (NASS): NASS provides timely, accurate, and useful statistics in the service of U.S. agriculture. The statistical data provided by NASS is essential for the public and private sectors to make effective policy, production, and marketing decisions on a wide range of agricultural commodities. Every 5 years, the Census of Agriculture (COA) provides comprehensive national, State, and county data as well as selected data for Puerto Rico, Guam, Virgin Islands, and Northern Mariana Islands. The COA includes data on the number of farms, land use, production expenses, the value of land and buildings, farm size and characteristics of farm operators, market value of agricultural production sold, acreage of major crops, inventory of livestock and poultry, and farm irrigation practices. Results from the 2012 COA were released in May 2014. Additionally, NASS publishes approximately 400 agricultural statistical national reports and thousands of additional agricultural statistical State reports annually, which cover more than 120 crops and 45 livestock items. These basic and objective data are necessary to maintain an orderly association between the consumption, supply, marketing, and input sectors of agriculture. The scientifically designed surveys provide the basis for developing estimates of production, supply, price, and other aspects of the agricultural economy.

Other USDA Organizations: While other USDA organizations, Forest Service Research and Development (R&D), for example, do not directly fall within REE Mission Area jurisdiction, their contribution is vital to USDA's science agenda. Forest Service R&D provides the basic and applied science that underpins the agency's efforts to promote resilient forests and sustainable communities that can adapt to forest threats such as climate change, fire, and insect and disease infestations. Its efforts are important contributors to the USDA Interagency Climate Change Initiative and Priorities. The knowledge and information gained from this research benefits the American public by improving the health and productivity of the Nation's forests, and the quality of life of communities by providing protection from fire, improving water and air quality, and supporting other ecosystem services in both urban and rural communities.

REE Action Plan Framework

In 2012, the REE Mission Area published an Action Plan designed to guide and help coordinate research activity across the Department and inform other agricultural research entities. A revised Action Plan was published in 2014 incorporating stakeholder needs and based on agency experience working with the Plan. It provides further delineation of USDA's research priorities.

In support of the REE mission, the Action Plan remains the roadmap for promoting innovations related to agricultural science and education.

The REE Action Plan has seven goals that are clearly informed by the USDA Strategic Goals. The cascading ensures alignment of USDA vision and REE Mission Area REE priority areas. This coordination supports unity of action to maximize resources and ensure complementary work.

The REE Action Plan is organized around seven strategic goals

- Goal 1** Local and Global Food Supply and Security
- Goal 2** Responding to Climate and Energy Needs
- Goal 3** Sustainable Use of Natural Resources
- Goal 4** Nutrition and Childhood Obesity
- Goal 5** Food Safety
- Goal 6** Education and Science Literacy
- Goal 7** Rural-Urban Interdependence and Prosperity

Goal 1: Local and Global Food Supply and Security

Summary: To improve production capacity, production efficiencies, and environmental sustainability, the REE Mission Area seeks to develop and transfer knowledge and technologies that promote sustainable agricultural systems locally, nationally, and globally for all types of agricultural production systems. This will enhance global food security and strengthen American agriculture.

Goal 1A

Crop and Animal Production

Background: The REE Mission Area invests in research, development, and extension of new varieties and germplasm to safely increase animal and crop production and its nutritional value, identify alternative feed and forage options for animal systems that do not compete for human food and energy needs, and develop and populate a framework for understanding the sustainability outcomes of agriculture/food/forestry practices.

Selected Accomplishments

New Crop Varieties Released

USDA released 348 new varieties of plants to the marketplace for commercialization, including ARS's new apple rootstocks with tolerance to apple replant disease, fire blight, and crown rot, diseases that infect apple trees with serious economic consequences. It also released new sweet orange tree hybrids and rootstocks with tolerance to citrus greening disease, which cost the Florida citrus industry an average of \$975 million each year from 2006 to 2014. Through grants to Louisiana State University, NIFA facilitated the release of new disease- and pest-resistant sweet potatoes, resulting in an over 20-percent increase in yields and over 100 jobs brought to rural Louisiana. With Hatch Act grants that focus on agricultural research programs at State Agricultural Experiment Stations in the 50 states, the District of Columbia, and the U.S. insular areas, University of Georgia horticulturalists developed several varieties of blueberries that resulted in larger berries and higher yield so that blueberry production increased from 3,500 acres to more than 20,000 acres in recent years.

Improvements in Animal Production

USDA NIFA facilitated a multistate, multi-disciplinary team of scientists in the Northeastern Region to improve reproductive performance in dairy and meat-producing livestock. As a result, new knowledge of ovarian follicles in cattle led to strategies to enhance ovarian function, molecular discoveries improved conception rates in artificially inseminated animals, and new methods for detecting infertility in sires helped farmers make better breeding choices, all resulting in increased production. ARS researchers also contributed to improved animal production by generating a broodstock of salmon, in collaboration with industry, based on a breeding program that was selected for increased growth, resistance to sea lice, and improved color. The new stocks are an average of 90 percent larger, and this improved breed is increasing the cost effectiveness, profitability, and sustainability of cold water marine aquaculture in the United States, while supplying a quality seafood product to consumers.

As part of the USDA/United States Agency for International Development (USAID) Feed the Future project, DNA sequences from 66 breeds of goats around the world were collected along with detailed phenotypic measures and standardized photographic images. The sequences were used to perform a phylogenetic analysis, identify unique genetic resources, and develop a community-based breeding program for genetic improvement of goat herds in African communities.

With Hatch Act grants, University of Georgia horticulturalists developed several varieties of blueberries that resulted in larger berries and higher yield so that blueberry production increased from 3,500 acres to more than 20,000 acres in recent years.

Goal 1A

Crop and Animal Production

Agricultural Research Service	Totals
Peer-reviewed journal publications	417
Non-peer-reviewed publications	145
Material Transfer Agreements ¹	58
Inventions	8
New incoming agreements ²	65
Economic Research Service	Totals
Briefings ³	2
Number of extramural grants awarded	2
National Agricultural Statistics Service	Totals
Census Report - Irrigation	1
Census Report - Organic	1
Census Report - Aquaculture	1
Census Report - Special tabulation on specialty crops	1
National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	948
Research publications from Formula grants	2,930
Direct youth contacts by Extension	886,810
Direct adult contacts by Extension	8,080,03
\$\$ Leveraged from Formula grant projects	\$521M
Patent applications reported by Formula grant recipients	54
Extension professional Full-Time Equivalent from Formula grants	1,401
Scientist years for Formula grant projects	1,072
Number of active extramural grant projects	4,107

¹ Material Transfer Agreements are contracts governing the transfer of tangible research materials between two organizations, when the recipient intends to use it for his or her own research purposes.

² New incoming agreements are agreements where ARS is receiving funds from an outside source to do research based on the statement of work in a proposal or agreement.

³ Briefings are for senior USDA staff, Congressional staff, or other Federal agencies.



Goal 1B

Crop and Animal Health

Background: The REE Mission Area invests in research, development, and outreach for new varieties and technologies to mitigate animal and plant diseases and increase productivity, sustainability, and product quality. It also supports sustainable systems that enhance crop and animal health.

Selected Accomplishments

New Green Technologies for Animal Health

ARS scientists isolated natural products from a native Texas shrub, *Amyris texana*, and a native cedar tree, *Juniperus virginiana*, both of which repel insects. The Texas shrub repellent is more powerful than the DEET repellent against mosquitoes, and the cedar oil repels several species of ants, houseflies, cockroaches, and blacklegged ticks. These insects are disease carriers, and effective repellents are essential to maintain animal and human health. ARS scientists also collaborated with Rangsit University in Thailand to test a novel, antimicrobial oil isolated from a fungus. The oil stops the growth of the disease-causing *Streptococcus* bacteria and could improve animal health in the dairy, swine, and aquaculture industries. A company funded by a NIFA Small Business Innovative Research (SBIR) grant developed a cost-effective and successful method to treat nematode infestations or rot on crops such as strawberries using steam instead of the ozone-depleting methyl bromide.

Antibiotic Alternatives

Cytokines are small proteins that can also stimulate the immune system to combat an infection and represent an alternative to antibiotic use that will not engender antibiotic resistance. ARS scientists tested a cytokine as a potential antibiotic alternative for use in animal production that boosts the animals' own white blood cells to protect against pathogenic bacteria. The scientists developed a technique that boosted the immune systems of pigs for more than 2 weeks. Antibiotic alternatives are also needed in agronomy. The Asian citrus psyllid is the insect that carries the bacteria causing citrus greening disease, which is devastating the Florida citrus industry by decreasing marketable fruit in infected groves by more than 50 percent. To prevent the bacteria from infecting new citrus trees, ARS scientists developed a molecular system to prevent the psyllids from feeding on the citrus sap, preventing them from transmitting the bacteria from tree to tree. This antibiotic alternative can be used in conjunction with other methods to stop the spread of citrus greening.

Increasing Animal Welfare in Bees and Chicks

In addition to the parasites and pathogens that attack honey bees, poor nutrition adds to honey bee stress and may be a contributing factor to colony decline. When pollen, a source of honey bee nutrition, cannot be collected due to the absence of flowering plants, beekeepers will often feed their honey bee colonies a protein supplement. ARS scientists demonstrated that these supplements have less protein than pollen and are not digested as well by the honey bees. Furthermore, bees in colonies fed protein supplements experienced a higher incidence of disease and queen loss and had higher mortalities overall than the colonies that consumed pollen. These findings underscore the need to supply bees with pollen and will be used by beekeepers and extension agents working with honey bees to ensure colonies are receiving proper nutrition. In addition to maintaining bee welfare, an ARS team funded by NIFA's Agriculture and Food Research Initiative (AFRI) has been working to improve the well-being of chickens. This team found that infrared beak trimming of chicks significantly reduces pain and discomfort compared to the standard practice of using a hot blade. Poultry growers regularly trim chicks' beaks to prevent damaging feather pecking, inter-bird pecking, and cannibalism among poultry. The success of this alternative practice was shared with industry, which has begun implementing the new practice.

The Asian citrus psyllid is the insect that carries the bacteria causing citrus greening disease, which is devastating the Florida citrus industry by decreasing marketable fruit in infected groves by more than 50 percent.

Goal 1B:
Crop and Animal Health

Agricultural Research Service	Totals
Peer-reviewed journal publications	1,012
Non-peer-reviewed publications	200
Material Transfer Agreements ¹	115
Inventions	30
New incoming agreements ²	186

Economic Research Service	Totals
Peer-reviewed journal publications	1
Responses to requests for research findings, information, or analysis by decisionmakers ⁵	1

National Agricultural Statistics Service	Totals
Census Report - Irrigation	1
Census Report - Organic	1
Census Report - Aquaculture	1
Census Report - Special tabulation on specialty crops	1

National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	571
Research publications from Formula grants	1,764
Direct youth contacts by Extension	438,128
Direct adult contacts by Extension	3,885,339
\$\$ Leveraged from Formula grant projects	\$546M
Patent applications reported by Formula grant recipients	33
Extension Professional Full-Time Equivalents from Formula grants	791
Scientist years for Formula grant projects	1,182
Number of active extramural grant projects ⁵	3,670

ARS scientists also collaborated with Rangsit University in Thailand to test a novel, antimicrobial oil isolated from a fungus. The oil stops the growth of the disease-causing Streptococcus bacteria and could improve animal health in the dairy, swine, and aquaculture industries.

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² New incoming agreements are agreements where ARS is receiving funds from an outside source to do research based on the statement of work in a proposal or agreement.

⁵ Requests for information, research findings, data, and analysis by decisionmakers in USDA, the Congress, and other Federal agencies.



Goal 1C.

Crop and Animal Genetics, Genomics, Genetic Resources, and Biotechnology

Background: The REE Mission Area and other USDA agencies generate new, fundamental knowledge through research in genomic sciences and apply systems approaches to enhance the sustainability of agriculture while increasing productivity.

Selected Accomplishments

New Approaches Using Genetic Techniques:

Infestations of immature screwworms (maggots) devastated the U.S. livestock industry until a sterile male release technique eradicated screwworms in the 1960s. This technique is still used to prevent re-entry of screwworms into the United States, but it requires the mass production, sterilization, and release of millions of sterilized, adult males at a cost of millions of dollars annually. ARS scientists, in collaboration with scientists at North Carolina State University, used genetic techniques to produce male-only screwworms, making the rearing and release program more efficient and affordable, saving the North American livestock producers over \$1.5 billion annually. Genetic techniques were also used by the Forest Service R&D to investigate the white-nose disease-causing fungus *Pseudogymnoascus destructans* from soil samples in bat caves. White-nose disease has caused the deaths of millions of bats, which are major predators of forest defoliating and disease-carrying insects and of agricultural pests, resulting in substantial ecological, economic, and management costs.

New Production Traits

With global climate change and increasing demands for animal protein worldwide, there is a need to understand and accelerate the adaptation of agricultural animals and plants to the environment. Cattle breeds in subtropical and tropical regions of the world maintain a stable, internal deep body temperature that is indicative of a genetic predisposition towards heat tolerance. Importantly, different tropical breeds demonstrate variations in their heat tolerance. ARS scientists collaborated with scientists at U.S. and foreign universities to identify distinct mutations in genes regulating skin formation, hair growth, and cooler body temperature that are inherited in heat-tolerant breeds. Results from the study are being used by producers to guide future breeding decisions and by researchers to better understand the biological processes involved in adaptation to climate change.

NIFA-funded animal science researchers in Missouri are improving feed efficiency in beef cattle. Investigators have located the chromosomal regions responsible for growth performance that help cattle get the most out of what they eat. By increasing the nutritional efficiency of their herds, cattle producers will see higher profits by reducing the amount of feed it takes to raise cattle. This will also reduce the environmental footprint of beef production by reducing the amount of manure and greenhouse gases.

In addition to new discoveries of production traits in animals, USDA scientists have also discovered genetic factors that confer resistance to wheat stem rust, one of the most devastating cereal crop diseases. This discovery may lead to the development of wheat stem rust varieties. NIFA-funded research discovered a chromosome in wild Peruvian lettuce that allows for germination at higher temperatures and transferred that gene into commercial lettuce. The result is less water used, a longer growing season, and a reduced need for shipping—a combination that means more water for other uses, more money for farmers, more fresh lettuce for consumers, and reduced greenhouse gas emissions.

With global climate change and increasing demands for animal protein worldwide, there is a need to understand and accelerate the adaptation of agricultural animals and plants to the environment.

Expansion of Biodiverse Genetic Resources:

Forest Service launched the National Genomics Center for Wildlife and Fish Conservation, a state-of-the-art facility for advanced research providing expertise in DNA sequencing and environmental and forensic DNA sampling. The Center is designed for cross-agency partnerships and provides cost-effective and reliable genetic and genomic data for species and environmental biodiversity monitoring through genetic code sampling, which will contribute to improvements in management of fish and wildlife resources through reduced costs and increased information reliability. Also, ARS scientists found new genetic factors in a wild soybean relative from a USDA soybean collection that may be important for future breeding initiatives.

Common Bean Reference Genome

NIFA funded a team of researchers to sequence and assemble the genome of the common bean, *Phaseolus vulgaris*, which is 473 million basepairs in length. Its genetic sequence was compared to that of the soybean to gain insights into its evolution, enabling the identification of 27,000 genes, including genes connected to agronomic traits such as increased leaf and seed size. The common bean genome represents the most important grain legume for human consumption.

Goal 1C: Crop and Animal Genetics, Genomics, Genetic Resources, and Biotechnology

Agricultural Research Service	Totals
Peer-reviewed journal publications	606
Non-peer-reviewed publications	159
Material Transfer Agreements ¹	176
Inventions	7
New incoming agreements ²	143
New or updated websites	9
New Plant Varieties and Enhanced Germplasm Lines	398

Economic Research Service	Totals
Research monographs	2
New or updated data products	1
Briefings ³	3
Responses to requests for research findings, information, or analysis by decisionmakers ⁵	8

National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	239
Research publications from Formula grants	737
Direct youth contacts by Extension	77,153
Direct adult contacts by Extension	515,649
\$\$ Leveraged from Formula grant projects	\$269M
Patent applications reported by Formula grant recipients	14
Extension professional Full-Time Equivalents from Formula grants	123
Scientist years for Formula grant projects	444
Number of active extramural grant projects ⁵	1,532

¹ Material Transfer Agreements are contracts governing the transfer of tangible research materials between two organizations, when the recipient intends to use it for his or her own research purposes.

² New incoming agreements are agreements where ARS is receiving funds from an outside source to do research based on the statement of work in a proposal or agreement.

³ Briefings are for senior USDA staff, Congressional staff, or other Federal agencies.

⁵ Requests for information, research findings, data, and analysis by decisionmakers in USDA, the Congress, and other Federal agencies.

NIFA-funded animal science researchers in Missouri are improving feed efficiency in beef cattle. Investigators have located the chromosomal regions responsible for growth performance that help cattle get the most out of what they eat.

Goal 1D

Crop and Animal Consumer and Industry Outreach, Policy, Markets, and Trade

Background: The REE Mission Area focuses on evaluating market performance and providing domestic and international market information for production and marketing decisions in agriculture's food, fiber, and energy sectors.

Selected Accomplishments

Consumer and Industry Support

An ERS study showed that beginning farmers and ranchers have declined as a share of all farmers and that their average age has risen to 49 compared with an average of 60 for established farmers. They tend to operate smaller farms and are more likely to work off the farm than established operators. Beginning farmers often report that their biggest challenge in getting started in farming is access enough capital and farmland to operate at a profitable size. ERS released an analysis of wheat price spikes and crashes showing that market-specific supply and demand shocks, and not speculation, were primarily responsible for the 2008 market spike in U.S. and global wheat prices. The ERS commodity outlook program continued to serve USDA stakeholders in the public and private sectors by delivering timely, independent and objective information about agricultural markets.

Beginning farmers often report that their biggest challenge in getting started in farming is access enough capital and farmland to operate at a profitable size.

Technical Assistance and Outreach

NASS provided technical assistance and training to improve agricultural statistics programs in 10 countries. Assistance ranged from basic survey concepts and procedures to complete Census of Agriculture support. NASS also conducted trainings to promote better quality data, and it improved access to data that would help scientists better understand the world supply and demand for food, water, and U.S. products. ERS also conducted a survey of genetically engineered (GE) crops. It found that about half of total American cropland is planted with GE corn, cotton, and soybeans and that adoption of insecticide-resistant (Bt) seeds led to higher yields and net returns while also finding mixed results from the adoption of herbicide-tolerant varieties. ERS also examined consumer acceptance of foods with ingredients produced using GE technology, finding that results varied with the consumer's geography, exposure to information, and the product's characteristics.

Goal 1D:

Crop and Animal Consumer and Industry Outreach, Policy, Markets, and Trade

Economic Research Service	Totals
Peer-reviewed journal publications	39
Research monographs	115
New or updated data products	285
Briefings ³	17
Responses to requests for research findings, information, or analysis by decisionmakers ⁵	199
Federal Register Notices or other Government use ⁴	20
Number of extramural grants awarded	16

National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	866
Research publications from Formula grants	2,678
Direct youth contacts by Extension	1,052,131
Direct adult contacts by Extension	4,006,736
\$\$ Leveraged from Formula grant projects	\$114M
Patent applications reported by Formula grant recipients	50
Extension professional Full-Time Equivalents from Formula grants	1,046
Scientist years for Formula grant projects	366
Number of active extramural grant projects ⁵	1,692

³ Briefings are for senior USDA staff, Congressional staff, or other Federal agencies.

⁴ Federal Register Notices and/or other government use are Federal Register Notices of Rules or other Federal Agency Decision Reports that use ERS research findings (Government Accountability Office, Congressional Research Service, Council of Economic Advisors, etc.).

⁵ Requests for information, research findings, data, and analysis by decisionmakers in USDA, the Congress, and other Federal agencies.



Goal 2: Responding to Climate and Energy Needs

Summary: The REE Mission Area includes research programs and initiatives that address challenges affecting production systems (food, feed, fiber, and fuels) resulting from changes in climate. This work will help the agriculture sector be prepared, agile, and adaptable to increased food and energy demands.

Goal 2A

Responding to Climate Variability

Background: The REE Mission Area and other USDA agencies develop and deliver science-based knowledge that empowers farmers, foresters, ranchers, landowners, resource managers, policymakers, and Federal agencies to adjust practices according to climate variability, positioning decisionmakers to develop informed policies that could reduce emissions of atmospheric greenhouse gases and enhance carbon sequestration. An essential strategy in support of this Goal is through the Regional Climate Hubs, which were created in 2014.

Selected Accomplishments

Assessment of Nutritional Indicators:

Producers and nutritionists are concerned about how climate change might affect the nutritional qualities of food crops. ARS researchers and multinational collaborators determined how climate change could affect the nutritional qualities of several staple crops, including wheat, rice, maize, sorghum, and soybean. In the first assessment of its kind, seed nutrient content of zinc, iron, and protein was evaluated. Scientists also measured seed properties, which are critically important for determining iron and zinc bioavailability. The scientists found that seed zinc, iron, and protein levels declined with rising carbon dioxide levels. Iron and zinc deficiencies are significant global public health challenges that impair the health of an estimated 2 billion people worldwide. These findings, which were published in the journal *Nature*, provide important new information for understanding how climate change could impact nutritional quality of crops.

Assessment of the Resiliency of Pollinators:

Pollinators assist 80 percent of flowering plants in fruit and grain production, accounting for much of the food humans and wildlife depend upon. The worldwide decline in pollinators highlights the importance of understanding the factors affecting plant-pollinator interactions. Forest Service scientists found that drought stress reduced pollinator visitation and altered floral scent, which some pollinators use to guide them to the flowers. These findings suggest that some plants and pollinators will be negatively affected if the frequency and severity of droughts increases due to climate change. Consequently, reducing drought stress must be an important consideration for forest managers in their management and restoration plans for native ecosystems.

Reduction of Fossil Fuel Use:

NIFA-funded researchers at Ohio State University identified ways to reduce fossil fuel usage associated with heating pork production facilities to prevent over 7 kilogram carbon dioxide from being released into the atmosphere per pig, which results in savings of \$1.71 per pig and no adverse impact on production.

Impacts of Climate Disruption on Agricultural Production:

ERS was a leading contributor to the Third National Climate Assessment Report, which provided reliable scientific information about current and future impacts of climate change and options for an effective response. The report's findings suggest that the impact of climate change on production will have consequences for domestic and global food security through changes in yields, prices, and processing, storage, transportation, and retailing.

Pollinators assist 80 percent of flowering plants in fruit and grain production, accounting for much of the food humans and wildlife depend upon. The worldwide decline in pollinators highlights the importance of understanding the factors affecting plant-pollinator interactions.

Goal 2A: Responding to Climate Variability

Agricultural Research Service	Totals
Peer-reviewed journal publications	174
Non-peer reviewed publications	43
Material Transfer Agreements ¹	4
Inventions	2
New incoming agreements ²	27

Economic Research Service	Totals
Peer-reviewed journal publications	8
Research monographs	1
Responses to requests for research findings, information, or analysis by decisionmakers ⁵	51

Forest Service	Totals
Peer-reviewed journal publications	489
Non-peer-reviewed publications	33
New or updated data products	2
Conferences supported	1

National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	438
Research publications from Formula grants	1,355
Direct youth contacts by Extension	285,896
Direct adult contacts by Extension	3,612,702
\$\$ Leveraged from Formula grant projects	\$135M
Patent applications reported by Formula grant recipients	25
Extension Professional Full-Time Equivalents from Formula Grants	431
Scientist Years for Formula Grant Projects	353
Number of active extramural grant projects ⁵	1,475

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⁵ Requests for information, research findings, data, and analysis by decisionmakers in USDA, the Congress, and other Federal agencies.



Goal 2B.

Bioenergy/Biofuels and Biobased Products

Background: Together with its partners, the REE Mission Area strives to lead global agricultural innovation to achieve energy efficiency and independence by integrating economically, environmentally, and socially sustainable region-based biomass production systems into existing agricultural systems.

Selected Accomplishments

Waste Products Turned Into Resources:

Scientists at Southern University and A&M College in Louisiana leveraged NIFA funds to obtain an externally funded grant to develop biofuels from sustainable, non-food sources, such as urban forest wood waste. ARS scientists have discovered ways to turn landfills into biorefineries by converting rural and urban solid waste into ethanol, biogas, compost, and other value-added recyclables. Each ton of food processing waste at this landfill can be converted to 65 gallons of ethanol or 108 gallons of liquefied transportation fuel. These efforts serve to reduce waste, increase biofuel availability, and develop the rural economy. ARS scientists are also improving the yeast used to convert biomass to ethanol by culturing yeast strains that reduced ethanol selling costs by \$0.31/gallon, an accomplishment that advances national efforts in developing renewable fuel systems to stimulate the rural economy, preserve the environment, and reduce dependence on foreign oil.

Advances in Switchgrass:

ARS researchers found that directed selection and breeding for high biomass yields of switchgrass following harsh winters could boost production by 50 percent in the more northern USDA Hardiness Zones 3 and 4, where the crop has not been as productive as when grown in the more southern Zones 5 and 6. This is especially useful in marginal environments where field crops are rarely profitable or sustainable. NIFA supported a grant to researchers from the University of Kentucky to test switchgrass production with 20 farmers and the East Kentucky Power Cooperative and Investigators. This team demonstrated the utility of switchgrass as a dual-use, grazing and biomass crop, and researchers developed a technique to improve germination and establishment rates.

ARS scientists have discovered ways to turn landfills into biorefineries by converting rural and urban solid waste into ethanol, biogas, compost, and other value-added recyclables. Each ton of food processing waste at this landfill can be converted to 65 gallons of ethanol or 108 gallons of liquefied transportation fuel.



Goal 2B:
Bioenergy/Biofuels and Biobased Products

Agricultural Research Service	Totals
Peer-reviewed journal publications	51
Non-peer-reviewed Publications	6
Material Transfer Agreements ¹	23
Inventions	6
New incoming agreements ²	11
Briefings ³	1

Economic Research Service	Totals
Peer-reviewed journal publications	3
New or updated data products	12
Responses to requests for research findings, information, or analysis by decisionmakers ⁵	4

Forest Service	Totals
Peer-reviewed journal publications	60
Non-peer-reviewed publications	14
Inventions	13

National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	102
Research publications from Formula grants	315
Direct youth contacts by Extension	22,842
Direct adult contacts by Extension	44,493
\$\$ Leveraged from Formula grant projects	\$61M
Patent applications reported by Formula grant recipients	6
Extension professional Full-Time Equivalents from Formula grants	42
Scientist years for formula grant projects	135
Number of active extramural grant projects ⁵	349

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Goal 3: Sustainable Use of Natural Resources

Summary: REE programs improve soil, air, and water resources while supporting agricultural and forest production on working lands. Climate, water, and natural resources interact in a dramatic and complicated way, and the REE programs inform long-term sustainability of resources. In an effort to improve agricultural productivity and economic performance while enhancing natural resources and ecosystem services, REE delivers the scientific knowledge (agronomic, climatic, ecological, economic, social and institutional) that promotes sustainable use of natural resources.

Goal 3A

Water Availability: Quality and Quantity

Background: The REE Mission Area and other USDA agencies develop and provide the best available science and technology to inform decisionmaking and improve practices in water conservation and quality by fostering a watershed-scale approach that encourages agricultural water management.

Selected Accomplishments

Water Conservation Practices Developed

A NIFA-funded study at the University of Nebraska found that using cover crops and reduced or no-till farming can save as much as 60 to 110 millimeters per year of irrigation water. NIFA also funded the University of Florida and Florida A&M University to develop extension programs on water conservation targeted to home owners, farmers, and the green industry. One of these extension programs used demonstrations in nurseries to illustrate how modern irrigation technologies save 55 to 90 percent more water than traditional practices. In one Florida county, a soil water-based technology used in residences saved over 66 million gallons of water annually. The 2014 NASS census study on irrigation helps inform conservation efforts.

Maintenance of Water Quality

ARS scientists used a combination of field and modeling research to inform producers on how to reduce phosphorus run-off, which can enter the drinking water supply and empty into surface waters, such as Lake Erie, causing harmful algal blooms. In Oregon, ARS scientists collected data over an 8-year period from 56 land use patterns to define how land use alters the water quality in nearby streams and rivers, an important aspect of pollution monitoring and natural resource stewardship. These data were incorporated into a Soil and Water Assessment Tool model, which predicts how land management alters nutrient and sediment load in waterways, enabling the determination of environmental consequences to changing land use patterns.

Vegetation buffers consisting of strips of trees and shrubs planted along waterways can also minimize runoff pollution in addition to reducing erosion and providing wildlife habitat. Forest Service researchers developed a Geographic Information System (GIS) tool that estimates the optimal width for a vegetation buffer for a given field situation, and case studies showed that this precision could double the effectiveness of buffers in improving water quality over the traditional, constant-width buffer design.

In Oregon, ARS scientists collected data over an eight-year period from 56 land use patterns to define how land use alters the water quality in nearby streams and rivers, an important aspect of pollution monitoring and natural resource stewardship.

Assessment of Changes in Soil Water on Crops and Forests

ARS scientists assessed how changes in temperature and water availability affected crops in the Midwest as part of the Midwest Climate Change Hub hosted by ARS in Ames, Iowa. In-season water availability in the soil was found to be the most significant factor affecting production. These findings indicate that practices that increase the soil's water storage capacity can help cropping systems become more resilient to climate-related variables during the growing season, and the research provides guidance for the development of climate smart crop varieties and management systems. Forest Service scientists assessed how water availability impacts forest growth and mortality; current landscape-scale forest models are not sufficient to predict the impacts of droughts. These researchers developed a model that links precipitation, temperature, and tree species competition for light and water, which is useful for applying climate change research to forest restoration decisions.

Goal 3A:

Water Availability: Quality and Quantity

Agricultural Research Service	Totals
Peer-reviewed journal publications	246
Non-peer-reviewed publications	68
Inventions	2
New incoming agreements ²	62
Conferences supported	1
Economic Research Service	Totals
Peer-reviewed journal publications	1
Research monographs	2
Responses to requests for research findings, information, or analysis by decisionmakers ⁵	7
Forest Service	Totals
Peer-reviewed journal publications	135
Non-peer-reviewed publications	9
New or updated data products	3
Conferences supported	1
National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	299
Research publications from Formula grants	924
Direct youth contacts by Extension	328,224
Direct adult contacts by Extension	2,502,041
\$\$ Leveraged from Formula grant projects	\$76M
Patent applications reported by Formula grant recipients	17
Extension professional Full-Time Equivalents from Formula grants	333
Scientist years for Formula grant projects	176
Number of active extramural grant projects ⁵	867

Forest Service scientists assessed how water availability impacts forest growth and mortality; current landscape-scale forest models are not sufficient to predict the impacts of droughts.

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Goal 3B

Landscape-Scale Conservation and Management

Background: In collaboration with USDA sister agencies, such as the Forest Service's R&D and the Office of Environmental Markets, the REE Mission Area develops and provides the best available science and technologies to inform U.S. Government policies and programs and to support application of land-management practices that improve the economic, social, and environmental sustainability of the Nation's working farms, ranches, and forests.

Selected Accomplishments

Reductions in Inputs:

Conventional spray application often results in excessive application of pesticide to achieve effective pest control in floral, nursery, and fruit crop production. ARS researchers invented an automated, variable-rate, air-assisted, precision sprayer that minimizes human involvement in determining the amount of pesticides needed for applications. The pest control efficacies of the new sprayer provide an environmentally responsible approach and reduce average pesticide use by up to 68 percent, for an annual average cost savings of \$230 per acre in floral nurseries and orchards.

Cover Cropping and Minimal Tillage Reduce Erosion:

More frequent high-intensity rainfall events may threaten conservation farming practices that have so far substantially reduced erosion and sediment loss. ARS scientists evaluated runoff and soil loss from conventionally tilled and conservation strip tilled fields, which utilize cover crops, over a 10-year rotational period, finding that runoff was 87 percent higher in conventional fields. ARS scientists found that cover crops and minimal tillage increased soil carbon sequestration by an average of 2,500 kilograms of carbon per hectare. These results demonstrate that cover cropping and strip tillage are essential best practices even and especially as high-intensity rainfall events increase.

Development of Effective Techniques for Soil Carbon Sequestration:

Trees planted in agroforestry systems, such as riparian buffers and windbreaks, can increase carbon sequestration on agricultural lands. Forest Service researchers collaborated with university partners to help farmers account for this increased carbon sequestration and participate in future carbon markets. The results indicated that biomass and, hence, carbon sequestration, were significantly underestimated for agroforestry species. ARS scientists also contributed to soil carbon sequestration efforts through research in comparing different tilling strategies. Researchers found that systems that use cover crops sequester over 85 percent more carbon than systems utilizing corn residue.

Invasive Species Control:

The Invasive Species Program within the Forest Service provides the scientific information, methods, and technology to reduce, minimize, or eliminate the introduction, establishment, spread, and impact of invasive species. This knowledge leads to the restoration of ecosystems affected by invasive species to prevent adverse economic and environmental consequences. FY 2014 was the second year that improvements in data quality assurance were realized through the use of the Research Information Tracking System for reporting invasive species tools. For example, the Asian long-horned beetle (ALB) is one of the most destructive non-native insects in the United States. ALB and other wood-boring pests cause an estimated \$3.5 billion in annual damage to our forests. Forest Service scientists and their partners have discovered and synthesized pheromones that may be useful in managing ALB in the field using a lure and kill method. Also, cheatgrass is one of the most destructive plant invaders in the West, costing the Nation an estimated \$138 billion annually in ecosystem damages, reduced yields, lost forest products, and control efforts. Forest Service researchers and their partners discovered and characterized the toxins employed by a biocontrol pathogen, "black fingers of death," to kill cheatgrass seeds.

Trees planted in agroforestry systems, such as riparian buffers and windbreaks, can increase carbon sequestration on agricultural lands. Forest Service researchers collaborated with university partners to help farmers account for this increased carbon sequestration and participate in future carbon markets.

Resiliency After Disasters:

Forest Service scientists are contributing to community efforts to recover after natural disasters. New York City's socially and ecologically diverse Jamaica Bay region, population approximately 900,000, became a focus of resiliency planning and adaptive management efforts following Hurricane Sandy in October 2012. Forest Service scientists, in partnership with the Natural Areas Conservancy of New York City and the New York City Department of Parks and Recreation, developed a rapid assessment methodology to understand the public use, social meaning, and stewardship potential of parks in the region. This study assessed the 2,140 acres of public parkland adjacent to the Bay that are managed by the New York City Department of Parks and Recreation. The assessment enables managers to examine change in social and cultural benefits and values over time in the wake of both acute, large-scale disasters and other chronic forms of disturbance to inform future mitigation and restoration decisionmaking.

Goal 3B: Landscape-Scale Conservation and Management

Agricultural Research Service	Totals
Peer-reviewed journal publications	286
Non-peer-reviewed Publications	88
Material Transfer Agreements ¹	12
Inventions	4
New incoming agreements ²	46

Economic Research Service	Totals
Peer-reviewed journal publications	5
Research monographs	7
Briefings ³	5
Responses to requests for research findings, information, or analysis by decisionmakers ⁵	21
Number of extramural grants awarded	3

Forest Service	Totals
Peer-reviewed journal publications	12
Non-peer-reviewed publications	15

National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	542
Research publications from Formula grants	1,676
Direct youth contacts by Extension	301,757
Direct adult contacts by Extension	1,873,644
\$\$ Leveraged from Formula grant projects	\$274M
Patent applications reported by Formula grant recipients	31
Extension professional Full-Time Equivalents from Formula grants	434
Scientist years for Formula grant projects	647
Number of active extramural grant projects ⁵	2,418

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Goal 4

Nutrition and Childhood Obesity

Background: The REE Mission Area and other USDA agencies build the evidence base for food-based and physical activity strategies to promote health and reduce malnutrition and obesity in children and high-risk populations, and these agencies develop effective education and extension translational activities

Selected Accomplishments

Foundational Research for School Meal Improvements

Because many children consume at least half of their meals at school, and with more than 32 million children participating in the National School Lunch Program and more than 12 million participating in the School Breakfast Program, assessing what children are eating and giving them the right amount of the best foods is key to good nutrition and preventing childhood obesity. ARS scientists collaborated with Baylor College of Medicine to analyze food consumption and plate waste in nearly 800 children. They found that the amount of food consumed correlated with the amount served, suggesting that large portions may contribute to over-eating and obesity. Other ARS scientists further determined that the current standard for calorie intake in children is set too high. Helping older children make better choices is similarly important. Cornell University scientists funded by NIFA AFRI developed new strategies to lead high school students to eat more fruits and vegetables by making them more convenient, attractive, and normative. ERS scientists conducted a pilot study of nutrition report cards in rural New York and found that families with parents receiving a weekly email with information of what foods their children had selected encouraged more home conversations about nutrition and was associated with those children selecting fewer of certain items, such as cookies. ERS-supported research by the USDA Behavioral Economics/Child Nutrition Research Initiative found that creating a “healthy express” school lunch line is another way to encourage healthy eating; the line significantly increased sales of healthy items and decreased sales of unhealthy foods. With its potential for improving child health and reducing obesity, programs based on this finding have begun to be implemented across the country.

Helping older children make better choices is similarly important. Cornell University scientists funded by NIFA AFRI developed new strategies to lead high school students to eat more fruits and vegetables by making them more convenient, attractive, and normative.

Programs That Help Low-Income Families Eat Better

Eat Smart Idaho is a NIFA-funded program through University of Idaho extension educators that provides nutrition education for low-income Idahoans. The number of Idahoans living below the poverty line increased 40 percent over the past 5 years, and nutrition education is especially critical for this vulnerable population. A recent study of Eat Smart Idaho graduates concluded that Idaho will save \$14.55 in future health care costs for every \$1 invested in nutrition education, resulting in net savings of \$1.7 million over 5 years. Family meals have also been found to improve childhood nutrition, and leading NIFA-funded scientists at Temple University to investigate the challenges low-income mothers of preschool-aged children face in preparing meals.

NIFA also funds community food projects that provide funds to low-income community, non-profit organizations that develop projects to combat food insecurity, the state of having limited access to adequate food. One such project in Camden, New Jersey, produced more than \$2.3 million in produce on more than 27 acres in the city, offering fresh food to at least 15 percent of the city’s 76,000 residents.

ERS scientists updated and integrated food access data with the factors that influence Americans’ access to nutritious foods, which may enable policymakers to better understand how to get nutritious foods to people in need. ERS and ARS scientists also analyzed the effects on Supplemental Nutrition Assistance Program (SNAP) participation on diet quality, and the ARS study of 661 Hispanic women in Texas found that SNAP participants had less healthful dietary patterns compared to non-participants.

Tastier Soy

NIFA-funded researchers in Kentucky found a way to remove the sulfur containing odorants

using potassium iodate to improve the flavor of soy-based products and promote consumer demand. The technology of this process, which has been patented and is undergoing trials in a large U.S. soy processing plant, is an example of how basic research funded by a NIFA competitive grants program has been transferred to private industry.

New Centers Founded for Competitive Grant-Making in Behavior and Policy

ERS established and funded the USDA Center for Behavioral and Experimental Agri-Environmental Policy Research. This competitive grant program will fund research that uses behavioral and experimental economics to determine how policies and programs influence the provision of ecosystem services from agricultural lands. Together, ERS and the Food and Nutrition Service (FNS) established and funded the Duke-University of North Carolina-USDA Center for Behavioral Economics and Healthy Food Choice Research. The Center facilitates innovative research on the application of behavioral economic theory to healthy food-choice behaviors that enhance the nutrition, food security, and health of American consumers.

Goal 4: Nutrition and Childhood Obesity

Agricultural Research Service	Totals
Peer-reviewed journal publications	272
Non-peer-reviewed publications	72
Material Transfer Agreements ¹	7
New incoming agreements ²	23
New or updated Websites	1
New or updated mobile apps	1

Economic Research Service	Totals
Peer-reviewed journal publications	18
Research monographs	16
New or updated data products	23
Briefings ³	10
Federal Register Notices or other Government use ⁴	10
Responses to requests for research findings, information, or analysis by decisionmakers ⁵	63
Number of extramural grants awarded	15

National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	1,060
Research publications from Formula grants	3,277
Direct youth contacts by Extension	4,192,293
Direct adult contacts by Extension	4,460,254
\$\$ Leveraged from Formula grant projects	\$215M
Patent Applications Reported by Formula Grant Recipients	61
Extension Professional Full-Time Equivalent from Formula Grants	1,438
Scientist Years for Formula Grant Projects	448
Number of active extramural grant projects ⁵	1,683

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ERS scientists updated and integrated food access data with the factors that influence Americans' access to nutritious foods, which may enable policymakers to better understand how to get nutritious foods to people in need.

Goal 5

Food Safety

Background: The REE Mission Area provides science that informs decisions and policies that contribute to a safe food supply and the reduction of foodborne hazards.

Selected Accomplishments

Contamination and Virulence Mitigation in Food Systems

One in six Americans (or about 48 million people) get sick, 128,000 are hospitalized, and 3,000 die of foodborne illness.* A NIFA-funded spinach contamination project showed that certain hygiene practices reduced pathogen contamination while some weather and landscape factors, such as farming on fields previously used for grazing, increased its likelihood. In animal production, antibiotics are often used to control and treat infections. ARS scientists found that using the antibiotic tetracycline to control Salmonella may play a role in increasing the virulence of multi-drug resistant strains, highlighting the need to develop alternative treatments for Salmonella and other bacterial diseases. E. coli is another virulent pathogen that causes severe foodborne illness, and although many different strains may be found on the hides of cattle entering a processing facility, ARS scientists determined that when facilities experience a cluster of contamination events in a short time period, only one strain is generally responsible. The strains that tend to cause these clusters are also often more likely to be associated with human illness. This research suggests that alternative efforts to control this pathogen are needed.

NIFA-funded scientists at North Carolina A&T State University have discovered a way to remove up to 98 percent of the allergens in peanuts.

Development of Antibiotic Alternatives

Salmonella is a leading cause of bacterial foodborne disease. In the United States, more than 50 percent of the swine farms experience Salmonella contamination. On-farm interventions are needed to reduce the levels of Salmonella in swine production and limit the potential risk of foodborne disease in humans, but the widespread use of antibiotics leads to resistance. ARS researchers in Iowa have developed a vaccine to prevent Salmonella infection, and trial analysis indicates that swine vaccination reduces disease severity and gastrointestinal distress. Importantly, the new vaccine can still be used to differentiate infected from vaccinated animals.

Peanuts Made Safer

NIFA-funded scientists at North Carolina A&T State University have discovered a way to remove up to 98 percent of the allergens in peanuts. The process does not affect flavor, and treated peanuts can be eaten whole, in pieces, or as flour in various products. Officials expect hypoallergenic peanut products to hit store shelves soon.

New Resources for Food Processors

A NIFA-supported team of scientists and engineers led by Washington State University developed a new, faster, microwave-assisted pasteurization system that results in higher quality, safe foods with lower energy expenditures. NIFA also funded the discovery and DNA sequence characterization of five new *Listeria* isolates; this data may help to identify how *Listeria* survives so tenaciously and how it impacts other foodborne pathogens, for example, through transfer to other microorganisms of antimicrobial resistance genes.

* <http://www.cdc.gov/foodborneburden>

Goal 5: Food Safety

Agricultural Research Service	Totals
Peer-reviewed journal publications	303
Non-peer-reviewed Publications	63
Material Transfer Agreements ¹	45
Inventions	8
New incoming agreements ²	33

Economic Research Service	Totals
Peer-reviewed journal publications	3
Research monographs	1
New or Updated Data Products	1
Briefings ³	1
Federal Register Notices or other Government use ⁴	1
Responses to requests for research findings, information, or analysis by decisionmakers ⁵	27
Number of extramural grants awarded	2

National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	369
Research publications from Formula grants	1,142
Direct youth contacts by Extension	613,076
Direct adult contacts by Extension	918,433
\$\$ Leveraged from Formula grant projects	\$53M
Patent applications reported by Formula grant recipients	21
Extension Professional Full-Time Equivalents from Formula grants	246
Scientist years for Formula grant projects	121
Number of active extramural grant projects ⁵	438

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⁵ Requests for information, research findings, data, and analysis by decisionmakers in USDA, the Congress, and other Federal agencies.

ARS scientists found that using the antibiotic tetracycline to control *Salmonella* may play a role in increasing the virulence of multi-drug resistant strains, highlighting the need to develop alternative treatments for *Salmonella* and other bacterial diseases.



Goal 6

Education and Science Literacy

Background: The REE Mission Area and our partners recognize the importance of recruiting, cultivating, and developing the next generation of scientists, leaders, and a highly skilled workforce for food, agriculture, natural resources, forestry, environmental systems, and life sciences.

Selected Accomplishments

Agricultural Education and Teacher Training

NIFA funded more than 1,270 kits, videos, and engagement activities to be distributed to classrooms through 134 participants in the bioenergy and bioproducts educational training program, which also trained 10 interns, 19 Certified Master Teacher Trainers, and 112 Master Teachers. NIFA also continued collaboration (2012-2015) with South Mountain Community College, a Hispanic-Serving Institution in Phoenix, Arizona, that pairs ARS scientists with a high school teacher and students to conduct research projects and present results.

Direct Public Outreach:

Virginia Cooperative Extension agents provided food preservation trainings and support in over 54 counties, and University of Tennessee educators developed a food safety education curriculum for middle school students with interactive, research-based lessons that integrate science, social studies, math, language arts, and vocabulary. Across America, NIFA funded Annie's Project courses that provide women in agriculture with answers, business skills, friendship, and confidence. For example, in New York's Chautauqua County, 228 women, or 16 percent, are primary farm operators and don't have to go it alone, as Cornell Cooperative Extension facilitates Annie's Project in New York and offers a 6-week program in risk management, farm business planning, marketing, and more.

Facilitation of Cross-Disciplinary Learning:

The ARS National Agricultural Library publically launched a Web application called "VIVO" that USDA scientists and others can use to collaborate across discipline and locations, enabling easier access to agricultural expertise and research outcomes.

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Goal 6:
Education and Science Literacy

National Institute of Food and Agriculture	Totals
Extension publications from Formula grants	95
Research publications from Formula grants	294
Direct youth contacts by Extension	111,104
Direct adult contacts by Extension	460,573
\$\$ Leveraged from Formula grant projects	\$9M
Patent applications reported by Formula grant recipients	5
Extension professional Full-Time Equivalents from Formula grants	53
Scientist years for Formula grant projects	22
Number of active extramural grant projects ⁵	284

⁵ Requests for information, research findings, data, and analysis by decisionmakers in USDA, the Congress, and other Federal agencies.



Across America, NIFA funded Annie's Project courses that provide women in agriculture with answers, business skills, friendship, and confidence.

Goal 7

Rural-Urban Interdependence and Prosperity

Background: The REE Mission Area and other USDA agencies strive to provide effective research, education, and extension to inform public and private decisionmaking in support of rural and community development.

Selected Accomplishments

Wealth-Based Strategies for Rural Communities

ERS researchers co-edited and co-authored *Rural Wealth Creation*, a book published by Routledge Press that is the first major book on rural wealth creation. The book considers how different kinds of wealth provide opportunities for rural development and how wealth-based strategies can effect rural community growth.

Support and Resources for Rural Communities and Veterans

ERS analyzed costs to farmers prior to planting utilizing data from the ERS/NASS Agricultural Resource Management Survey (ARMS). This analysis informed the USDA Risk Management Agency (RMA) on future prevented planting crop insurance. Crop insurance is the leading source of Government support to farmers, and decisions regarding insurance provisions have substantial budgetary implications. ERS also performed research measuring the impact of investments in broadband Internet, which suggests that it promotes rural population growth. Also, the ARS National Agricultural Library developed new editions of online publications supporting rural communities and informing them of funding resources.

A team from the University of Arkansas used funding from NIFA's Beginning Farmer and Rancher Development Program to develop online educational modules and in-person training and mentoring to underserved groups. The team of university, non-profit, and USDA scientists trained approximately 300 veterans in the region, plus 650 veterans nationally through the Farmer Veteran Coalition. A total of 26,823 people used the online training—16,059 in English and 10,764 in Spanish.

A team from the University of Arkansas used funding from NIFA's Beginning Farmer and Rancher Development Program to develop online educational modules and in-person training and mentoring to underserved groups.

Goal 7:
Rural-Urban Interdependence and Prosperity

Economic Research Service

Peer-reviewed journal publications	22
Research Monographs	6
New or updated data products	9
Briefings ³	10
Federal Register Notices or other Government use ⁴	18
Responses to requests for research findings, information, or analysis by decisionmakers ⁵	73
Number of extramural grants awarded	4

National Institute of Food and Agriculture

Extension publications from Formula grants	1,103
Research publications from Formula grants	3,409
Direct youth contacts by Extension	9,900,113
Direct adult contacts by Extension	8,839,889
\$\$ Leveraged from Formula grant projects	\$79M
Patent applications reported by Formula grant recipients	63
Extension Professional Full-Time Equivalents from Formula grants	2,885
Scientist years for Formula grant projects	204
Number of active extramural grant projects ⁵	1,068

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⁵ Requests for information, research findings, data, and analysis by decisionmakers in USDA, the Congress, and other Federal agencies.

ERS researchers co-edited and co-authored Rural Wealth Creation, a book published by Routledge Press that is the first major book on rural wealth creation.





2014 Progress and Achievements



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