



Research, Education, and Economics Mission Area Action Plan 2012 Annual Progress Report

Preface

Agriculture and natural resources are at the crossroads of the world's most critical problems: establishing sustainable food production, providing clean and abundant water, responding to climatic variability, developing renewable energy, improving human health, and strengthening food safety. From fostering continued economic growth to adapting to the effects of climate change and addressing food security, the United States can continue to be a leader in global agriculture. Yet, the challenges facing agriculture, natural resources, and conservation are immense and need to be addressed using a robust research enterprise and educational programs.

The purpose of the REE Action Plan is to identify and outline focused efforts in mission-critical core areas. This focus enables a shared vision for USDA science across the Department. These priorities are clearly linked—in science, nature, and through the multitude of goods and services produced on our Nation's working lands. These linkages between priority areas reflect the inherent complexity of agricultural systems and highlight our need for even more interdisciplinary investigations as we move forward.

It was a particularly fruitful year. The National Agricultural Statistics Service (NASS) released over 400 statistical reports, providing timely, accurate, and useful statistics in service to U.S. agriculture. The Agricultural Research Service (ARS) released 17 new plant cultivars and filed 137 new invention disclosures, demonstrating tangible research results. The Economic Research Service (ERS) published 127 ERS reports and released 162 new or updated data products on the ERS Web site for public use. The National Institute of Food and Agriculture (NIFA) administered over \$1 billion of congressionally appropriated funds to projects and partners across the Nation to focus on the mission-critical goals identified in the Action Plan.

Drafting the first annual report of the REE Action Plan brought to light several areas to strengthen in terms of data management and reporting.

USDA now participates in STAR METRICS, an interagency initiative with the National Institutes of Health (NIH), the National Science Foundation (NSF), the Environmental Protection Agency (EPA), and the Department of Energy (DOE) that is developing new approaches to document Federal scientific investments and their impacts. STAR METRICS integrates project- and award-level data at both Federal agencies and extramural partners, allowing a comprehensive accounting of Federal research. This data platform will enable new tools for analysis of investments by region and topic, with links to publications, patents, scientific workforce development, and technology commercialization. As STAR METRICS develops, these tools will provide empirical evidence of progress toward REE Action Plan goals.

Additionally, NIFA is preparing to launch a new reporting system, which will gather outputs set by the Research Performance Progress Report (RPPR) for government-wide research grants. These standard outputs—including publications, patents and plant variety protection, and other product types such as audio or video, databases, data and research material, educational aids or

curricula, evaluation instruments, models, physical collections, protocols, software or netware, survey instruments, and new germplasm—will be captured in the Research, Education, and Economic Information System (REEIS) so NIFA can report on them annually.

The REE Action Plan will be reviewed and evaluated for continued relevancy on an ongoing basis. Periodic reviews will ensure that the plan addresses the appropriate priority areas as well as necessary foundational research.

I am pleased to share our progress and notable accomplishments resulting from the first full year of strategic and coordinated efforts focused on priority areas since the release of the REE Action Plan. I emphasize that this is not a comprehensive list of every achievement but, rather, a very small sampling of several significant accomplishments for each goal.

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Highlights and Progress From 2012:

Goal 1. Local and Global Food Supply and Security

Goal 1A. Crop and Animal Production

The Research, Education, and Economics (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; identifies alternative feed and forage options for animal systems that do not compete for human food and energy needs; and develops and populates a framework for understanding the sustainability outcomes of agriculture/food/forestry practices.

Goal 1A. Crop and Animal Production by the Numbers	
Agricultural Research Service:	
<ul style="list-style-type: none"> • 245 publications • 19 Material Transfer Agreements¹ 	<ul style="list-style-type: none"> • 15 inventions • 39 new incoming agreements²
Economic Research Service:	
<ul style="list-style-type: none"> • 21 publications • 8 new or updated data products 	<ul style="list-style-type: none"> • 3 briefings³ • 1 Federal Register Notices and/or other government use⁴
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 620 Extension publications from Formula grants • 2,337 research publications from Formula grants • \$605M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 7,090,652 direct adult contacts by Extension • 695,487 direct youth contacts by Extension
<p>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.</p> <p>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.</p> <p>³ Briefings are for senior USDA staff, Congressional staff, or other Federal Agencies.</p> <p>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.).</p>	

Highlights:

- Agricultural Research Service (ARS) scientists developed a new control strategy using RNA interference (RNAi) technology to protect bees against Israeli acute paralysis virus infections (a pathogen suspected of being linked to Colony Collapse Disorder). Worldwide, this was the first large-scale field proof-of-concept use of RNAi for bee disease control. This technology opens a new approach to pest control based on insect genomics.
- Meeting growing global demand for food, fiber, and biofuel requires robust investment in agricultural research and development (R&D) from both public and private sectors. Two related ERS reports—food manufacturing and biofuel—examine global R&D spending by private industry in seven agricultural input sectors and describe the changing structure of these industries. In 2007 (the latest year for which comprehensive estimates are available), the private sector spent \$19.7 billion on food and agricultural research and accounted for about half of total public and private spending on food and agricultural



R&D in high-income countries. The private sector performed 53 percent of total food and agricultural research in the United States; over the long term, privately funded R&D has grown faster than publicly funded R&D. Public sector funders and performers of R&D play a largely complementary role by emphasizing social returns in the selection of research topics and valuing rapid and widespread disclosure of new knowledge.

- ARS scientists developed a method to recover phosphorus from animal waste in a concentrated form. The recovered phosphorus is effective as a fertilizer source when applied to land as small particles. It 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 large animal feeding operations. Recycling manure phosphorus will lengthen the duration of the world's finite supply of minable phosphorus.
- ARS scientists generated the first comprehensive nutrient accumulation dataset for establishing highbush blueberry. The dataset begins with information from planting and continues through fruit harvest. This research was the basis for a useful tool for developing efficient fertilizer management practices during the critical stage of field establishment. Adoption of these guidelines will help protect the environment from unneeded or poorly timed nutrient applications.



Goal 1. Local and Global Food Supply and Security

Goal 1B. Crop and Animal Health

The REE Mission Area invests in research, development, and outreach of new varieties and technologies to mitigate animal/plant diseases and increase productivity, sustainability, and product quality. An additional focus is to establish more sustainable systems that enhance crop and animal health.

Goal 1B. Crop and Animal Health by the Numbers	
Agricultural Research Service:	
<ul style="list-style-type: none"> • 265 publications • 20 Material Transfer Agreements¹ 	<ul style="list-style-type: none"> • 18 inventions • 55 new incoming agreements²
Economic Research Service:	
<ul style="list-style-type: none"> • 3 publications • 0 new or updated data products 	<ul style="list-style-type: none"> • 0 briefings³ • 0 Federal Register Notices and/or other government use⁴
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 362 Extension publications from Formula grants • 1,365 research publications from Formula grants • \$647M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 4,482,343 direct adult contacts by Extension • 295,652 direct youth contacts by Extension
<p>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.</p> <p>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.</p> <p>³ Briefings are for senior USDA staff, Congressional staff, or other Federal Agencies.</p> <p>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.).</p>	

Highlights:

- In collaboration with the Animal and Plant Health Inspection Service (APHIS), ARS researchers developed a diagnostic test to detect Pseudorabies in feral swine. The test was transferred to APHIS and State diagnostic laboratories. The diagnostic test provided the means for implementing a national Pseudorabies surveillance program.
- The U.S. Veterinary Immune Reagent Network was established as a collaborative activity between NIFA and ARS to systematically address the immunological reagent gap for the U.S. veterinary immunology research community. These veterinary immune reagents are used to speed vaccine and diagnostic development, to evaluate changes during disease and following vaccination, and to manipulate immune system cells to ascertain their roles in protective immunity, as well as in immunopathology.
- ARS researchers developed a set of smartphone applications for determining spray system performance. The apps have each been downloaded 1,300 times from users in 45 countries. User-friendly interface makes the information more useful to a diverse



audience. Efficient spray systems are able to protect crops and animals while minimizing the potential for off-target drift.

- A NIFA Agriculture and Food Research Initiative (AFRI) grant was funded to coordinate national research to systematically develop the knowledge needed to detect and manage citrus greening (Huanglongbing, HLB). The multidisciplinary project involves collaborators from ARS, citrus industry groups, academia, and State departments of agriculture. The vector of the plant pathogen and that of the plant pathogenic bacterium have been sequenced, providing targets for RNAi and diagnostics. The more sensitive diagnostic tests available now can detect even a single cell of the pathogen. Information gained from the team's research resulted in insecticide application efficacy for the HLB disease vector, leading to areawide HLB management in Florida. APHIS and State departments of agriculture used epidemiological methods for HLB sampling following the first positive detections of it in Texas and California. Early detection is the first step in reducing the spread of HLB.
- A report published in 2012 by STAR-IDAZ (a global network for animal disease research) recognized USDA as the worldwide leader in published research 2006-2010 (the time frame examined) in the areas of salmonellosis, avian influenza, and mycobacterial animal diseases.



Goal 1. Local and Global Food Supply and Security

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

The REE Mission Area generates new fundamental knowledge through research in genomic sciences and applications of systems approaches required to enhance the sustainability of agriculture while increasing productivity.

Goal 1C. Crop and Animal Genetics, Genomics, Genetic Resources, and Biotechnology by the Numbers	
Agricultural Research Service:	
<ul style="list-style-type: none"> • 736 publications • 216 Material Transfer Agreements¹ 	<ul style="list-style-type: none"> • 31 inventions • 114 new incoming agreements²
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 154 Extension publications from Formula grants • 580 research publications from Formula grants • \$289M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 1,074,940 direct adult contacts by Extension • 66,439 direct youth contacts by Extension
<p>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.</p> <p>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.</p>	

Highlights:

- Scientists sequenced two tomato genomes, providing a foundation for understanding the molecular and genetic basis of key traits, particularly how the tomato has diversified and adapted to new environments. Researchers are discovering the relationships between tomato genes and traits, i.e. ripening and nutritional composition. The sequenced genome broadened the understanding of how genetics and environmental factors interact to determine a field crop's health and viability.
- The Triticeae Coordinated Agricultural Project (TCAP), funded by NIFA, merged two large communities of U.S. barley and wheat breeders, researchers, and educators across 21 States and developed an integrated plant breeding education network to train the next generation of modern plant breeders. New genotyping and phenotyping tools have resulted in a comprehensive characterization of the natural variation available in the wheat and barley core germplasm collections at the USDA-ARS National Small Grains Collection. Breeders are using the data to develop new varieties and germplasm to increase productivity.
- A multidisciplinary team of scientists funded by NIFA sequenced the wheat genome. The team included researchers from ARS and multiple universities. The wheat genome sequence provides the tools and foundation for enhancing global food security by accelerating new wheat variety development, increasing yields, enhancing nutritional value, increasing disease and pest resistance, and enabling the genetic analysis of target traits.



- NIFA supported a multidisciplinary project involving ARS, industry, and academic collaborators who genetically mapped sorghum grain quality. Starch is one of the most important grain qualities in cereals that provide the basis of subsistence for the world population. The analysis distinguished five sorghum subpopulations that differed in kernel hardness, acid detergent fiber, and total digestible nutrients. The knowledge created from this research can complement breeding efforts to improve sorghum's end-use value. Genetic mapping of sorghum can be further used by breeders to improve grain quality including kernel hardness, which affects grain mold resistance; grain storage ability; insect resistance; milling behavior; flour particle size; cooking properties; and other characteristics.
- Three multidisciplinary teams funded by NIFA are studying feed efficiency (FE) in beef cattle, dairy cattle, and swine. ARS, university, and industry researchers are working cooperatively to improve FE with reduced greenhouse gas emissions to not only address global food security but also climate change. Feed efficiency is one of the major concerns for sustainability and profitability of animal agriculture. Researchers collected phenotypes and estimated molecular breeding values. They identified an association between certain cell proteins and greenhouse gas emissions and FE. The dairy cattle team established decision support tools for determining the benefits of nutritional grouping on farms and shared these results with farmers. The swine team also examined the ability of animal with high FE to cope with behavioral, physiological, and immunological stressors. The valuable scientific data generated from these three FE projects serves to genetically identify animals with high and low FE. The education and extension materials developed will aid farmers in making decisions about dairy, beef, and swine metabolism and diet, and further efforts to gain competitive advantage for U.S. companies in the global market.



Goal 1. Local and Global Food Supply and Security

Goal 1D. Crop and Animal Consumer and Industry Outreach, Policy, Markets, and Trade

The REE Mission Area focuses on characterizing and evaluating market performance and the provision of market information in domestic and international markets that affect producer production and marketing decisions in agriculture’s food, fiber, and energy sectors.

Goal 1D. Crop and Animal Consumer and Industry Outreach, Policy, Markets, and Trade by the Numbers	
Economic Research Service:	
<ul style="list-style-type: none"> • 138 publications • 139 new or updated data products 	<ul style="list-style-type: none"> • 24 briefings¹ • 21 Federal Register Notices and/or other government use²
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 579 Extension publications from Formula grants • 2,186 research publications from Formula grants • \$123M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 4,035,404 direct adult contacts by Extension • 1,310,858 direct youth contacts by Extension
¹ Briefings are for senior USDA staff, Congressional staff, or other Federal Agencies. ² 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.).	

Highlights:

- ERS published monthly outlook analyses and data products for major commodities. Public and private sector decisionmakers benefitted from timely, accurate, and complete information on the performance of U.S. and global agricultural markets. USDA and ERS agricultural outlook information is a primary source of market information for public and private sector decisionmakers around the world.
- ERS published estimates and analyses of food-insecure populations in the United States and 76 developing countries. Estimates show that global food security improved slightly in 2012 as the number of food-insecure people in the 76 developing countries declined from 814 million in 2011 to 802 million in 2012. National and international policymakers received objective estimates of food security status and issues. Quantitative estimates and methods are shared and reviewed by multiple audiences. ERS contributed to comprehensive review of food balance data behind Food and Agriculture Organization (FAO) hunger and food security estimates.
- USDA publishes the World Agricultural Supply and Demand Estimates (WASDE) to inform U.S. market participants about current and forecasted market conditions related to trade, consumption, prices, and stocks. ERS research showed that markets place a high value on the situation and outlook information published in WASDE.



Goal 2. Responding to Climate and Energy Needs
Goal 2A. Responding to Climate Variability

The REE Mission Area develops and delivers science-based knowledge that empowers farmers, foresters, ranchers, landowners, resource managers, policymakers, and Federal agencies to manage the risks, challenges, and opportunities of climate variability, and positions decisionmakers to reduce emissions of atmospheric greenhouse gases and enhance carbon sequestration.

Goal 2A. Responding to Climate Variability by the Numbers	
Agricultural Research Service:	
<ul style="list-style-type: none"> • 84 publications • 1 Material Transfer Agreements¹ 	<ul style="list-style-type: none"> • 0 inventions • 6 new incoming agreements²
Economic Research Service:	
<ul style="list-style-type: none"> • 9 publications • 0 new or updated data products 	<ul style="list-style-type: none"> • 1 briefing³ • 0 Federal Register Notices and/or other government use⁴
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 290 Extension publications from Formula grants • 1094 research publications from Formula grants • \$145M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 1,692,537 direct adult contacts by Extension • 183,776 direct youth contacts by Extension
<p>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.</p> <p>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.</p> <p>³ Briefings are for senior USDA staff, Congressional staff, or other Federal Agencies</p> <p>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.).</p>	

Highlights:

- The GRACenet project team developed a greenhouse gas (GHG) emissions data management system and continued work on GHG model development. Basic data on GHG emissions was acquired on different agricultural systems at 33 locations across the United States. A synthesis of 5 years of research on GHG emissions and carbon sequestration in agriculture was completed, providing the scientific basis for policy decisions on GHG management.
- The National Agricultural Statistics Service (NASS) released a new vegetation condition portal named VegScape <http://nassgeodata.gmu.edu/VegScape> for monitoring crops in this time of highly variable growing conditions. Vegetation indices contained in VegScape have proven useful for assessing crop condition and identifying the aerial extent of floods, drought, major weather anomalies, and vulnerabilities of early/late season crops. Thirteen years of data for the indexes from the National Aeronautics and Space Administration’s (NASA) Moderate Resolution Imaging Spectroradiometer (MODIS) satellite has been loaded into VegScape. This tool will allow users to monitor



and track weather anomalies' effects on crops in near real time and compare this information to historical data a localized levels or across States.

- ARS researchers and collaborators developed algorithms for remote sensing of hydrologic cycle elements such as soil moisture. Water loss via evapotranspiration (ET) and drought mapping via satellite data are currently running in test mode for the National Integrated Drought Information System (NIDIS). Algorithms for mapping soil moisture via imagery were improved and tested for an upcoming NASA satellite system launch. The extent of the U.S. 2012 drought was mapped throughout the year using satellite data. A new, automated tool for mapping landscape water use provides decisionmaking criteria for water management at local and regional scales that is accessible on the Web.
- An ERS study of the effects of increases in average temperatures worldwide suggests that, while impacts are highly sensitive to uncertain climate projections, farmers have considerable flexibility to adapt to changes in local weather, resource conditions, and price signals by adjusting crops, rotations, and production practices. Such adaptation, using existing crop production technologies, can partially mitigate the impacts of climate change on national agricultural markets. Adaptive redistribution of production, however, may have significant implications for both regional land use and environmental quality.
- Working with multiple collaborators, NIFA-funded ecology researchers presented the initial draft genome sequence of the loblolly pine, an important conifer species that can aid in climate change mitigation. The researchers have launched a region-wide internship program at forestry schools to prepare students to address climate change mitigation and adaptation issues in southern pine forests. Extension programs are developing guidelines to help growers understand where to plan loblolly pine seed sources given future climate scenarios. The projects are on track to produce the fundamental knowledge and the extension and education programs that will increase greenhouse gas sequestration through improved forestry management.
- Since its establishment, the NIFA Climate Variability and Change Challenge Area under the AFRI Program has funded various projects in climate adaptation and mitigation, impacts on animal health and production, reduction of greenhouse gas emissions, and increasing carbon sequestration. Additionally, the restructuring of the program encouraged large, integrated, trans-disciplinary projects focused on best management practices and development of advanced food, feed, and fiber production systems and new plant cultivars and animal breeds adapted to changing climates. Most recently, in 2012, NIFA started collaborations with the National Science Foundation (NSF) on two joint programs: (1) Water Sustainability and Climate and (2) Earth System Modeling. Interagency cooperation can accelerate the advancement of complex research topics by providing opportunities for large scientific and institutional collaboration, while minimizing or eliminating duplicating efforts.



Goal 2. Responding to Climate and Energy Needs
Goal 2B. Bioenergy/Biofuels and Biobased Products

Together with 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.

Goal 2B. Bioenergy/Biofuels and Biobased Products by the Numbers	
Agricultural Research Service:	
<ul style="list-style-type: none"> • 1 publications • 0 Material Transfer Agreements¹ 	<ul style="list-style-type: none"> • 0 inventions • 1 new incoming agreement²
Economic Research Service:	
<ul style="list-style-type: none"> • 12 publications • 2 new or updated data products 	<ul style="list-style-type: none"> • 0 briefings³ • 1 Federal Register Notices and/or other government use⁴
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 95 Extension publications from Formula grants • 357 research publications from Formula grants • \$63M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 335,681 direct adult contacts by Extension • 86,157 direct youth contacts by Extension
<p>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.</p> <p>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.</p> <p>³ Briefings are for senior USDA staff, Congressional staff, or other Federal Agencies⁴ 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.).</p>	

Highlights:

- The Biomass Research and Development Initiative (BRDI), funded by NIFA, continued to fill a significant gap in the continuum of technology development and commercialization supported by USDA and other Federal programs. Fourteen new jobs were created, five undergraduate summer interns were hired, and over 100 undergraduate students were educated at participating universities. Projects demonstrated success optimizing the fermentation processes for wood sugar. Microchannel hydroprocessing—adding hydrogen via thousands of tiny channels in the presence of a solid catalyst—improved the efficiency of gas to liquid conversion by up to 20 times. Increased conversion efficiency means producers can generate a greater volume of liquid fuel while reducing the size of the chemical reaction hardware. Scientists also developed new varieties of willow that increase biomass yields by 38 percent over older varieties.
- The NIFA Agriculture and Food Research Initiative (AFRI) program funded several multi-institutional, multi-disciplinary Coordinated Agriculture Project (CAP) grants in bioenergy. One project team quantified the energy required to harvest switchgrass and other perennial grasses using two different methods. They determined feedstock physical and chemical parameters and developed protocols for safely handling biochar for



horticultural applications. Upon completion, this project will lead to the low input establishment of switchgrass and other regional perennial grasses as buffer zones surrounding traditional row crop production and on land less suitable for row crop production in central United States.

- A NIFA AFRI CAP project team successfully developed a working model for the conversion of biomass to a gaseous form, which is being integrated into a general thermochemical biorefinery process model. Thermochemical biorefineries convert solid biomass and its residues to fuels, chemicals, and power. The researchers developed a system that monitors carbohydrate quantity and quality during batch and continuous biorefinery operations. A database compiles information on species, genetics, site characteristics, chemical data, physical properties, and performance traits. It also provides searchable access to all raw spectral data and other metadata. Upon completion, the project will lead to the low input establishment of switchgrass and purpose-grown trees in southeastern United States, which will be converted to biobased fuels for use by the aviation and automobile industries.
- ERS modeling tools and analyses have served as the basis for understanding the specific economic and environmental tradeoffs associated with increased bioenergy production. For example, an ERS study provided an overview of how the Renewable Identification Number (RIN) market works to ensure compliance with the Renewable Fuel Standard provision of the Energy Independence and Security Act, as well as how RIN prices are determined and which factors influence their prices.
- In collaboration with industry and university partners, Forest Service (FS) R&D continues to identify and develop sustainable woody biomass production systems while improving forest health and productivity, and to effectively integrate knowledge about sustainable bioenergy production systems. Researchers developed soil amendments to compensate for biomass removal impacts on soil properties, biological diversity, and tree growth. They studied potential for fast pyrolysis to produce bio-oil and biochar from woody residues. They quantified carbon relationships in short rotation woody crop systems. Cooperative research with industry and university partners resulted in significant results that contributed to the best management of forests for bioenergy production.



Goal 3. Sustainable Use of Natural Resources
Goal 3A. Water Availability: Quality and Quantity

The REE Mission Area develops and provides the best available science and technology to inform decisionmaking and improve practices on water conservation, use, and quality by fostering a watershed/landscape-scale approach that encourages place-based agricultural water management.

Goal 3A. Water Availability: Quality and Quantity by the Numbers	
Agricultural Research Service:	
<ul style="list-style-type: none"> • 225 publications • 0 Material Transfer Agreements¹ 	<ul style="list-style-type: none"> • 1 inventions • 43 new incoming agreements²
Economic Research Service:	
<ul style="list-style-type: none"> • 5 publications • 0 new or updated data products 	<ul style="list-style-type: none"> • 0 briefings³ • 0 Federal Register Notices and/or other government use⁴
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 193 Extension publications from Formula grants • 729 research publications from Formula grants • \$82M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 1,271,206 direct adult contacts by Extension • 213,404 direct youth contacts by Extension
<p>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.</p> <p>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.</p> <p>³ Briefings are for senior USDA staff, Congressional staff, or other Federal Agencies.</p> <p>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.).</p>	

Highlights:

- ARS launched the Long Term Agro-ecosystem Research (LTAR) network consisting of 10 of its existing agricultural production, watershed, rangeland, and other landscape-scale experimental sites across the country. Using historical data from these platform sites, as well as agricultural production and environmental data to be obtained from new long-term and coordinated experiments using common research protocols on all the sites, improved and optimized management practices will be formulated for sustainable agricultural production across different regions of the United States.
- In collaboration with the Natural Resources Conservation Service (NRCS), a conservation practice (blind inlet) was developed to reduce agricultural pollutant discharges from upper Midwestern glacial landscapes characterized by the presence of potholes. Research led to the development of this new alternative conservation practice, with the potential to reduce nitrogen losses by 50 percent and phosphorus losses by 78 percent. NRCS in Indiana now offers blind inlets as a cost-sharable practice through the Environmental Quality Incentives Program (EQIP). Using this new practice will reduce



nitrogen and phosphorus losses from Midwestern glacial landscapes that include farmed potholes.

- ARS continues to improve understanding of the aggregate effects of conservation practices at the watershed scale. Scientists quantified the adoption level of a special EQIP practice needed to reduce atrazine pesticide concentrations at the watershed scale. Every dollar spent by NRCS in EQIP practice incentives results in a \$2.04 savings for the City of Columbus's (OH) downstream water treatment facility. As a result of this research, NRCS used EQIP to incentivize operators working in a drinking supply reservoir watershed to adopt one of four practices aimed at reducing atrazine concentrations. Atrazine concentrations in the drinking water reservoir were significantly reduced.
- Cooperative Extension-affiliated volunteer monitoring programs engaged citizens in water monitoring to better understand the effects of climate change and/or aquatic invasive species on local waters. Collectively, these programs interacted with hundreds of local, State, and Federal partners. The programs help citizens detect the presence of invasive species and harmful algal blooms. Volunteers educate the public on health concerns related to water quality and invasive species and offer information on how to help minimize further spread of invasive species. Programs addressing aquatic invasive species and climate change reported 308,794 hours of service by volunteers in 2011. At \$21.79 per hour, the program's value exceeds \$6.7 million in effort.
- Markets for farm-based environmental services are designed to allow farmers to sell "credits" for environmental improvements in water quality, carbon sequestration, wetlands restoration, and other areas. These markets use an environmental baseline to help determine whether proposed improvements qualify for market credits and, if so, the number of credits that should be awarded. An ERS study examined the issues involved in measuring baselines, the strengths and weaknesses of alternative types of baselines, and the tradeoffs involved when selecting a baseline to measure environmental improvement.
- In 2012, Project NEMO (Nonpoint Education for Municipal Officials), funded by NIFA, conducted watershed pollution education training for 18 States. To date, 30 States have geospatial information system (GIS)-based watershed planning for low-impact development to reduce stormwater and erosion. Seven States set stormwater pollution policies.



Goal 3. Sustainable Use of Natural Resources
Goal 3B. Landscape-Scale Conservation and Management

In collaboration with USDA sister agencies such as the Forest Service’s Research and Development 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 our Nation’s working farms, ranches, and forests.

Goal 3B. Landscape-Scale Conservation and Management by the Numbers	
Agricultural Research Service:	
<ul style="list-style-type: none"> • 35 publications • 0 Material Transfer Agreements¹ 	<ul style="list-style-type: none"> • 0 inventions • 0 new incoming agreements²
Economic Research Service:	
<ul style="list-style-type: none"> • 7 publications • 1 new or updated data products 	<ul style="list-style-type: none"> • 0 briefings³ • 0 Federal Register Notices and/or other government use⁴
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 436 Extension publications from Formula grants • 1,644 research publications from Formula grants • \$296M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 2,130,353 direct adult contacts by Extension • 306,591 direct youth contacts by Extension
<p>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.</p> <p>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.</p> <p>³ Briefings are for senior USDA staff, Congressional staff, or other Federal Agencies.</p> <p>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.).</p>	

Highlights:

- Based on research and modeling efforts, work was undertaken with technology transfer partners with the Forest Service and NRCS to develop user-friendly tools to assist in upland and riparian buffer placement within fields, landscapes, and watersheds to enhance their water quality functions. The tools provide more efficient delivery of conservation investment for, and enhanced delivery of, water quality services provided.
- USDA and Agri-Food Canada (AAFC) established a Memorandum of Understanding to increase cooperation between the USDA National Agroforestry Center and the AAFC Agroforestry Development Centre on research and development regarding climate-change integrated agroforestry strategies for supporting climate-ready agricultural operations and landscapes. Incorporation of agroforestry into the suite of climate-change integrated strategies for agriculture provides producers with an additional means to build a more climate-ready agricultural operation, meeting the multiple demands for production of crops and ecosystem services, along with adaptation and greenhouse gas mitigation.



- The Rangeland Hydrology and Erosion Model tool was implemented. This tool was used by USDA ARS and NRCS to estimate runoff and erosion rates on non-Federal rangelands in the 17 western States and to provide maps of which place-based areas to reduce soil loss would be most cost-effective. The work was incorporated into the USDA Resource Conservation Assessment report.
- ERS examined the linkages between direct payments—a type of farm commodity program payment—and economic incentives for compliance with conservation or wetland provisions in farm legislation. An ERS study found that compliance incentives would be reduced on many farms, potentially increasing environmental quality problems, if direct payments were sharply reduced or eliminated. Some farmers would still be subject to compliance through existing Federal agricultural programs (e.g., conservation or disaster programs) or programs that may succeed direct payments.
- The Western Rangelands Partnership and International Arid Lands Consortium, partially funded by NIFA, redesigned and developed Web portals for rangeland professionals in an effort to increase global Web presence. The revised and retooled Web portal—Rangelands West—is linked to 19 State-based sites assembled by State cooperative extension specialists and subject matter librarians. The portal has strengthened the relationship between university extension and library personnel and provided an extensive rangeland reference. The Rangelands West portal links international rangeland information with more than 10,000 full-text articles and has created a new stakeholder audience.



Goal 4. Nutrition and Childhood Obesity

The REE Mission Area builds the evidence base for food-based and physical activity strategies and develops effective education/extension translational activities to promote health and reduce malnutrition and obesity in children and high-risk populations.

Goal 4. Nutrition and Childhood Obesity by the Numbers	
Agricultural Research Service:	
<ul style="list-style-type: none"> • 64 publications • 0 Material Transfer Agreements¹ 	<ul style="list-style-type: none"> • 0 inventions • 0 new incoming agreements²
Economic Research Service:	
<ul style="list-style-type: none"> • 32 publications • 5 new or updated data products 	<ul style="list-style-type: none"> • 9 briefings³ • 6 Federal Register Notices and/or other government use⁴
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 848 Extension publications from Formula grants • 3,200 research publications from Formula grants • \$241M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 8,221,023 direct adult contacts by Extension • 9,370,107 direct youth contacts by Extension
<p>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.</p> <p>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.</p> <p>³ Briefings are for senior USDA staff, Congressional staff, or other Federal Agencies.</p> <p>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.).</p>	

Highlights:

- ARS evaluated school characteristics associated with healthier or less healthy food preparation practices and offerings and found that the school nutrition environment could be improved by requiring food service managers to hold nutrition-related college degrees and/or to pass a food service training program, and by participating in a school-based nutrition program such as USDA Team Nutrition.
- Researchers at ARS studied the influence of eating breakfast in children 8-11 years of age on doing mental arithmetic and showed that greater mental effort is required for mathematical thinking in children who skipped breakfast. Children who ate breakfast got significantly more problems correct and solved them faster. These results justify the availability of school breakfast in the USDA school meals programs.
- Funding from NIFA helped set children of the Salish, Ksanka, and Qlispe Tribes on a lifetime of fitness by teaching them traditional outdoor sports, combined with nutritionally sound diet information grounded in American Indian philosophy and culture. It is critical to set these patterns of health early—at the preschool to kindergarten level. A 1994 Land Grant Extension established in 2011 began with five participating schools, and the number of participating schools more than doubled in the first year.



Since then, the program has grown from 12 Head Start programs and 200 youths to over 1,300 youths and 381 adults. The schools have seen the difference the program has made on learning. As a result, a full-time wellness instructor has been hired at Head Start to build upon this Extension effort and ensure the activities can continue. Other youth programs have joined the effort, expanding the initial project's reach.

- ERS research on the costs of healthy foods demonstrated that when costs were estimated on the basis of average portion size, healthy foods were affordable compared with foods high in saturated fat, added sugars, and/or sodium. ERS research showed that the SNAP program significantly improved the well-being of low-income households, especially those with children.
- Researchers at ARS completed a longitudinal study of infants fed exclusively breast milk, soy formula, or cow's milk formula for 6 months and evaluated development of mental, motor, and language development 4 times in first year of life. They found that breastfeeding is slightly better, and the two formulas were equivalent and within the normal range for all outcomes. This result is critical to building the evidence base for dietary guidance in the birth to 24 months age range, which will be added to Dietary Guidelines for Americans in 2020.
- ERS research conducted in partnership with the ERS-FNS-supported Cornell Center for Behavioral Economics in Child Nutrition Programs and other grantees has led to new strategies for increasing students' consumption of healthy foods at school and decreased plate waste, with potential for improving child health and reducing childhood obesity.



Goal 5. Food Safety

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

Goal 5. Food Safety by the Numbers	
Agricultural Research Service:	
<ul style="list-style-type: none"> • 363 publications • 63 Material Transfer Agreements¹ 	<ul style="list-style-type: none"> • 18 inventions • 41 new incoming agreements²
Economic Research Service:	
<ul style="list-style-type: none"> • 8 publications • 0 new or updated data products 	<ul style="list-style-type: none"> • 0 briefings³ • 4 Federal Register Notices and/or other government use⁴
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 260 Extension publications from Formula grants • 983 research publications from Formula grants • \$60M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 665,300 direct adult contacts by Extension • 853,218 direct youth contacts by Extension
<p>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.</p> <p>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.</p> <p>³ Briefings are for senior USDA staff, Congressional staff, or other Federal Agencies.</p> <p>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.).</p>	

Highlights:

- Interdisciplinary research led by an ERS economist is updating the ERS estimates of the annual costs of foodborne illness using previous research conducted by other economists on cost of illnesses and quality-adjusted life year losses in the United States due to 14 foodborne pathogens compatible with Centers for Disease Control and Prevention (CDC) disease incidence estimates. The Food Safety and Inspection Service (FSIS) has updated its estimates of the burden of foodborne illnesses for use in policy analysis, based on the ERS work as well as the CDC incidence estimates. FSIS is citing this research in their estimates of the benefits of new food safety rules.
- Researchers completed the Listeria Market Basket Survey Phase 1. Data showed that in ready-to-eat foods (RTE), *Listeria monocytogenes* (Lm) levels are appreciably lower than those seen a decade ago. Data collected on prevalence and levels of Lm in RTE foods will be considered, along with other data, in the updated risk-ranking of RTE foods. The data suggest that science-based control procedures instituted and attendant advancements made by food safety professions in government, industry, and academia have effectively contributed to lowering Lm contamination in high-risk, high-volume RTE foods over the past decade.



- NIFA supported a research project to commercialize a diagnostic platform for detecting viruses and bacteria. The microarray-based diagnostic platform is capable of detecting viruses and bacteria simultaneously. In collaboration with the Food and Drug Administration's (FDA) Center for Food Safety and Applied Nutrition (CFSAN), pilot scale studies were conducted and the detection assay successfully discriminated between pathotypes and serotypes. Researchers shared results of the project with the Food Emergency Response Network and the Department of Defense. Development of detection technologies results in a safer food supply through identification of food contamination before the food reaches the consumer.
- ARS scientists, in collaboration with FDA, NASA, and industry researchers, collected data over a 2.5-year period in the Salinas Valley of California to show the prevalence of enteric pathogens in fresh produce. Scientists conducted a survey of the Salinas watershed for the presence of enteric bacterial and viral pathogens. The survey provided data for a predictive geospatial risk assessment model (PGRAM). The data collected indicates substantial differences in the prevalence of different pathogens with a definite correlation to sampling region and date. The information provides the industry and public health agencies with valuable epidemiological data for risk assessment of these pathogens from this important United States agricultural region.
- The NIFA-AFRI program provided funds to a multi-disciplinary Coordinated Agricultural Project (CAP) grant in 2012 for ongoing research, education, and extension strategies in addressing the top seven Shiga toxin-producing *Escherichia coli* (STEC) and O101:H4 bacteria. The research team, comprised of land grant institutions, private colleges and universities, Federal researchers, and industry researchers, recently discovered a potential strategy for combating future infections of pathogenic *E. coli*. A standard set of non-O157:H7 STECs were developed, stored, and shared with collaborating researchers. Standardized reagents are being used across STEC collaborators to ensure meaningful and comparative results of farm-to-fork fate and transmission studies.



Goal 6. Education and Science Literacy

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, and environmental systems, and life sciences.

Goal 6. Education and Science Literacy by the Numbers

National Institute of Food and Agriculture:

- 46 Extension publications from Formula grants
- 174 research publications from Formula grants
- \$11M leveraged from Formula grant projects
- 192,190 direct adult contacts by Extension
- 79,437 direct youth contacts by Extension

Highlights:

- The 4-H Science Youth Engagement, Attitudes and Knowledge (YEAK) survey was conducted to measure various aspects of youth engagement in 4-H science programs. The YEAK study found that 4-H Science has a positive impact on youth interest and engagement in STEM-related programs. Respondents to the survey reported having high educational aspirations, and more than 80 percent indicated that they intended to finish college or pursue post-baccalaureate education.
- The NIFA interagency agreement with the U.S. Fish and Wildlife Service leverages technology and innovation and involves youth in STEM outreach and exposure. Youth participants developed science process skills related to using GIS and research design, analyzing and interpreting data, and reporting findings to the community. Youth became better consumers of science and citizens capable of making wise STEM policy choices.
- As a result of NIFA funding, Alabama A&M University implemented a high school summer research program to increase the enrollment of minority students in its undergraduate Food Science program. Over a 3-year period (culminating in 2012), 70 students conducted research at public (e.g. USDA/ARS) and private institutions (e.g. Kellogg’s, General Mills, Cargill, and Coca-Cola). Approximately 80 percent of the students participating in the program enrolled in the undergraduate Food Science program at Alabama A&M University after graduating from high school.
- The NIFA Fellows program helps to develop the next generation of research, education, and extension professionals in the food and agricultural sciences. Recently, a post-doctoral researcher at the University of Delaware received funding from the program to study microalgae that may help control air pollutants affecting agricultural production and human health. Her work has resulted in two pending patents and interest from an industry partner that specializes in algal biomass cultivation on industrial emissions on a commercial scale. Funding from NIFA’s AFRI Fellows Program enabled the scientist to establish an independent research program that has become the foundation for her career in academics. Since the Program’s inception in 2010, awards totaling \$18 million have supported 163 pre-doctoral and post-doctoral students.



Goal 7. Rural-Urban Interdependence and Prosperity

The REE Mission Area strives to provide effective research, education, and extension that inform public and private decisionmaking in support of rural and community development.

Goal 7. Rural-Urban Interdependence and Prosperity by the Numbers	
Economic Research Service:	
<ul style="list-style-type: none"> • 17 publications • 7 new or updated data products 	<ul style="list-style-type: none"> • 8 briefings¹ • 10 Federal Register Notices and/or other government use²
National Institute of Food and Agriculture:	
<ul style="list-style-type: none"> • 893 Extension publications from Formula grants • 3,369 research publications from Formula grants • \$97M leveraged from Formula grant projects 	<ul style="list-style-type: none"> • 8,098,796 direct adult contacts by Extension • 13,071,711 direct youth contacts by Extension
¹ Briefings are for senior USDA staff, Congressional staff, or other Federal Agencies. ² 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.).	

Highlights:

- Promoting sustainable rural prosperity is one of the pillars of USDA’s strategic plan, and achieving this requires investments in multiple forms of wealth. An ERS research report provided the conceptual framework for rural wealth creation, drawing upon U.S. and international development literature. The framework emphasizes the importance of multiple types of assets (physical, financial, human, intellectual, natural, social, political, and cultural capital) and the economic, institutional, and policy context in which rural wealth strategies are devised. The report discusses the role of wealth creation in the rural development process, how wealth can be created in rural communities, and how its accumulation and effects can be measured.
- Extension educators were informed of USDA/NIFA strategy with the Financial Literacy Education Commission to improve financial literacy and education improvement. Curricula and materials were updated to be applicable for effective educational programs. USDA/NIFA Family and Consumer Sciences Program Leadership collaborated with Strike Force Communities (those where 45 percent or more of the children receive free or reduced-price school meals) in 10 States to educate adults and youth through the Cooperative Extension system.
- NASS held outreach events throughout the Census cycle with underserved and minority and disadvantaged farming groups to promote participation in the Census of Agriculture. NASS identified community-based organizations (CBO) that demonstrated potential to work collaboratively with NASS to improve outreach to targeted producers during the Census. Participants were selected based on a map of socially disadvantaged operators (2007 Census of Ag data). Both geographic and cultural diversity were considered when



selecting participants. NASS field staff and HQ staff have been supporters of collaborations with CBOs since the 2002 Census.

- The ERS Atlas of Rural and Small Town America brings together over 80 demographic, economic, and agricultural statistics for every county in all 50 states. It assembles statistics in four broad categories, on people, jobs, agriculture, and geography that can be mapped or downloaded in an Excel file for later analysis. In 2012, county-level economic and demographic data on veterans were added to the Atlas, including period served, unemployment, median income, education, gender, race, and ethnicity. Also included in this update were the most recent local area unemployment and employment data for 2011.
- Tribal colleges have taken a leadership role in helping American Indian families thrive financially. With funding and support from NIFA, many Tribal Colleges are offering Reservation citizens training ranging from basic financial literacy to business start up and marketing information so that families not only survive, but thrive. Northwest Indian Community College (Washington) conducted a financial literacy needs assessment and developed a profile of community needs. Their train-the-trainer efforts reached over 300 citizens, who learned how to start a business, buy a home, pay off a debt, or send children to college. The needs assessment showed great diversity in the challenges faced by Reservation communities. The College of the Menominee Nation (Wisconsin) has such success with their financial literacy training that the Tribe has made the trainers part of committees and boards that influence community programs throughout the region. At the end of 2012, the College of the Menominee Nation had served 458 participants via workshops with Extension educators providing 1,182 teaching hours.
- Research and action on rural wealth creation led by ERS in collaboration with the Ford Foundation and other institutions and researchers led to development of an online “community of practice,” where researchers, practitioners, and policymakers can share ideas and knowledge about wealth creation efforts across the United States. Collaborators have agreed to extend work on applications of wealth creation in the rural context with an edited volume. The online community of practice has over 840 members.
- NASS refined the mail list for the 2012 Census of Agriculture. The final list of 3 million records was of much higher quality and contained 200,000 fewer records than the previous census with 80 percent of the records determined to be active farms (as contrasted with 69 percent of the 3.2 million records in 2007). A workbook for engaging with Community Based Organizations was prepared and launched with great success to representatives of 47 national and State organizations at a workshop. The census data collection was coordinated with the Agricultural Resource Management Survey so that survey respondent data were used for that producer’s census response. Statistically defensible methodology for adjusting the census data for undercoverage, nonresponse, and incorrect farm status classification was developed and reviewed by the National Academy of Sciences. All operating systems were prepared for the collecting and processing of data. All these efforts contributed to a census of agriculture that provided a local measure of rural-urban interdependence and prosperity relevant to agriculture.