



United States Department of Agriculture

Agricultural Research Service

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A close-up photograph of a bee, likely a bumblebee, on a purple flower. The bee is the central focus, with its head and thorax clearly visible. It has a fuzzy, brown and black body. The background is dark, making the bee and the purple petals stand out. The text is overlaid on the lower right portion of the image.

SCIENTIFIC DISCOVERIES

The Impact of ARS Research – Fiscal Year 2015



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INTRODUCTION

The Agricultural Research Service (ARS) is the U.S. Department of Agriculture's (USDA) chief in-house scientific research agency. Each day, more than 2,000 ARS scientists at 90 laboratories throughout the country discover real-world solutions to America's agricultural challenges.

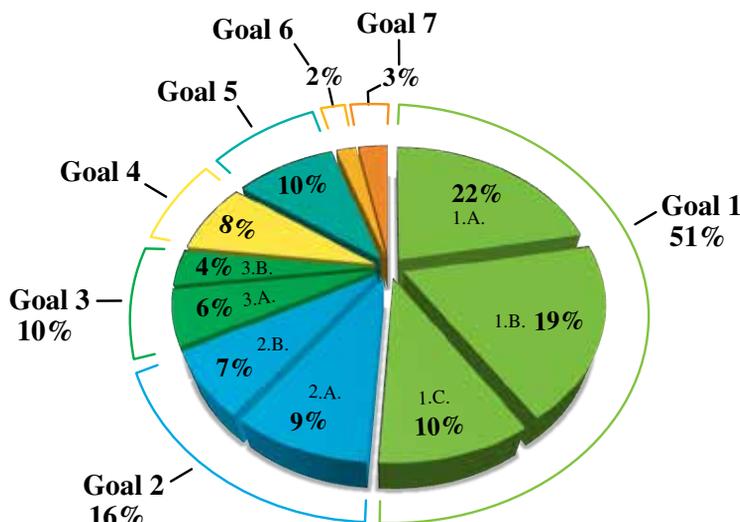
Our unique capacity to conduct research that has an impact on the food we eat, the water we drink, and the air we breathe makes ARS one of the world's premier scientific organizations and a recognized champion of integrated research targeting national and regional agricultural priorities.

ARS's mission, vision, and research plans are directly linked to the strategic goals and priorities of USDA and the Research, Education, and Economics (REE) Mission Area Action Plan. Through strategic use of more than \$1 billion in annual congressional appropriations, ARS routinely collaborates and shares findings with research partners from universities, private companies, non-profit organizations, other Federal agencies, and other countries. ARS leadership on a wide range of agricultural issues ensures the timely transfer of new knowledge and technologies to potential users—a key element of ARS's mission.

The following select accomplishments are examples of ARS's impact in crop and animal production, disease and pest protection, bioenergy, natural resources, food safety, and human nutrition.

ARS FY 2015 Funding by REE Goal

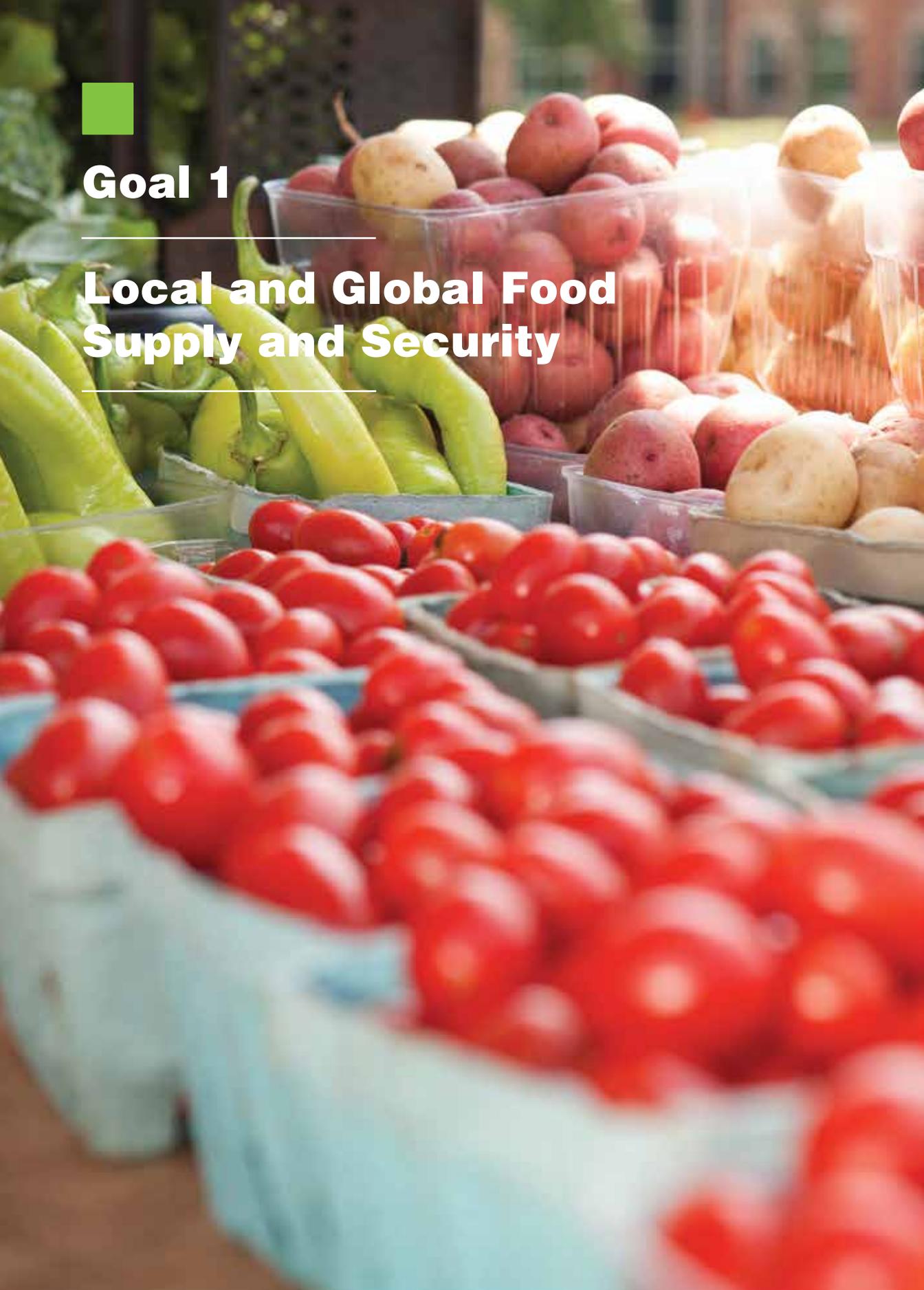
	Goal 1. Local and Global Food Supply and Security	51%
	1.A. Crop and Animal Production	22%
	1.B. Crop and Animal Health	19%
	1.C. Crop and Animal Genetics, Genomics, Genetic Resources, and Biotechnology	10%
	1.D. Consumer and Industry Outreach, Policy, Markets, and Trade	–
	Goal 2. Responding to Climate and Energy Needs	16%
	2.A. Responding to Climate Variability	9%
	2.B. Bioenergy/Biofuels and Biobased Products	7%
	Goal 3. Sustainable Use of Natural Resources	10%
	3.A. Water Availability: Quality and Quantity	6%
	3.B. Landscape-Scale Conservation and Management	4%
	Goal 4. Nutrition and Childhood Obesity	8%
	Goal 5. Food Safety	10%
	Goal 6. Education and Science Literacy	2%
	Goal 7. Rural Prosperity/Rural-Urban Interdependence	3%
	Total:	100%





Goal 1

Local and Global Food Supply and Security



1

Making Bees Stronger



Honey bees and their pollination efforts increase crop values in the United States by more than \$15 billion annually. Commercial production of many specialty crops like almonds and other tree nuts, berries, fruits, and vegetables depends on honey bee pollination. A collaboration between ARS scientists and more than 30 national and international institutions resulted in two

new pollinator bee genome sequences—the Eastern bumble bee (the North American bumble bee used most commonly for commercial pollination) and the Alfalfa leafcutting bee. This research resulted in the identification of genes associated with behavioral and disease-related traits of these species, as well as of the honey bee, and provided insights into social behavior and other key biological

traits—like immune response to pathogens and diseases. While honey bees are attacked by a number of pathogens, little is known about their immune response. Researchers are now targeting genes for immune proteins that are especially responsive to diseases. This information will ultimately result in improved management strategies to promote better bee health.

Guarding Against Citrus Greening



Citrus greening, also known as Huanglongbing (HLB), is a disease costing citrus growers millions of dollars annually. Once present only in Florida, the disease has spread to parts of Texas and California. HLB is the most serious threat to the U.S. citrus industry in history. ARS researchers are developing new strategies to combat this devastating disease, including introducing an improved diagnostic test to detect the responsible bacterium. This bacterium is transmitted from plant to plant by the Asian

citrus psyllid, and reliably detecting and quantifying the bacterium is crucial for preventing citrus greening outbreaks. During the past year, ARS scientists conducted field trials and improved the assay test currently used by USDA's Animal and Plant Health Inspection Service (APHIS) to detect the disease in citrus groves.

ARS researchers made another unique advance in protecting our Nation's citrus from diseases—using dogs to detect

citrus diseases. A team of researchers trained 10 dogs to detect citrus greening and 3 dogs to detect citrus canker with accuracy rates in excess of 99.97 percent. APHIS will deploy trained dogs during the next 2 years and is working with dog training companies to commercialize this service. The use of trained dogs is the only currently available way to quickly detect citrus greening before symptoms are visible. That makes dogs an especially valuable tool in the fight to manage citrus greening.

1

Building a Better Peanut



OLé peanut seeds are commercially available to growers for 2016 plantings.

An economically important crop throughout the world, peanuts are susceptible to many pathogens, particularly soilborne fungi that adversely affect peanut health and productivity. ARS scientists and collaborators at Oklahoma State University and Texas Agri-Life Research developed and released OLé last year. During field test, this new Spanish peanut variety demonstrated an increased resistance to Sclerotinia blight, a fungal disease causing yield loss that is a particular problem in Oklahoma, Texas, and the Virginia-North Carolina region. Depending on field infestation severity, yield losses from this type of soilborne disease can reach 50 percent. Planting OLé may reduce Sclerotinia blight infestation, saving growers nearly \$100 per acre in fungicide costs alone. The variety also has good resistance to pod rot and packs high levels of oleic acid, a beneficial monounsaturated fatty acid that may provide healthy heart benefits. OLé peanut seeds are commercially available to growers for 2016 plantings.

Redrawing the DNA Map for Cattle and Turkeys



ARS researchers are developing better ways to improve animal production by using more precise techniques and tools, such as DNA markers, to map an animal's genetic makeup. The scientists are using single nucleotide polymorphisms (or SNPs, pronounced "snips") to look at the genetic makeup of dairy cattle and turkeys. After having applied the technology successfully in beef cattle production, ARS researchers identified 40,000 SNPs that were included in a new genotyping chip that was put into commercial

production by Neogen Corporation. The Council of Dairy Cattle Breeding is now using this ARS tool as its standard for national evaluations of Holstein dairy cows.

Expanding this tool also led to a new genetic tool for turkey producers. Historically, genetic improvements for commercial turkeys were based on physical traits, such as body size and breast muscle development. ARS scientists, in partnership with poultry industry leaders and university collaborators, identified 5.49 million SNPs

that are now being developed as a genomic evaluation tool for the turkey industry. During November 2015, Affymetrix, Inc. commercially released the Axiom® Turkey Genotyping Array. This new tool allows turkey producers to select for difficult-to-evaluate traits, such as those associated with immunity and reproduction. The array development was led by ARS researchers under a public-private partnership with Hendrix Genetics, Aviagen, and Affymetrix.

Doing Our Part To Protect the U.S. Military

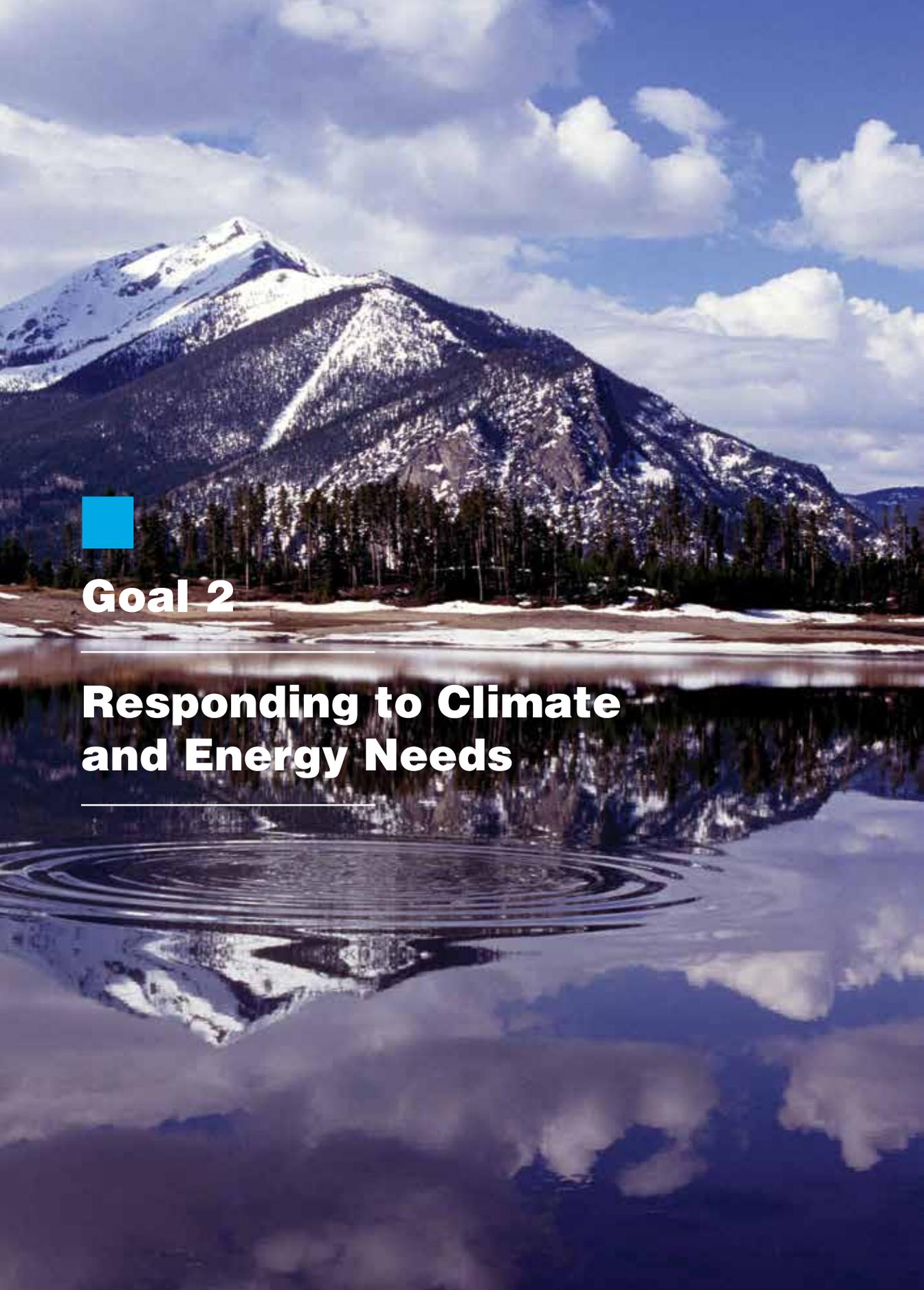


ARS has tremendous expertise dealing with agricultural insects. As a result, ARS scientists partnered with our Nation's military to develop products that protect military personnel from insect-transmitted diseases such as malaria, epidemic typhus, dengue fever, and more recently West Nile and Zika virus. ARS made two advances this past year to protect U.S. troops from insects. First, ARS researchers completed a study for a new U.S. military clothing treatment that the U.S. Environmental

Protection Agency (EPA) approved for registration. When applied, this product can protect the wearer from insect bites and is suitable for undergarments and clothing made of multiple fabric types. The protocol used during this study will become an EPA guideline for future registration of repellent-treated clothing.

ARS made another important advancement in protecting our military by demonstrating that applying aerial insecticide

treatments to U.S. military blast walls containing geotextile material and radar-scattering camouflage netting reduces adult mosquito populations. This study also provided additional evidence that existing models used to guide U.S. aerial pesticide application do not adequately represent actual spray deposit. These findings will be integrated into future versions of the Mobile Pesticide App to improve spray application and will better track spray droplet deposit.



Goal 2

Responding to Climate and Energy Needs

Keeping Close Watch on Rift Valley Fever, a Livestock Disease



Rift Valley fever (RVF) is a viral disease spread to livestock (cattle, sheep, goats, and camels) and humans by mosquitos. Though it has yet to reach the United States, the disease is a major human, agricultural, and economic threat in Africa and the Middle East. ARS researchers partnered with the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO), and Federal partners from the National Aeronautics and Space Administration (NASA), Centers for Disease Control and Prevention (CDC), and the

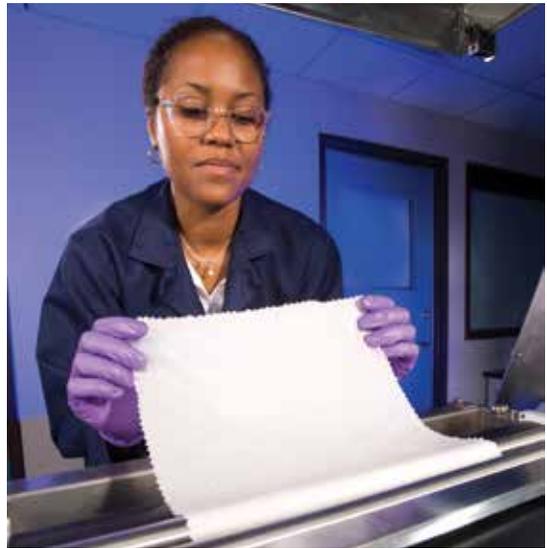
Department of Defense (DOD) to form the Rift Valley Fever Outbreak Early-Warning Team. Their focus is establishing an early-warning system to detect and reduce RVF threats. The team recently identified environmental signals that predict the occurrence of unusually large mosquito populations. This allows mosquito control professionals additional time, from weeks to months, to deploy surveillance and control measures. Continued monitoring of RVF activity is a critical step in reducing the potential risk of RVF introduction into the United States.

Releasing “Hidden Valley” Grass



Livestock producers using management-intensive grazing systems need improved, high-quality forage grass varieties that support cattle growth and milk production. To help fill that need, ARS scientists have developed and released “Hidden Valley” meadow fescue. Cattle are more productive when foraging on the new variety, which is a significant improvement over current pasture forage varieties. “Hidden Valley” also has a higher cold tolerance and is better adapted for humid temperate regions in the Eastern United States and Canada. Released in response to industry demand, “Hidden Valley” fills a significant demand for a cold-tolerant, drought-tolerant, high-quality grass for intensive grazing systems in the North Central and Northeastern United States.

Increasing Cotton’s Healthcare Benefits



ARS has developed an improved cotton-based, blood-clotting wound dressing. This nonwoven cotton product is an improvement over standard care dressings, such as gauze, and shows promise as a rapid blood-clotting agent for use by first responders and for battlefield wounds. ARS scientists were able to increase the product’s clotting ability by varying the composition and design of the dressing. In laboratory tests, the ARS wound dressing outperformed commercial wound dressings. This new technology supports the U.S. Government mandate for using domestic cotton for Department of Defense materials. It was developed in collaboration with H&H Medical, which will manufacture the cotton-based wound dressings on an industrial scale.

Improving Bioenergy Production



ARS researchers are developing sustainable, regional approaches for producing crops allowing rural communities to participate in the emerging biofuels and biobased products economy. As part of this effort, ARS made numerous advances in bioenergy production this past year. ARS scientists converted Napier grass into ethanol with an estimated yield of 1,100 gallons per acre. By comparison, a corn field typically produces around 500 gallons per acre. Napier grass, a warm-season grass that has low water and nutrient requirements,

can grow in marginal or uncultivated lands, and it does not compete with food crops for growing space. It is being developed as a high-yielding bioenergy crop for ethanol production in the Southeastern United States. When grown alongside corn as a “pull” crop, Napier grass attracts insects, improves soil fertility, and prevents erosion.

A challenge to using crops as biofuels involves converting the crops into usable bioenergy. Nearly 1.3 billion tons of plant biomass is available each year

in the United States for use as energy crops. Conversion of this biomass into 30 billion gallons of biodiesel per year (62 percent of current U.S. diesel consumption) could happen using microorganisms called “oily” yeasts. Scientists at ARS’s Culture Collection in Peoria, IL, screened yeast strains and identified those that can convert biomass into biofuel. This new technology is expected to advance the economic feasibility of producing high-quality biodiesel and jet fuels from renewable biomass.



Goal 3

Sustainable Use of Natural Resources

Fighting a Pretty But Potent Weed



Water hyacinth is a free-floating perennial herb that grows to about 3 feet tall. Though known for its showy flowers and landscaping appeal, this native South American plant infests rivers and lakes and is considered one of the world's worst aquatic weeds. It has become especially problematic in Florida, the Southeastern United States, the Gulf Coast, and the Sacramento-San Joaquin River in northern California. Water hyacinth impedes commercial and recreational navigation and degrades native aquatic plants and fish habitats. ARS scientists and collaborators have developed two new tools to improve water hyacinth control. The first uses satellite images to identify water hyacinth from other floating plant species. This tool tracks seasonal water hyacinth growth and allows pest control operators to track their success. The second tool is a biological control agent called "planthopper," which reduces water hyacinth size and reproduction, making the plant more susceptible to other control methods. Nearly 400,000 planthoppers have been released in Florida and California. These new control tools make successful adaptive, integrated aquatic weed management possible. For example, peak water hyacinth coverage in the Sacramento-San Joaquin River declined 50 percent between 2014 and 2015, and the integrated control system in Florida is saving approximately \$60 million per year in public lakes management.

Forecasting Water Supplies Based on Snowmelt



In 2015, California faced one of the most severe droughts on record. Snowmelt from the Sierra Nevada is a key water source for California's agricultural industry, as well as other urban uses. Standard methods for estimating water supply from snowpack do not reflect current drought data and critical management information. ARS scientists developed a solution. In collaboration with the National Aeronautics and Space Administration/Jet Propulsion Laboratory (NASA/JPL), the team developed the iSnoBal model, a new technology for forecasting water supply derived from melting snow. NASA/JPL and the Airborne Snow Observatory (ASO) program used remote sensing to provide snow cover distribution measurements across the Sierra Nevada, while ARS scientists generated sophisticated snow density estimates for the same region. Combining these precise data resulted in highly accurate estimates of snowpack water content, significantly improving critical water resource management.

3

Improving Soil and Water Conservation and Agricultural Production



SWAT is the world's leading simulation model for assessing the watershed-scale environmental effects of crop, forest, and rangeland management.

ARS scientists, in collaboration with USDA's Natural Resources Conservation Service (NRCS), made significant enhancements to the Soil and Water Assessment Tool (SWAT). Originally developed by ARS scientists, SWAT is the world's leading simulation model for assessing the watershed-scale environmental effects of crop, forest, and rangeland management. It is a critical part of the Conservation Effects Assessment Project (CEAP), through which USDA evaluates the regional and national effects of conservation practices. The new model includes improved data structures and data analysis, a new Web-based interface, and improved representation of critical agricultural production regions. Congress, USDA agencies, and international decision-makers rely on this state-of-the-art tool to support natural resource management and conservation practices and to help shape agricultural policy.

Protecting Our Water Supply



Recent Lake Erie algae blooms affecting Toledo, Ohio’s drinking water supply have increased pressure on farmers and ranchers to improve and optimize nutrient application and management. ARS scientists developed the “Haney Test,” an award-winning soil health tool that major soil testing laboratories are quickly adopting to determine optimal soil fertilizer rates. During field tests in Texas, fertilizer recommendations based on the Haney Test resulted in reduced fertilizer application rates and a 20- to 40-percent reduction in fertilizer costs. In addition, using the Haney Test reduced nutrient losses and the related negative impacts of excess fertilizer use on air and water resources. This procedure is a revolutionary advancement for fertilizer management and could become an important tool for agricultural producers to increase profitability and sustainability.

Monitoring Climate Change From Space



Photo by Kim Shiflett, NASA.

The best way to gather data about the Earth's water and land resources is viewing it from space. In 2015, ARS scientists helped the National Aeronautics and Space Administration (NASA) with the launch of SMAP (Soil Moisture Active-Passive), a new satellite measuring the amount of water in top soil layers around the world. SMAP gathers soil moisture data that help track diseases and famine, help predict weather and climate patterns, help emergency workers respond to natural disasters, and help farmers decide what crops to plant. SMAP provides the best global view of soil moisture to date. Early users include those in agriculture, weather, human health, emergency response, and military readiness. This past year, SMAP data were used to predict the water supply in New York City and predict large regional dust storms in Saharan Africa and throughout the Middle East. SMAP data were also used to map sea ice to help improve maritime navigation and to look at the impact of hurricanes on power outages.



Goal 4

Nutrition and Childhood Obesity



4

Reducing Children's Risk of Summer Weight Gain



Children who were overweight or obese gained more weight during the summer than during the school year.

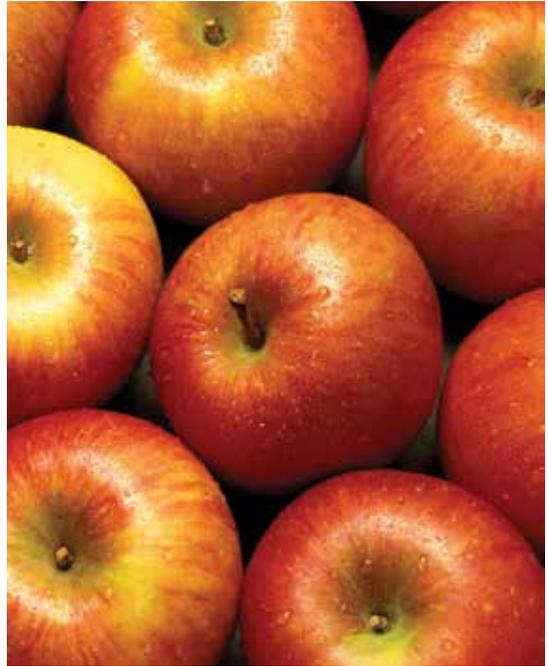
An essential part of a child's annual physical exam is a weight check. Annual visits, however, do not help healthcare practitioners monitor seasonal fluctuations in weight. ARS-supported researchers recently tracked weight changes of more than 7,500 elementary school children. They found that children who were overweight or obese gained more weight during the summer than during the school year. While the researchers did not assess the reasons for these seasonal fluctuations, the findings shed light on the need for dietary strategies to help children maintain healthy body weights year round.

Identifying How Emotions Affect Children's Eating Habits



For the first time, scientists have found a relationship between cognitive control and emotional eating behavior in preschool children. ARS and University of California, Davis, scientists found that cognitive control—which includes abilities to make decisions, plan, manage time, and maintain emotional and self-control—is significantly associated with the relationship between overeating and emotions. Not much is known about this connection in younger children. The research team examined the balance between emotional state, snacking, and cognitive control in children ages 3 to 6 at a preschool. Using computerized and hands-on tasks, parental questionnaires, and standardized teacher reports, researchers learned that children with low cognitive-control scores snacked more and experienced more emotions. Children with higher cognitive-control scores did not engage in this type of behavior. The research suggests that preschool age is a good time for anti-obesity intervention as both eating habits and cognitive control are developing rapidly.

Developing a Fruit-Based Nutrient Snack Bar



U.S. obesity rates related to poor diets are a major health issue, with one in three adults considered obese. ARS scientists, in collaboration with the Children's Hospital Oakland Research Institute in Oakland, CA, have developed a low-calorie, fruit-based snack bar fortified with micronutrients, fiber, and other healthy components that are lacking in a typical U.S. diet. In a clinical study, subjects ate two bars daily for 8 weeks without other changes in diet or exercise. Study results showed healthy changes in cardiovascular health, insulin resistance, inflammation, and obesity. ARS has applied for a patent for this fruit-based snack bar.

Promoting Better-Informed Habits in Food Consumption



ARS scientists have linked excessive consumption of foods with higher calories, sodium, saturated fat, and *trans* fat with increased disease risk. Trends in fast-food restaurant portion sizes may impact the consumption of these components. ARS-funded research examined portion sizes in popular food items in three U.S. fast-food restaurants during the past 18 years. The study included tracking changes in portion size and key components in French fries, cheeseburgers, grilled chicken sandwiches, and regular cola. Overall, 56 percent of items decreased in calorie content between 1996 and 2013. Sodium levels in 18 percent of the items decreased significantly, while sodium levels in 33 percent of the items were higher. Calorie content of a large-size “meal” (cheeseburger, French fries, and regular cola) represented 65 to 80 percent of a 2,000-calorie-per-day diet, as well as a significant portion of the recommended sodium intake. These findings suggest that efforts to promote reductions in calories, sodium, saturated fat, and *trans* fat intakes need to be shifted from emphasizing portion size only to emphasizing additional factors such as total calories, eating frequency, number of items ordered, menu choices, and high-calorie beverages.



Goal 5

Food Safety



Speeding Bird Flu Vaccine Development



Since mid-December 2014, USDA agencies, poultry producers, and other State and local governments worked cooperatively to combat an outbreak of highly pathogenic avian influenza (HPAI), or bird flu, in commercial poultry, wild birds, captive wild birds, and backyard poultry. The virus quickly spread across 21 States in 2015, resulting in the loss of 7.5 million turkeys and 42.1 million chickens, at a cost of more than \$950 million to U.S. taxpayers. In response to the December 2014 detection of new HPAI viruses (H5N8 and H5N2) affecting wild waterfowl and captive raptors in the United States, ARS refocused its avian influenza research team and within 2 weeks developed an emergency avian influenza vaccine.

ARS scientists designed and developed portable and stationary LED-light grading systems and a computerized software system.

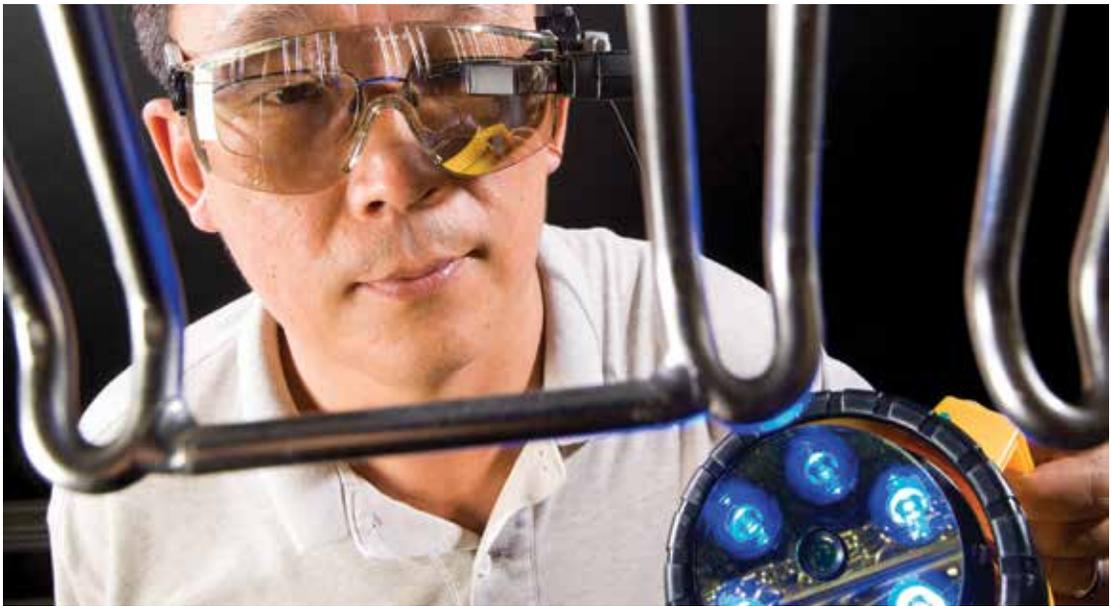
Improving Egg Production Operations



Food safety inspectors use egg candling systems to check egg quality and grade eggs. Current commercial egg candling grading lights were based on obsolete incandescent bulbs that are no longer manufactured. USDA's Agricultural Marketing Service (AMS) requested that its grading units be upgraded to new, high-intensity, energy-efficient LED candling lights. To meet this need, ARS scientists designed and developed portable and stationary LED-light grading systems and a computerized software system. ARS's new system can monitor, collect, and process egg cracking data without using current paper forms. This allows for real-time statistical and trend analysis of egg production operations. An industry-manufactured LED egg candling system is under development based on this ARS technology.

5

Preventing Foodborne Pathogens



One of the leading concerns for the food industry is preventing foodborne pathogens, such as Shiga-toxigenic *Escherichia coli* O157:H7. It is estimated that annually *E. coli* O157:H7 causes tens of thousands of foodborne illnesses and more than 60 deaths in the United States. Identifying the correct foodborne pathogen strain is an important step to enhancing food safety. To reduce foodborne illnesses, ARS collaborated with the Food and Drug Administration (FDA) to develop a low-cost, portable detection system that can differentiate between active and non-active toxins in food samples. Built with off-the-shelf components, the sensor system costs about \$300 compared with current commercial systems costing \$35,000.

Another important step in food safety is preventing cross-contamination of pathogens on surfaces. ARS has developed a battery-operated, handheld fluorescence imaging device that can detect food residues on spinach leaf, milk, and beef—three foods particularly associated with foodborne illness outbreaks. Useful in a variety of situations and on large, complex processing surfaces, the cost-effective optical sensing device has received considerable national and international interest from Federal regulatory agencies, the U.S. Department of Homeland Security, and the United Kingdom Food Standards Agency.



Goal 6

Education and Science Literacy



6

Tapping the Hidden Value of ARS Research

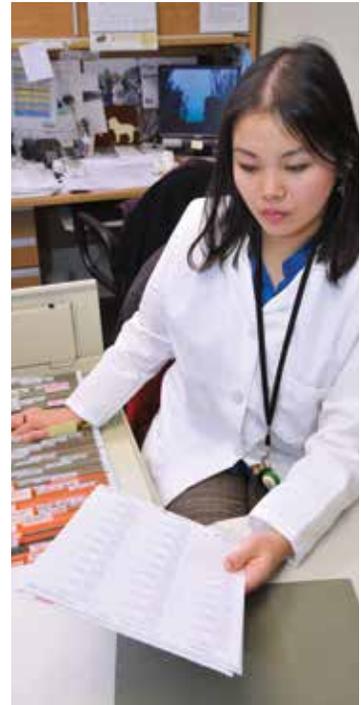


ARS Involvement in Training and Mentoring - 2015

Pathways interns	159
Pathways recent graduates	20
Graduate students	575
Undergraduate students	878
Adjunct or other appointments	908
Scientists serving as advisors	541

The key to solving problems facing agriculture today and in the future is to invest in the next generation of scientific minds—America’s students. Each year, ARS scientists bring hundreds of students, from high-schoolers to those seeking postgraduate degrees, into laboratories to conduct experiments, feed and care for animals, help with field work, and provide substantive support to ARS research. These students learn the research methods, procedures, and discipline needed for future scientific discovery. While mentoring students and young scientists is not the primary function of ARS researchers, it is an important measure of the leadership and community stewardship ARS scientists have always demonstrated toward agriculture and related sciences. Additionally, more than half of ARS scientists hold adjunct appointments at the land-grant universities where they are co-located, which provides them opportunities to serve as academic advisors to students and maintain strong research relationships with other faculty members.

Building a Diverse Workforce



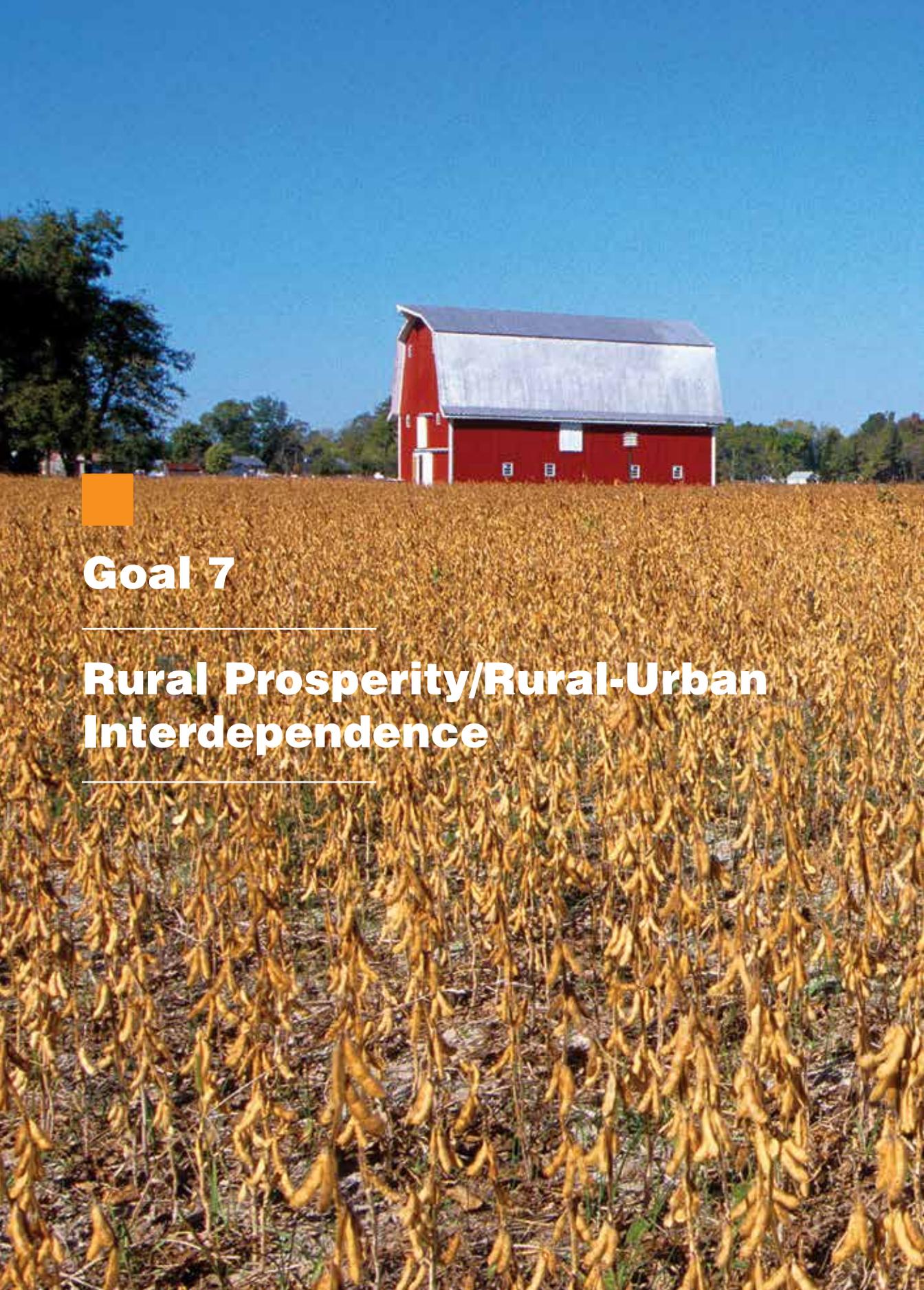
ARS is committed to increasing the diversity of its workforce. The agency has several ongoing programs to provide workplace training and experience for students from underserved communities. In cooperation with the Hispanic Association of Colleges and Universities (HACU), ARS hosted 65 HACU students during 2015 who received on-the-job training and gained experience in information technology, real and personal property management, budget processes, human resources, and general management. In addition, ARS continues outreach activities at K-12 schools, land-grant colleges and universities, and minority-serving institutions to educate students about ARS career opportunities. ARS has partnered with a number of organizations including the Society for Advancement of Chicanos/Latinos and Native Americans in Science; Minorities in Agriculture, Natural Resources, and Related Sciences; Federal Asian Pacific American Council; the League of United Latin American Citizens; and the Thurgood Marshall College Fund to provide opportunities for minority and under-represented groups.

Educating the Public on Turfgrass



In collaboration with the turfgrass industry, ARS scientists developed a new exhibit called “Grass Roots” to educate the public on the importance, diversity, and benefits of turfgrass and their crop relatives. As part of this partnership, ARS developed a 1.3-acre outdoor exhibit at the U.S. National Arboretum in Washington, DC. The exhibit presents fundamental information about turfgrass, including its value as a landscape element and scientific efforts to improve turfgrass and turfgrass management. The exhibit features a small putting green and an array of grain crops such as wheat and sorghum. Tens of thousands of people have visited the exhibit and the Web site to learn about the importance of turfgrass to the U.S. economy and the environment.

ARS also promotes scientific literacy by sharing scientific data, which often accelerates scientific discoveries and improvements. ARS scientists partnered with university cooperators at the iPlant Collaborative—a national project to facilitate access to high-performance computing, software, and DNA sequence analysis tools—to facilitate scientific innovation. As a result, the team developed a series of coordinated software programs that, for the first time, will enable researchers to assemble the rice genome in a day. Knowledge of crop sequencing and crop genomes is critical for accelerating progress in crop research and genetic improvement. Such information is particularly important for identifying gene sources to increase yield, enhance disease resistance, and accelerate adaptation to weather extremes. The iPlant Collaborative has been expanded to include an iAnimal project.



Goal 7

Rural Prosperity/Rural-Urban Interdependence

7

Using Recycled Waste To Reclaim Land



The U.S. Army often uses large amounts of land to prepare and train its troops to protect U.S. citizens. Extensive wear on the land results in lack of sufficient topsoil, organic matter, and nutrients—making it unsuitable for revegetation. ARS scientists developed a new garbage-processing technology that reduces the municipal solid waste disposal in landfills and generates a co-product that can be used to reclaim damaged soils. This technology sterilizes and separates municipal solid waste into metal and plastic recyclables and turns it into an organic material called Fluff[®], which can be land applied to improve soil conditions. ARS field studies conducted at Fort Campbell, KY, and Fort Benning, GA, showed improved results when native grass was established in damaged areas. Fluff[®] reduced soil compaction and increased soil carbon and nitrogen.

Increasing Water Supply by Saving Fuel



A secure, resilient, and sustainable food supply requires continued progress toward controlling soil erosion. However, the most common wheat production method in low-rainfall areas of the Pacific Northwest relies on intensive tillage, leaving the soil susceptible to wind erosion. In field studies evaluating reduced-tillage farming practices, ARS scientists found that reducing tillage timing and frequency (an average of two fewer tillage equipment passes per year) on 4 million acres of low-precipitation-zone wheat can save 1.75 million gallons of diesel fuel annually. In addition, crop yields either met or exceeded previous yields and exhibited greater resilience to weather conditions, such as wind and water erosion. This study also revealed that leaving crop residue on the soil surface through reduced tillage improves soil moisture. Using these management practices, farmers can reduce tillage and still meet or exceed crop yield goals, help protect soil from erosion, reduce fuel costs, and reduce greenhouse gas emissions.

Preventing Sugarcane Juice Losses



Microbial contamination of extracted sugarcane juice during commercial processing is a serious problem that degrades production and causes sugar loss. Although commercial biocides that control microbial growth are currently added to juice in U.S. sugarcane factories, their effectiveness is questionable. ARS scientists evaluated three commonly used commercial biocides—bleach, sodium carbamate, and hops—and a newly developed ARS heat treatment. The researchers studied the biocides individually and in combinations at two commercial Louisiana sugar-processing facilities, and they found that none of the treatments were effective. However, applying the ARS heat treatment during the juice clarification process completely eliminated microbial contamination. As a result of these findings, numerous U.S. sugar factories replaced costly commercial biocide treatments with the ARS heat treatment. Each factory has saved approximately \$47,000 per year—an estimated savings of about \$515,000 annually for the Louisiana sugarcane processing industry.



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