



United States
Department of
Agriculture

National Institute
of Food
and Agriculture

2015 IMPACTS

NATIONAL INSTITUTE OF FOOD AND AGRICULTURE



User-inspired science, *transforming lives.*



INVESTING IN SCIENCE | SECURING OUR FUTURE

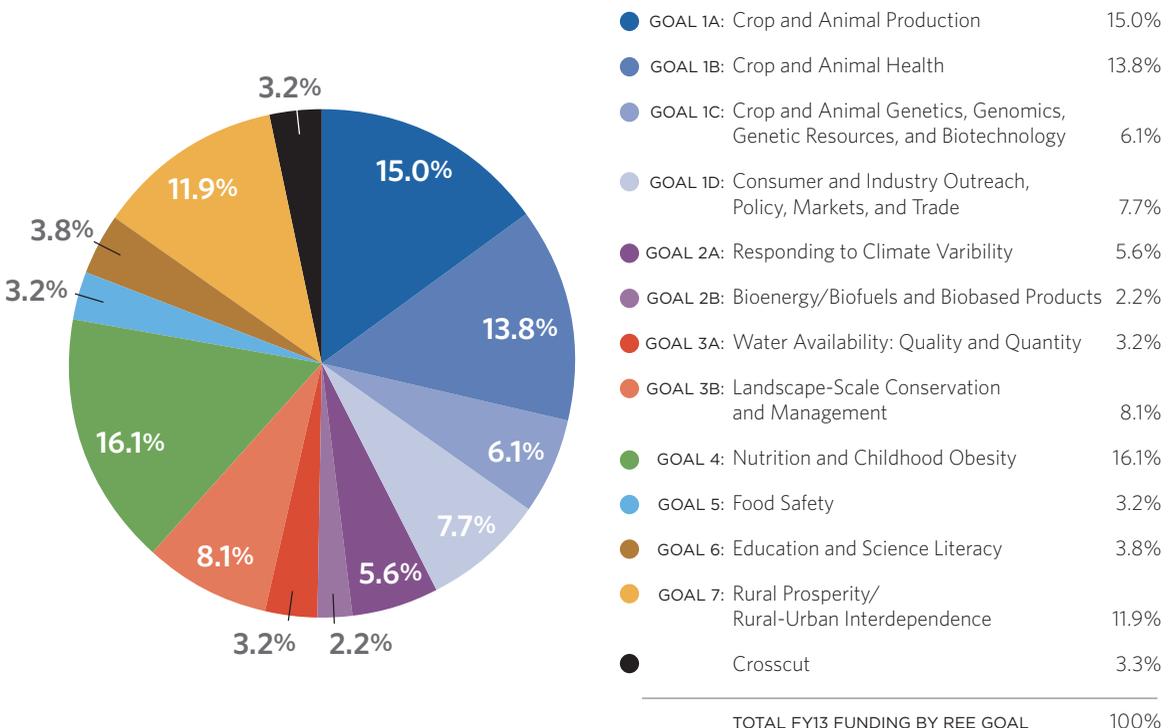
NIFA 2015 IMPACTS REPORT

THE UNITED STATES DEPARTMENT OF AGRICULTURE'S (USDA) NATIONAL INSTITUTE OF FOOD AND AGRICULTURE (NIFA) invests in the agricultural sciences to solve societal challenges. Through the integration of research, education, and extension, NIFA ensures innovative solutions to problems in agriculture, food, the environment, and communities go beyond the laboratory, into the classroom, and to people who can put the knowledge into practice.

Scientific advances resulting from NIFA-funded research—more than \$1.5 billion in fiscal year 2015—enhance the competitiveness of American agriculture, ensure the safety of the nation's food supply, improve the nutrition and health of the populace, sustain the environment and natural resources, and bolster the U.S. economy. NIFA's educational grants increase the capacity of institutions to educate the next generation of agricultural experts, while NIFA's investments in extension activities provide producers, communities, and families with practical information that can improve their lives.

The following are just a few examples of NIFA projects from the thousands across our nation that impact people's lives every day.

NIFA FUNDING GLOBALLY BY REE GOAL



FOOD SECURITY AND SUPPLY

SPRAYING SMARTER STRENGTHENS STRAWBERRY PRODUCTION

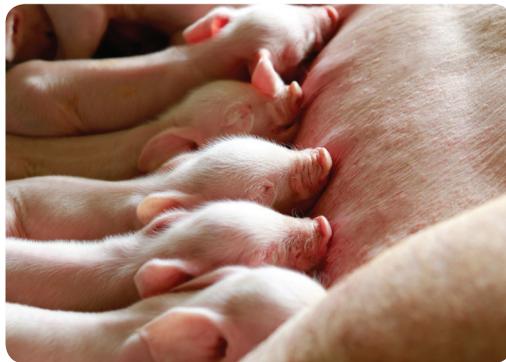
Strawberry production in the United States is valued at more than \$2 billion. Growers, however, face high production costs, particularly for managing pests, including diseases, insects, mites, nematodes, and weeds. Producers can now receive help from the **University of Florida** in the form of an online tool, the Strawberry Advisory System. The tool alerts farmers of factors that indicate a perfect environment for disease. Once alerted, farmers can spray their crops and log the information online to track each spray. This tool helps farmers spend less money on fungicides and spray less often, while achieving better results with what and when they spray.



iStockphoto.com

ENGINEERING FLU RESISTANCE IN PIGS

Researchers from the **University of Maryland** are testing a cutting-edge approach for eradicating the most ancient disease known to mankind, influenza. The research team used advanced genome editing techniques to delete receptors in the pigs' genetic code to block the virus's entry and inserted what are called "decoy" genes to prevent the virus from replicating. This technology has the potential to develop flu resistance in pigs and prevent the flu from spreading to other pigs and to humans, who can and do contract the virus from swine.



iStockphoto.com

DELIVERING PAIN MEDICINE TO PIGLETS THROUGH SOW'S MILK

Iowa State University veterinary researchers have developed a new means of delivering pain medication to nursing piglets through the mother sow's milk. This new method could help pork producers reduce the stress and pain experienced by piglets that are castrated or docked to remove their tails without the need to inject each piglet with medicine. The researchers tracked the level of medication in blood samples and used a thermography camera to measure changes in skin temperature on the piglets' heads after they underwent castration and tail removal. The piglets that received pain medication through the mother's milk maintained a more consistent, higher surface skin temperature, which the scientists say is suggestive those piglets were under less stress.

GENETIC DATA LEADS TO IMPROVED WHEAT AND BARLEY VARIETIES

The **University of California-Davis**-led Triticeae Coordinated Agriculture Project (T-CAP) and Wheat CAP and the **University of Minnesota**-led Barley CAP have used knowledge gained from the genomes of these crops to develop improved varieties. Approximately 20 percent of the harvested wheat acreage—worth approximately \$3.5 billion—and four percent of the harvested barley acreage in the United States come from wheat and barley varieties developed

continued next page >>

by these projects. These new varieties have traits that include improved disease resistance, nutritional value, yield, drought tolerance, and adaptability to a changing environment. The T-CAP team also created a toolbox to provide plant breeders with additional information so they can develop improved wheat and barley lines. Project investigators have mentored 108 undergraduate students, 136 graduate students, and 25 postdoctoral researchers.

RESPONDING TO CLIMATE AND ENERGY NEEDS

DIGITAL TOOLS HELP FARMERS ADAPT TO CLIMATE, WEATHER CHANGES

Weather and climate patterns are a driving force behind the success or failure of Corn Belt cropping systems. “Useful to Usable” (U2U) is a collaboration among nine North Central universities led by **Purdue University** designed to improve the resilience and profitability of U.S. farms in the Corn Belt amid a variable climate. The U2U initiative has launched several new decision support tools in the past two years to help farmers and agricultural advisors manage increasingly variable weather and climate conditions. For example, “Corn Split N” combines historical weather data and fieldwork conditions with economic considerations to determine the feasibility and profitability of completing a post-planting nitrogen application for corn production.

INSECT RESISTANCE IN BIOFUEL POPLARS

A team of **University of Wisconsin** researchers explored insect resistance in two types of genetically modified poplar trees that had been altered to improve their use as a biofuel feedstock. Poplar tree species and hybrids have been identified as one of the nation’s most promising woody feedstocks for the production of cellulosic ethanol. This research explored whether particular genetic modifications might have the undesirable side effect of reducing poplar’s natural resistance to pest

insects, leading to crop loss or additional need for pesticide, which proved not to be the case. These genetic modifications may be used to enhance hybrid poplar as a biofuel crop without substantially affecting pest resistance.

SUSTAINABLE USE OF NATURAL RESOURCES

PROFITABLE OPTION FOR FORMER TOBACCO PRODUCERS

Since the tobacco quota buyout of 2005, farmers in Virginia have experienced a loss of income and cropland. Researchers at **Virginia State University** have developed varieties of vegetable soybean (edamame) that can provide a profitable option for former tobacco farmers and a new use for the



iStockphoto.com

farmland. Edamame is an ideal substitute for tobacco because it can be grown using the same methods as grain-type soybean, but marketed as a high-value vegetable crop. The research team is identifying varieties that can be grown year-round, providing a fresh supply during the times of the year when supply is low and demand is high.

THE GRASS IS CLEANER ON THE OTHER SIDE

Texas A&M University researchers have discovered that bioenergy sorghum not only serves as a viable fuel source, but also acts as a greenhouse gas sink. Researchers made this discovery while measuring greenhouse

gases from biofuel production lab experiments. Analyzing the effects of crop rotation, nitrogen fertilization, and residue management were their main objectives. The research helped quantify the carbon footprint of a bioenergy cropping system and has significant implications for net greenhouse gas emissions, soil organic carbon sequestration, and life-cycle analyses.

NUTRITION, CHILDHOOD OBESITY, AND HEALTH

ENCOURAGING HEALTHY LIFESTYLES CHOICES THROUGH DIGITAL INTERACTION

The transition for young adults from high school to college can be overwhelming and unhealthy habits can begin to form. **South Dakota State University** researchers launched the Young Adults Eating and Active for Health (YEAH) project and found a positive link between consistently encouraging exercise and healthy eating through digital interaction with improved lifestyle habits. Over a 10-week period, researchers used email “nudges” and short videos to remind participants of targeted goals: exercising 150 minutes per week, consuming five cups of fruits and vegetables per day, and managing stress. Eighty percent reported that they met the exercise goal and all participants ate more fruits and vegetables daily.



iStockphoto.com



Partner-supplied photo

iCOOK MAKES HEALTHY LIVING FUN FOR KIDS

As childhood obesity rates have been on the rise, researchers from the **University of Maine** developed the 4-H iCook project to tackle this issue in the home. Researchers identified a lack of parental education in nutrition, sedentary lifestyles, availability of high-caloric foods, and scarcity of healthful foods as contributing factors to the obesity crisis. A decrease in regular family meals has also been associated with low socioeconomic status and overweight youth. The program encourages families to cook, eat, and exercise together while improving culinary skills and increasing physical activity. Through iCook, 9- and 10-year-old youth learn the importance of a healthy lifestyle by preparing meals in their homes and increasing physical activity with their families.

SCIENTISTS LEARN HOW SOY FOODS PROTECT AGAINST COLON CANCER

University of Illinois scientists have evidence that lifelong exposure to genistein, a bioactive component in soy foods, protects against colon cancer by repressing an internal signal that leads to accelerated growth of cells, polyps, and, eventually, malignant tumors. In healthy humans, the cells lining the gut turn over and are completely replaced on a weekly basis. However, in 90 percent of colon cancer patients, a growth-promoting signal is always on, leading to uncontrolled growth

continued page 8 >>



STRENGTHENING POLLINATOR HEALTH

THERE IS A DIRECT CORRELATION BETWEEN THE HEALTH OF AMERICAN agriculture and the health of bees and other pollinators. Pollination is critical to the production of fruits, vegetables, and nuts, which are important parts of a healthy diet. Unfortunately, there is no quick fix or singular cause of the declining honeybee and native bee populations across the United States. A number of likely reasons underlying the loss of pollinators includes lack of plant biodiversity and high quality floral resources, parasitic mites, exposure to various pesticides, diseases, and modern beekeeping practices.

An estimated 1/3 of all foods and beverages depends on pollination for production.

NIFA is supporting researchers to halt the declining bee population and address the threat it poses to our nation's long-term agricultural productivity. Through a coordinated effort across USDA and with land-grant university partners, NIFA has funded a number of projects seeking to find solutions.

When one thinks of bioenergy policy, bee health is probably not the first thing that comes to mind. However, new research shows that the lack of attention to plant biodiversity when creating policies to dedicate lands to the production of biofuels could have serious consequences for honeybees, wild bees, and other pollinators. Research conducted at **Michigan State University** and the **University of Wisconsin-Madison**, explored how bees might respond to two contrasting bioenergy production scenarios: annual row crops, such as corn or soybeans, and perennial grasslands, such as switchgrass or diverse prairie. The researchers used field observation data to

develop models for predicting the abundance, diversity, and community composition of flower-visiting bees. Findings suggest the expansion of annually planted bioenergy crops could reduce bee abundance by as much as 71 percent and bee diversity by as much as 28 percent. In contrast, converting annual crops on marginal soils to perennial grasslands could increase bee abundance by as much as 600 percent and bee diversity by as much as 53 percent.

In the United States, pollination contributes to the production of \$29 billion worth of products annually.

Researchers at **Pennsylvania State University** discovered the diet of honeybees can significantly impact their resistance to pesticides. The study found that feeding honeybees a natural diet of pollen makes them significantly more resistant to pesticides than feeding them an artificial diet. Pesticide exposure also causes changes in the expression of genes that are sensitive to diet and nutrition. The study also revealed a strong link, at the molecular



U.S. beekeepers lost more than one in five honey bee colonies in the winter of 2013-2014.

level, between nutrition, diet, and pesticide exposure. Exploring this link further, the researchers found that diet significantly impacts how long bees can survive when given lethal doses of a pesticide.

American foulbrood disease is another contributor to the declining honeybee population in the United States. American foulbrood is a honeybee disease caused by the spore-forming bacteria, *Paenibacillus*, which infects and kills developing broods. Antibiotics can eliminate the active infections, but the spores are easily transferred between colonies and can remain viable for decades, re-infecting generations of bees. American foulbrood is highly regulated and requires the use of confirmatory diagnostics. This often results in the forced incineration of the bees and equipment, making it a costly disease. However, **University of Nevada-Las Vegas** researchers have discovered a groundbreaking prophylactic treatment of honeybee larvae

using a cocktail of phage—or anti-bacterial viruses considered safe to humans—that increased bee survival up to 70 percent following exposure to American foulbrood.

Researchers at **Emory University** suggest that modern beekeeping practices may be creating an environment that increases the development of more virulent strains of deadly parasitic mites and associated diseases. They hypothesize that there is a direct relationship between transmission rate and incidence of more virulent strains of Varroa mites. To test this, they will track the movement of different mite lineages in managed and feral colonies and evaluate parameters of colony health. Fortunately, there is great potential for modifying beekeeping practices by encouraging the adoption of best management practices to better protect colonies from mites and diseases, thereby ensuring production of healthy honeybees.

The research and outreach efforts supported by NIFA, such as the **Bee Health eXtension Community of Practice**, provide growers and producers with information on pollination, pollinators, and management practices that will continue to keep these crops and honey yields productive in the future. ●

>> continued from page 5

and malignancies. The scientists noticed a change in the expression of three genes that control this growth-promoting signal, suggesting that soy-rich diets can slow or protect against the development of colon cancer.

FOOD SAFETY

ELIMINATING NOROVIRUS

Human noroviruses cause more than five million cases of foodborne disease every year, more than any other pathogen including *Escherichia coli* and *Salmonella*. A team of researchers led by **North Carolina State University** has discovered how noroviruses contaminate fresh produce, such as lettuce and kale. The research team has developed

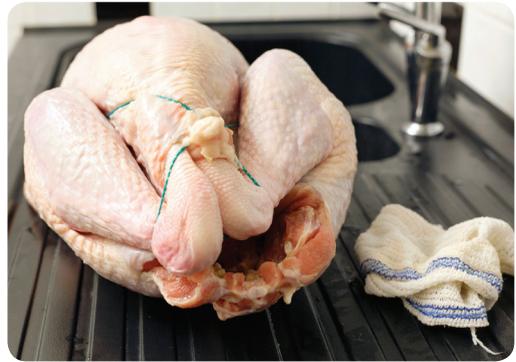


iStockphoto.com

surface sanitizers that reduce norovirus on food service worker gloves and food processing surfaces. Other promising approaches for the inactivation of noroviruses include gamma irradiation, high intensity pulsed light, copper surfaces, and nanomaterials. The project's education component is also training and placing food safety virologists, armed with the skills to tackle future food safety challenges, in academia and industry.

DON'T WASH YOUR CHICKEN

Up to 90 percent of people in the United States have been taught to rinse their raw chicken and turkey, and many recipes call for the practice. But a NIFA-funded project at **Drexel University** shows that washing



iStockphoto.com

raw poultry actually increases the chance of spreading bacteria around the kitchen. Instead of getting rid of bacteria, it increases the chance that rinsing will spray these harmful germs onto other surfaces in the kitchen. With NIFA's funding, the team also developed a public service campaign to inform people of the only tried and true method of killing bacteria: proper cooking techniques.

NEW NANOSURFACE REPELS BACTERIA

The invention of non-stick pans was a welcome relief for households and restaurants. Now, using nanotechnology, scientists have created a new surface that promises to repel bacteria and lessen the chance for contamination. Developed by researchers at **Cornell University** and **Rensselaer Polytechnic Institute**, the new technology uses an electrochemical process to create nanoscale pores that change the electrical charge and surface energy of a metal surface, which in turn exerts a repulsive force on bacterial cells and prevents attachment and biofilm formation. When this process was applied to aluminum, it created a surface called alumina, which proved effective in preventing *Escherichia coli* and *Listeria* from attaching to the surface. Alumina could provide a low-cost solution to bacterial contamination in the biomedical and food processing industries.

EDUCATION AND SCIENCE LITERACY

MISSOURI 4-H HELPS CHILDREN OF INCARCERATED PARENTS

The **University of Missouri's** 4-H Living Interactive Family Education Program promotes child-centered family visits between incarcerated parents, their children, and children's caregivers who raise them. These comprehensive visiting sessions consist of pre-approved, hands-on 4-H club activities and projects designed to promote citizenship, positive leadership, and healthy living. Evaluations have consistently shown that the program helps children learn how to be leaders and make healthy lifestyle choices, which helps keep them out of juvenile and adult criminal justice systems. The program also creates an estimated taxpayer savings of \$16,690 in juvenile delinquency costs and \$40,195 in adult crime costs per child in the program. The program is now being replicated in several other states.



istockphoto.com

TRIBAL RESEARCH PROJECT LEADS TO CLUES ON WATER CONTAMINATION

Blackfeet Community College in Montana used a NIFA research grant to teach students how to establish and monitor water quality in key Blackfeet waterways. Students learned to collect samples and analyze for benzene, toluene, ethyl benzene, and xylene. By establishing a baseline for water quality on these rivers, the Blackfeet reservation will now be



Photo supplied by university partner

able to detect changes in water quality caused by hydraulic fracturing near the reservation. This project taught students field research techniques and how to calibrate and read data from hydrocarbon analyzer sensors. In the future, the college hopes to find the source of contamination of the northernmost watershed of the Blackfeet Tribe, which has the highest concentration of hydrocarbons.

RURAL PROSPERITY/ RURAL-URBAN INTERDEPENDENCE

EMPOWERING YOUTH TO FIGHT FOOD INSECURITY

Orange County, California, is home to 155,210 children who are food insecure, more than 21 percent of the population. **California State University-Fullerton**, a Hispanic-serving institution, created a community-based Urban Agriculture Research Experience (U-ACRE) program to engage students to expand their interest in gardening and improve their access to food. The project is also training the next generation of food, agriculture, natural resources, and human scientists. U-ACRE gives hands-on, community-based research experience to undergraduate students who help local communities develop sustainable urban agriculture to achieve food security and provide families healthier food options.

FINDING SOLUTIONS TO AGRICULTURAL WATER CHALLENGES

A **MERICANS DEPEND ON A SAFE AND RELIABLE WATER SUPPLY. THE DROUGHTS** of recent years have put the issue in the spotlight, but it is much broader than a lack of water resources. Continued significant variations from the historical rate of water supply, demand, and quality are projected to have major impacts on agricultural, forest, and rangeland production systems. The science and management of water requires consideration about how this vital resource impacts food security, climate change, energy, health, and the environment.

In 2014, NIFA introduced a new Water for Agriculture initiative to address these challenges through the Agriculture and Food Research Initiative (AFRI) program. The grants funded through this program will be used to develop management practices, technologies, and tools for farmers, ranchers, forest owners, and citizens to improve water resource quantity and quality. NIFA's approach will link social, economic, and behavioral sciences with traditional biophysical sciences and engineering to address regional-scale issues.

NIFA has made the science of water a priority for many years, tackling critical issues by catalyzing development of both regional systems for the sustainable use and reuse, flow, and management of water, and at the watershed and farm scales, focusing on issues related to production agriculture and environmental sustainability efforts. Here are a few highlights of impacts from NIFA's water portfolio.

Contamination of raw produce has been increasingly implicated as the cause of foodborne outbreaks in the United States, with the bacteria *Escherichia coli* being one of the main culprits. Often the primary cause

of *E. coli* outbreaks is the contamination of the internal surface and tissue of plants, something that a postharvest wash is not effective in stopping. With NIFA funding through the Small Business Innovation Research (SBIR) program, **Saint Onge Orchids** in San Marcos, California, developed an automated irrigation system that generates and injects a food-safe disinfectant into irrigation water to prevent microbial growth on internal plant surfaces and tissues. The process uses ozonated water as the disinfectant solution. The average external contamination level was reduced by 22 times when the ozonated water was applied, and incidents of internal contamination, which were found to be directly linked to external contamination, were dramatically reduced using this new irrigation method.

Information and data are key for producers developing management plans for their production systems. But there is one thing they can never plan for: weather. Researchers from **Texas A&M University, North Carolina State University, and Purdue University** are using past climate data and analyses of current climate and precipitation and converting them into drought indices.



That data has been compiled into a drought trigger tool developed by these universities and is available online. Digital resources from this project also include other detailed drought information to help farmers and ranchers across the country make informed decisions tailored to their regional needs.

World freshwater usage:

70% ~ for food production

22% ~ for industry

8% ~ for households

Agriculture is a key player in reducing the growing pressure on water resources. Researchers at **Colorado State University** have been working to identify the water-related changes and pressures producers face in the Colorado River Basin to learn about management solutions that are working or have potential to conserve water throughout the region. The U.S. Department of the Interior has called for an initiative to help Colorado River Basin agriculture conserve as much as one million acre feet of water, which will require unprecedented changes in how water is used in agriculture. These changes

would affect current irrigation practices but, more importantly, multiple levels of political, social, economic, environmental, and administrative factors. During the severe drought of 2012, Colorado State University Extension staff worked with producers around the state to prepare them for the upcoming growing season and provide information on up-to-date, cutting-edge agricultural practices designed to maximize water use without compromising yields. The project team saw widespread adoption of limited irrigation techniques and well-designed irrigation technology, crop splitting, no-till, and moisture monitoring practices. Despite the historic drought conditions that occurred that same year, producers in Colorado achieved the 25th most productive corn harvest and 14th most productive wheat harvest in state history.

Water is the lifeblood of agriculture, and investing in science to preserve the quality and quantity of this essential element is critical. NIFA's investments are leading to solutions that maintain or improve water quality and resources for producers, industry professionals, and consumers across the country. ●



iStockphoto.com

MEETING CRITICAL VETERINARY NEEDS IN RURAL AMERICA

Livestock production in the United States is a complex operation. Veterinary services are critical to ensuring the health and well-being

of livestock. Many rural areas, however, face a shortage of veterinarians. A contributing factor is the high student debt incurred by these professionals, leading them to take higher paying jobs in urban areas. To help address this shortage, since 2010, **NIFA's Veterinary Medicine Loan Repayment Program** has made loan repayment awards to 286 veterinarians who have committed to working in a shortage area. Many recipients have been able to start large-animal care facilities in rural areas and acquire necessary equipment they would not have been able to purchase until after paying off their student debts.

NIFA IMPACTS

share your
SCIENCE!



Partner with NIFA to highlight your discoveries and accomplishments!



FOLLOW @USDA_NIFA & TWEET YOUR STORIES USING #NIFAIMPACTS



E-MAIL IMPACTSTORIES @NIFA.USDA.GOV



OR CALL THE IMPACTS COORDINATOR: 202-720-6133

ILLUSTRATE

to the American people how research, education, and extension are improving lives.

REPORT

to Congress that NIFA-funded projects are making a difference.

INFORM

state and local governments about the ways their partnership betters their communities.

COMMUNICATE

to partners and stakeholders the opportunities available to educate the next generation.

ENABLE

USDA *Leadership* to make sound decisions regarding mission priorities.

NIFA invests in and advances agricultural research, education, and extension and seeks to make transformative discoveries that solve societal challenges. Learn more by visiting WWW.NIFA.USDA.GOV or following @USDA_NIFA on Twitter.