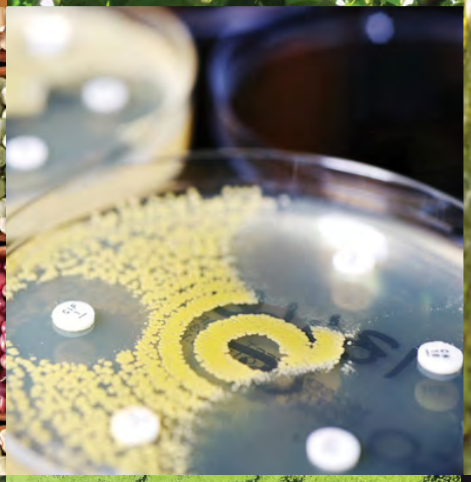
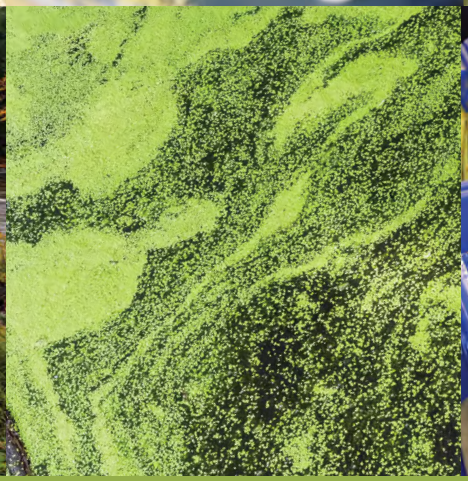
MICHIGAN STATE UNIVERSITY | AgBioResearch

MICHIGAN STATE UNIVERSITY | Extension

Legislative Report

2015-2016





MICHIGAN STATE UNIVERSITY | AgBioResearch

MICHIGAN STATE UNIVERSITY | Extension

Douglas D. Buhler
Director,
MSU AgBioResearch

We continue to appreciate the funding support granted to us by the Michigan Legislature. This allows Michigan State University (MSU) to carry on its land-grant mission of providing cutting-edge research, technology and outreach in an effort to boost Michigan's prosperity and economic vitality. This work is especially crucial as we face the challenge of finding solutions to feed and protect a growing world population.

The Flint water emergency highlighted the importance of having university resources embedded in communities throughout the state. The MSU Extension staff members on the ground in Flint responded quickly to community needs because we are a trusted local resource. (Find out more about how we continue to help Flint residents rebound on page 18.) Our staff members there mobilized quickly to help residents learn how to fight lead absorption through nutrient dense foods, feed their families healthful foods on a budget and band together as a community. They connected quickly with partners to expand the resources and assistance available to Flint residents.

In addition, we have regained capacity in MSU Extension after extensive budget cuts in 2010 forced us to reduce staffing numbers. Since late 2014, we have hired eight staff members focused on agriculture, increasing our expertise in dairy, field crop, vegetable, consumer horticulture and tree fruit production. These new staff members have hit the ground running and are quickly establishing partnerships with farmers and agricultural organizations that are helping farms and agriculture businesses drive progress in Michigan. By the end of 2016, we will add four more agriculture and agribusiness educators to our ranks.

Our research endeavors in agriculture and natural resources focus on such important topics as antibiotic resistance, animal well-being, invasive species, food safety, climate change, water quality and quantity, environmental impacts of agriculture and biotechnology. In this report, you will see how MSU continues to sharpen its focus on food production, our natural resources and things that matter most to Michigan residents and families.

It is widely known that we are facing a global food challenge – the need to double the world's food supply by 2050. Who will use their breadth and depth of expertise, from agriculture production to food safety to human health impacts, to make these discoveries?

Spartans Will.

Sincerely,

Doug Buhler, Director
AgBioResearch

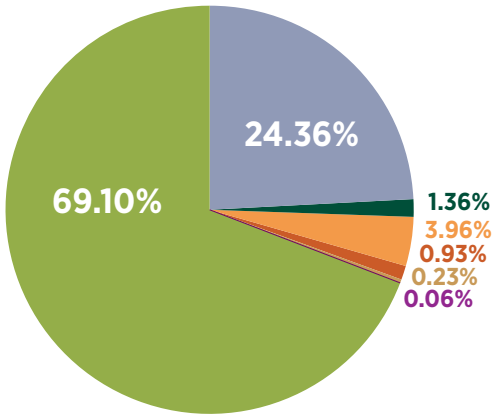
Jeff Dwyer, Director
MSU Extension

Jeffrey W. Dwyer
Director,
MSU Extension

Funding

MICHIGAN STATE UNIVERSITY | AgBioResearch

FUNDING FISCAL YEAR 2015–2016



State Appropriations
$32,508,300 .... 24.36%
FY Oct. 2015–Sept. 2016

MSU General Fund
$1,816,984 ..... 1.36%
FY July 2015–June 2016

Federal Hatch
$5,292,474 ..... 3.96%
FY Oct. 2015–Sept. 2016

Federal Hatch Multistate
$1,242,724..... 0.93%
FY Oct. 2015–Sept. 2016

Federal McIntire-Stennis
$309,403 ..... 0.23%
FY Oct. 2015–Sept. 2016

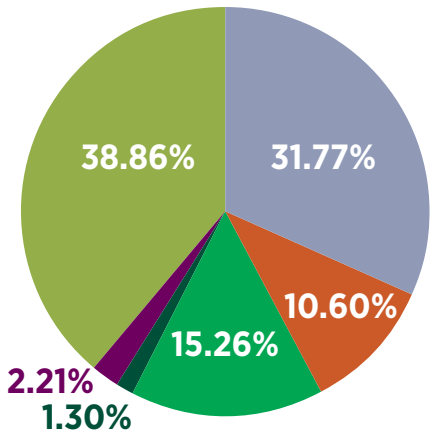
Federal Animal Health
$77,423 ..... 0.06%
FY Oct. 2015–Sept. 2016

Grants
$92,235,009 ..... 69.10%
FY July 2015–June 2016

TOTAL: $133,482,317

MICHIGAN STATE UNIVERSITY | Extension

FUNDING FISCAL YEAR 2015–2016



State Appropriations
$27,994,800 ..... 31.77%
FY Oct. 2015–Sept. 2016

MSU General Fund
$1,142,738 ..... 1.30%
FY July 2015–June 2016

Federal Cooperative Extension
$9,339,809 ..... 10.60%
FY Oct. 2015–Sept. 2016

Federal Special Projects
$1,945,277 ..... 2.21%
FY Oct. 2015–Sept. 2016

County Investments
$13,446,660 ..... 15.26%
FY Varies

Grants
$34,244,662..... 38.86%
FY July 2015–June 2016

TOTAL: $88,113,946

Connecting with residents

Since its inception more than 100 years ago, MSU Extension has been actively helping people improve their lives by reaching them where they are – in their homes, farms, businesses and communities.

Through combined face-to-face trainings, online webinars, social media, website interaction and electronic newsletters, MSU Extension has made more than 8.8 million connections using the most recent available data.

More than 149,000 adults* and 203,000 youth† participated in MSU Extension programming in the most recent year. More than 3.7 million people viewed more than 7.2 million pages on the MSU Extension website.‡ Of those, more than 760,000 were Michigan residents. MSU Extension remains one of the most visited Cooperative Extension System education websites in the country.

MSU Extension also distributes a series of electronic newsletters that cater to residents' unique interests. Last year, nearly 1.3 million newsletters covering 90 topic areas were distributed to about 16,900 email addresses.‡

MSU Extension uses social media channels to reach people with educational content. Currently, Extension reaches more than 3,500 Facebook followers and more than 2,800 Twitter followers.‡ In addition, Michigan 4-H families and volunteers stay informed about activities through social media channels, including on Michigan 4-H Facebook with more than 4,000 likes and on Twitter with more than 1,300 followers.‡

Year-to-year increase using most recently available data:

- **37.5% increase in connections made by MSU Extension**
- **4.2% increase in adult participation in MSU Extension programs**
- **11.5% increase in youth participation in MSU Extension programs**
- **48% increase in MSU Extension website visits**
- **35.9% increase in MSU Extension website page views**
- **55.8% increase in MSU Extension website visits from Michigan**
- **73% increase in sign-ups for topic newsletter distribution**

*From ES237 Federal Report – Oct. 1, 2014, to Sept. 30, 2015
†From Michigan Extension Planning and Reporting System – Jan. 1, 2015, to Dec. 31, 2015
‡From July 1, 2015, to June 30, 2016

Fueling the economy

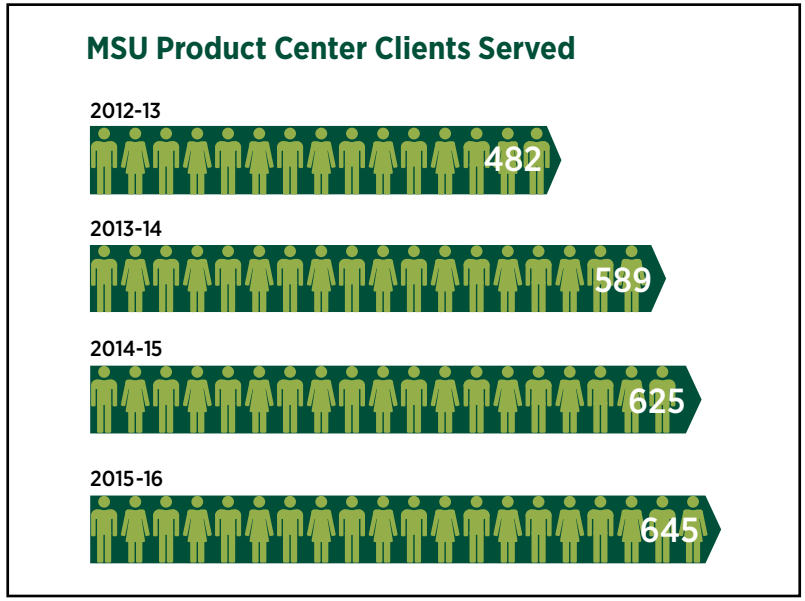
Fundamental to the mission of MSU Extension is working with entrepreneurs to grow businesses, create jobs and strengthen the economic vitality of individuals and communities. Food and agriculture are a driving force in Michigan's economy, with an MSU Product Center Food-Ag-Bio report showing that the agriculture system generates more than $100 billion of economic activity every year.

The MSU Product Center strengthens this important sector of the economy by connecting food entrepreneurs with innovation counselors who offer the latest research and best practices, identify markets, innovate new products and help guide the process from concept to launch.

The center's statewide network of counselors helps both new and established businesses deliver high-value products to consumers in Michigan and throughout the United States.

In 2015-16, MSU Product Center professionals conducted 4,168 counseling sessions with 645 clients, resulting in:

- **Nearly $40.5 million in total capital formation, including more than $9.4 million of owner capital investment in Michigan businesses.**
- **62 new ventures launched.**
- **324 jobs created or retained.**



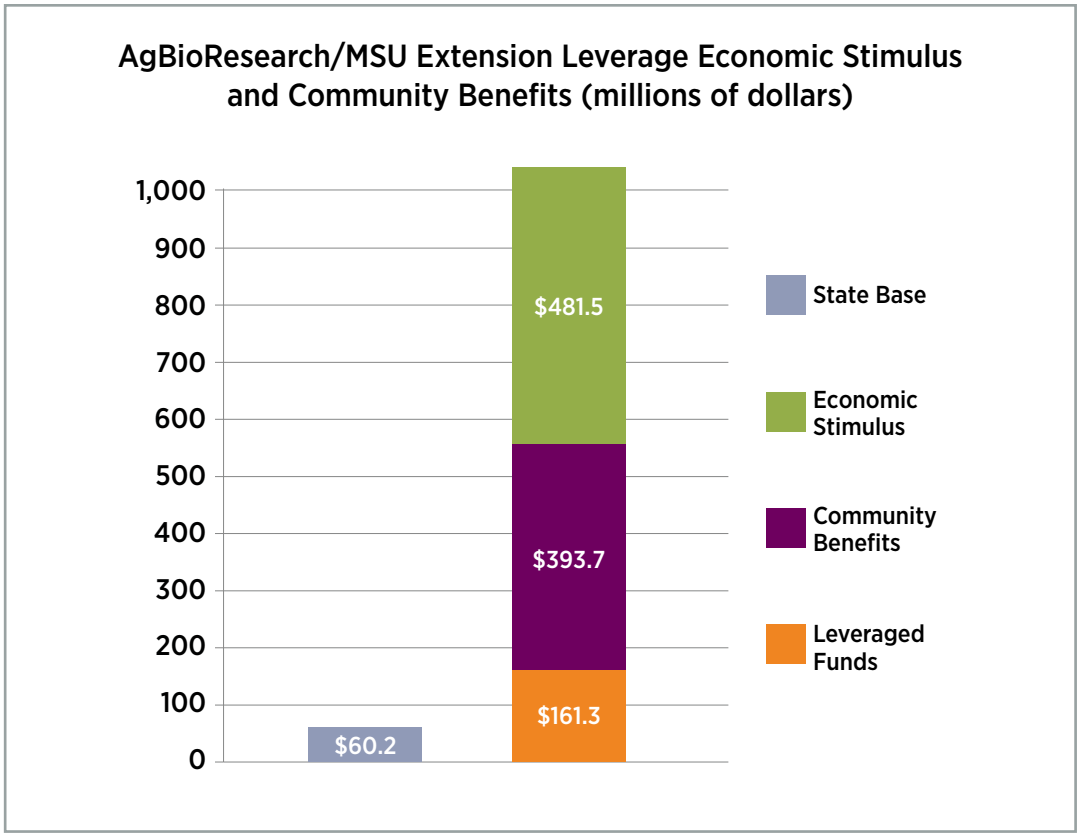
Leveraging state funding

The state's $60.2 million investment in MSU AgBioResearch and MSU Extension generated a total impact of more than $1 billion for Michigan residents in 2015-16.

Every dollar the state invested in MSU AgBioResearch and MSU Extension resulted in:

- **LEVERAGE** of an additional $2.68 in federal funds and external contracts, grants and other revenues to serve Michigan residents.
- **COMMUNITY BENEFITS** worth an additional $6.54 to the state and nation.
- When the leveraged funds and community benefits are added to the initial investment, they yield a net **ECONOMIC STIMULUS** valued at nearly $500 million in state economic activity and state tax revenues.
- Combining the above effects, along with the additional tax revenue, returns to the state economic and social benefits in a **BENEFIT/COST RATIO** of 19:1.

Continuing to invest in MSU AgBioResearch and MSU Extension is vital to the state's economy, our communities and our residents.



Economic analysis by Steven R. Miller, Center for Economic Analysis, MSU Department of Agricultural, Food and Resource Economics

Educating the nonfarming public with Breakfast on the Farm

Less than 2 percent of the U.S. population is directly involved with agriculture and food production, and 72 percent of consumers surveyed reported knowing nothing or very little about farming. As the public becomes increasingly disconnected from their food sources, MSU Extension is working to rekindle those connections to help consumers better understand the role of agriculture in everyone's lives.

Since its debut in 2009, nearly 75,000 visitors and volunteers have participated in MSU Extension Breakfast on the Farm (BOTF) events at various farms throughout Michigan to help bridge the gap between consumers and producers. To educate consumers about the wide variety of agriculture produced in Michigan, BOTF has hosted events at beef, dairy, field crop, potato and apple farms. This helps keep the program fresh and grants consumers a greater understanding of Michigan's vast agriculture industry.

Photo: © Memories by Mindy

Photo: © Luna Duke Photography

- **In 2015, five BOTF events around the state attracted 12,068 participants and 1,413 volunteers.**
- **According to exit surveys, 72.5% of all participants had been on a farm five times or less in the past 20 years.**
- **Exit surveys show that participants have an increased level of trust for local farms after the visit.**

Helping producers with new FDA guidelines pertaining to antibiotic use

Antibiotics are vital to a thriving animal agriculture industry, combatting a range of serious infections caused by bacteria, such as bovine mastitis, enteritis and respiratory disease. Antibiotics have proven so effective that, for the past half-century, they have been applied in low doses to animal feed and water even in the absence of disease for small gains in growth and productivity.

However, new Food and Drug Administration guidelines eliminate the use of feed- and water-based antibiotics for livestock production enhancement. All antimicrobial use for food-producing animals will now take place under the guidance of veterinarians through a veterinary feed directive.

Dale Rozeboom, an MSU professor of animal science and Extension specialist, said the change in antimicrobial policy is an opportunity for positive growth within the industry. The less antimicrobials used, the greater the chance that genes will not develop resistance or be passed on to future generations of pathogens. This process increases the hardiness of the genes and reduces the effectiveness of drugs employed against them. In absence of antibiotics, Rozeboom said there are a range of management strategies and nonpharmacological additives available, such as:

- Farmers will be able to select those strategies and additives that best fit the specific situations of their farms.
- Water is another possible means to deliver additives to the animals. For example, a research trial in which dried egg yolk containing antibodies for specific *E. coli* strains was added to the drinking water of young pigs to optimize health showed promising results.
- Sanitation, climate control, weaning age and farm traffic are all important dimensions of the livestock industry that researchers are working on to improve animal health. They are partnering with farmers on sanitation protocols – specifically on "all-in/all-out sanitation," a technique designed to break disease cycles on the farm by ensuring that rooms that have been cleaned are not immediately re-exposed to pathogens.
- Improvements in ventilation and heating also stand to benefit livestock. MSU Extension conducted a project, finding that reducing housing temperatures at night may actually improve animal health.
- Adjusting the age at which animals are weaned for production purposes could make up for the lack of antimicrobials. Currently, pigs are weaned between 19 and 21 days, but new research suggests delaying that to 24 or 25 days may help the animals be less susceptible to disease.
- Improving biosecurity also protects farm animals. Preventing unnecessary traffic to and from the farm, keeping feed trucks clean and knowing where they come from is one of the best ways to limit the spread of pathogens.

Photo: © Istock

- MSU AgBioResearch and MSU Extension provide educational sessions, such as the annual Great Lakes Professional Cattle Feeding and Marketing course, and help veterinarians prepare for the increased demand that producers will have for services.

"The big thing to understand, from the public's point of view, is that our food supply is still one of the safest, if not the safest, in the world with regard to animal foods," said Daniel Grooms, MSU professor of large animal clinical sciences. "We understand consumer concern and are always looking to improve our production practices, and this is one step we can take to improve on an already pretty safe system. At MSU, we're always looking for ways to help producers adapt without antibiotics and make that transition while still maintaining productivity and economic viability."

Photo: MSU Communications & Brand Strategy

Improving feed efficiency in dairy cattle through genomics

MSU livestock nutritionist Michael VandeHaar (photo above right) and his colleagues are working to bring the cost of dairy cattle feed down by combining genomics and nutrition science to breed cows that require less food to produce the same volume of milk.

By studying the DNA of cows in university dairy herds, the team has been able to identify the animals that ate less than expected based on their production. Through genetic samples they took, the team members are analyzing the genetic data to determine which genes are related to feed efficiency. Once complete, they will have a final equation for feed efficiency to deliver to the industry.

MSU Extension educators and specialists are also developing educational tools to communicate these findings to breeders, producers and dairy nutritionists, and working to provide the industry with a state-of-the-art web-based tool to analyze feed efficiency and grouping practices on commercial farms.

- **Michigan dairy farmers spend an estimated $730 million annually to feed their herds, or about $5 per cow per day.**
- **Michigan is home to approximately 400,000 dairy cows spread across nearly 1,900 herds.**
- **Improving feed efficiency in dairy cows is estimated to reduce feed costs by approximately 50 cents per cow per day.**

Increasing dairy farm profits with Calf Care Schools

Proper care and management of heifer calves has a tremendous impact on their future success as lactating dairy cows, which in turn affect a farm's profitability. Dairy farmers strive to raise healthy heifers that are ready to enter the milking herd at 22 to 24 months of age to ensure maximum return on investment. To achieve this, farm employees need to have the knowledge of and employ science-based best practices to care for calves, and understand the benefits of specific calf-care protocols.

MSU Extension dairy educator-led Calf Care Schools provide important, trusted information and training that can be implemented on any dairy farm. These workshops teach participants the practical application of profitable calf management during the calves' first two months of life – from birth to weaning.

- **In 2015, more than 80 participants took part in three Calf Care Schools programs.**
- **Based on survey results, over 70% of participants said the program significantly increased their knowledge in colostrum management and the proper sanitation of equipment.**
- **Roughly 50% of survey participants said they planned to make changes on their farms based on what they learned.**

Teaching youth and the public about animal care and well-being

As the public moves farther and farther from the food production process, many consumers have questions about the care and well-being of animals raised for human consumption. These concerns are often voiced to youth at fairs and exhibitions – an easy access point for consumers looking to connect with animal producers. As unsuspecting spokespersons for the food animal industry, young people must be equipped with the appropriate answers to address these questions as well as the skills to be good animal caretakers at home and in the public eye.

To instill youth with this knowledge, MSU Extension developed the Michigan 4-H Animal Care and Well-Being materials. These resources have the answers to the most frequently asked questions about animal welfare and behavior for 11 different 4-H project areas, as well as for general animal well-being concepts. In 2015-2016:

- **More than 60,000 copies of Animal Care and Well-Being resources were distributed across Michigan and 11 trainings were held to educate 4-H'ers.**
- **Preliminary program data indicate more than 5,000 individuals have already read or used the materials and 100% of respondents agreed the resources were useful for youth, adults working with youth and the public.**

Photo: ©iStock.com/Hillview1

Photo: ©iStock.com/curtoicurto

Educating the public on new regulations for group sow housing

Housing sows in individual stalls is commonplace across the pork industry because fighting between pigs can negatively affect performance and result in injury. However, growing consumer concerns and increased scrutiny of individually housed sows prompted several states throughout the country – including Michigan – to pass legislation mandating that pregnant female swine be group-housed for specified portions of gestation. To help producers solve issues such as aggressive behavior that may arise from group-housing sows, MSU Extension and MSU AgBioResearch are taking a threefold approach that addresses customized housing solutions, management practices and tools, and research that looks into genetic traits that lead to aggression in pigs.

- **The Sow Housing Options Tool and accompanying resources help producers economically evaluate different group-housing options and allow for examination of individual production scenarios to find a customized solution.**
- **The Positive Pig Handling program identifies proper equipment, facilities and tools needed to move pigs in a manner that creates low-stress environments for animals and handlers.**
- **A collaborative project between MSU and Scotland's Rural College will determine how swine genetics play a role in aggressive behavior, aiming to use genetics to reduce aggression in group-housed pigs.**

Photo: MSU Extension Communications

Preparing youth for future careers in agriculture

As a pillar of Michigan's economy, agriculture must continue to grow and thrive. One way to ensure this success is to prepare an informed and skilled workforce ready for careers in this essential sector.

To meet this need, MSU Extension offers youth a continuum of learning opportunities in the agriculture industry. These opportunities range from interactive experiences such as 4-H Renewable Energy Camp and World Food Prize Michigan Youth Institute, to educational resources such as the Youth Business Guide to Success animal marketing curriculum and zoonotic disease prevention tools. Through these experiences and resources, as well as county 4-H projects, youth are educated about agriculture and prepared for careers in this important industry. In the last program year:

- **More than 24,000 4-H youth participated in animal, biological and plant science projects in 78 counties.**
- **More than 850 youth took part in Michigan 4-H pre-college programs with an agricultural focus. These programs, which include 4-H Exploration Days and 4-H Animal and Veterinary Science Camp, among others, are designed to help youth explore potential careers or academic areas.**

Tilling healthier soils through long-term research

Soil organic matter is a key feature of healthy, high-yield soil. Accruing in the form of aggregates in the soil, organic matter builds slowly over the course of decades. These aggregates provide food for countless species of bacteria and fungi, which then release nutrients back into the soil that are consumed by the crops above. This results in higher yields, better drought resistance and a lower reliance on chemical fertilizers. Conventional tilling breaks up soil organic matter however, slowly eroding the healthy soil and reducing its productivity.

MSU researchers at the W.K. Kellogg Biological Station (KBS) have been conducting long-term studies of soil health management practices to help farmers restore soil organic matter and, in turn, improve soil health. Researchers have found practices such as no-till management, which does not disturb the soil with plows and preserves existing soil organic matter while providing an environment in which more can form.

- **It can take more than 10 years for soil change.**
- **Over the course of 40 to 60 years, soil under conventional agriculture will lose between 40% and 60% of its organic matter.**
- **During the 2012 drought, soybeans under no-till management at KBS experienced 50% greater yields than those under conventional management.**

Photo: MSU Communications & Brand Strategy

Leading the charge against the spotted wing drosophila

A tiny vinegar fly from eastern Asia called spotted wing drosophila (SWD) is fast becoming one of the most intensively studied insects at MSU. MSU scientists began studying SWD in 2010 immediately after its discovery in Michigan. Since then, more than 30 MSU research projects targeting the fly have launched.

In 2010, MSU entomologist Rufus Isaacs began monitoring for SWD in Michigan using small plastic containers with holes, filled with an attractant (at first, apple cider vinegar and now, a mixture of sugar and yeast) and a sticky trap. Since then, the invasive pest has been discovered across the Lower Peninsula.

SWD populations can balloon quickly, and because SWD does not have distinct generations, it is a difficult pest to target and treat.

- **The SWD infests various fruit crops, a Michigan industry valued at more than $375 million per year.**
- **MSU researchers are also utilizing attraction methods first studied with the Japanese beetle and Oriental fruit moth. A project examines the use of small nylon pouches that hang from trees or bushes. The pouches are treated with insecticides and filled with attractants such as pheromones or food to lure and kill the insects on contact.**

Illustration: MSU AgBioResearch

Improving food security through pollination

Specialty crops including apples, blueberries, cherries and peaches, depend on pollination to produce marketable fruit. Recent years, however, have seen the nation's pollinators face serious challenges. From 2006 to 2013, approximately 10 million American honeybee hives have been lost due to colony collapse disorder. During the same period, wild pollinators such as bumblebees have been in serious decline across the country.

MSU researchers have joined with scientists from 15 partner institutions to explore the viability of using native and wild bee species as an alternative pollination strategy. Researchers are endeavoring to provide fruit, nut and vegetable crop growers with a comprehensive set of pollination options to implement on farms, combining data from around the country to identify which regions will benefit from a greater investment in pollinator habitat.

The findings will help growers assess their pollination needs, and an electronic decision support tool will help managers select farm-appropriate pollination strategies.

- **Approximately $4 billion of the national agricultural economy is dependent on pollination.**
- **35% of the world's food crops are reliant on pollinators.**
- **Between 2008 and 2013, wild bee populations have diminished across 23% of the country, including 39 percent of the agricultural regions most heavily dependent on pollination.**

Photo: MSU Communications & Brand Strategy

Photo: MSU Communications & Brand Strategy

Adapting human medical technology to predict plant diseases

A biosensor developed at MSU to detect pathogens in humans has been reconfigured with plant genomic data to target specific plant pathogens. By combining research from plant pathology, plant genetics and human medicine with cutting-edge technology, the MSU team is pushing the boundaries of what is possible in plant epidemiology. Predicting the next plant epidemic could have far-reaching benefits across agriculture.

Plant diseases are spread by a wide range of pathogens – including fungi, bacteria, nematodes and viruses – and the potential damage is alarming.

- **An outbreak of fire blight in 2000 carved a wide swath through Michigan's orchards, resulting in an estimated $42 million in losses and destroying between 350,000 and 450,000 apple and cherry trees.**
- **Plant pathogens cause about $60 billion in losses each year in the U.S. alone.**
- **In 2014, an outbreak of white mold in Michigan soybeans destroyed approximately $50 million worth of crops.**

Raising awareness of the benefits of cover crops

Cover crops are a hot topic in agricultural circles, thanks to an MSU Extension specialist's message that's resonating with the right crowd. Dean Baas, a senior research associate, conducts cover crop and organic agriculture research and education.

Cover crops are plants seeded into agricultural fields, either within or outside of the regular growing season, with the primary purpose of improving or maintaining ecosystem quality. Environmental benefits include enhanced biodiversity, increased soil infiltration and attraction of honeybees and beneficial insects.

Researchers are focusing on ways cover crops can be used by farmers to bring diversity to the crop system; to reduce reliance on fertilizers, herbicides and pesticides; and to determine the impact of cover crops on overall operation economics.

Initial studies have shown that:

- **Farming benefits include reduced erosion, improved soil quality through increased porosity, soil organic matter and water-holding capacity, as well as the addition of beneficial microbes.**
- **Cover crops help retain nutrients that otherwise would be lost.**
- **Cover crops add nitrogen through fixation while combatting weeds and breaking disease cycles.**

Photo: MSU Communications & Brand Strategy

Community & Economic Development

Photo: MSU Communications & Brand Strategy

Animal agriculture challenges addressed through partnership between MSU, commodity groups

Michigan food and agriculture has a $100 billion economic impact on the state and includes diverse cropping systems and a wide range of animal agriculture. In an effort to leverage Michigan's leadership in the field, animal agriculture commodity groups invited MSU to join the Michigan Alliance for Animal Agriculture (M-AAA) in 2014. The initiative is focused on addressing the most relevant challenges facing the industry through research and outreach programs in the areas of enhanced growth and sustainability of animal agriculture, improvements in food safety, protection of the environment and growth in the available workforce in the livestock sector.

The M-AAA annually offers a competitive grants program with projects fitting into one of three categories: applied research, extension or seed grants. A team consisting of representatives from each of the M-AAA stakeholder groups reviews project submissions. Awards are granted based on applicability to industry priorities. Limited funding makes the process extremely competitive, and many worthy projects are left out.

"The Michigan Alliance for Animal Agriculture is a testament to the strong partnerships between Michigan State University and the agriculture sector in Michigan," said George Smith, associate director of MSU AgBioResearch. "The M-AAA grants program has enhanced the ability of MSU scientists to tackle relevant issues linked to economic growth and sustainability, and environmental stewardship within the animal industries."

MSU researchers and Extension specialists actively engage with the industry, combining scientific expertise with practical knowledge, to address and solve real-world issues in areas such as:

- Nutrition management
- Food safety
- Animal health and welfare
- Disease management
- Biosecurity
- Antibiotic resistance
- Manure management
- Food processing
- Workforce development
- Food security
- Reproductive management
- Consumer behavior
- Environmental issues

In 2015, the first year of M-AAA research, 17 projects were funded by an MSU contribution of more than $630,000. Topics such as dairy cattle productivity and profitability, winter manure storage, poultry housing and welfare, and feedlot cattle welfare were studied. Fifteen projects are underway in 2016, with more than $600,000 in MSU funding, including examining attitudes toward animal agriculture, controlling bovine leukemia virus and reducing antibiotic resistance. The Michigan Milk Producers Association (MMPA) contributed $50,000 for work with the bovine leukemia virus.

The M-AAA anticipates roughly $1.6 million in funding for 2017 from the State of Michigan, MSU and the MMPA.

"We believe the growth of the M-AAA grants program will allow our research to have an even more significant impact on our partner organizations and producers around Michigan," Smith said. "More projects will receive funding, and that means more research findings can be shared with the animal agriculture community in a timely manner."

M-AAA partner organizations include the Michigan Allied Poultry Industry, the Michigan Cattlemen's Association, the Michigan Farm Bureau, the Michigan Horse Industry, the Michigan Meat Association, MMPA, the Michigan Pork Producers Association, the Michigan Sheep Breeders Association, MSU AgBioResearch, MSU College of Agriculture and Natural Resources, MSU College of Veterinary Medicine and MSU Extension.

For more information, visit *maaa.msu.edu*. The M-AAA website contains information on industry priorities, the 2017 request for proposals and more.

Photo: ©iStock.com/ Laura Flugga

Building entrepreneurial spirit and skills

As the backbone of the economy, small business owners play a critical role in the prosperity of the nation. But to be a successful entrepreneur, one must have not only the ambition and moxie to take a risk, but also the business sense and skill to make a profit. To ensure the business owners of tomorrow – today's youth – are triumphant in their future endeavors, they need to learn the entrepreneurial concepts that pave the way for success.

MSU Extension is helping to meet this need by providing youth and the adults that support them with the skills and resources necessary to turn ideas into business ventures. Through simulations and workshops, youth learn how to develop business plans and operate their own companies, as well as how to be more entrepreneurial in their everyday 4-H experiences. In 2015, these programs were delivered to nearly 1,200 people in 59 Michigan counties.

As a result:

- **92% said they learned how entrepreneurial skills could be used in any career, and 60% reported planning to start their own businesses.**
- **Six youth from the Branch County 4-H Youth Entrepreneurship Program started their own businesses and began selling their products at a local store.**

Improving the fiscal health of Michigan communities

Only with healthy, vibrant communities can Michigan residents be expected to thrive. To help Michigan prosper in a sensible, sustainable fiscally responsible way, MSU Extension launched the Center for Local Government Finance and Policy in late 2015.

The center is led by MSU Extension economist Eric Scorsone, (photo below), who has assisted multiple cities during fiscal crises including Detroit, Flint and Lansing. The center will advise cities during fiscal hardships so communities can find a sustainable path forward. It will also develop fiscal tools and offer outreach to help communities improve their fiscal health. In addition, the center is committed to connecting legislators with experts in public policy and forging partnerships in the public and private sector.

The center's efforts include:

- **Assisting in the development of performance metrics for government budgets, strategic plans and public accountability reporting.**
- **Providing an overall assessment of long-term and short-term trends in revenues, expenditures, debt, general fiscal health and recommendations regarding adoption of financial policies.**
- **Publishing an annual local government fiscal health report for communities wishing to improve fiscal health.**
- **Publishing an annual legislative mandate report that identifies the costs imposed on local governments and their impact on fiscal and operational health.**

Photo: MSU Extension Communications

Providing the wine industry with important market research

Wineries are a major tourist draw, but most Michigan wineries are small operations, primarily selling from tasting rooms rather than major retail outlets. Most cannot afford to engage in lengthy, detailed market research. MSU tourism expert Dan McCole is helping wineries better understand their customers by researching consumer habits.

Important characteristics about Michigan winery customers emerged as identified in McCole's findings. For example, most are casual drinkers without extensive background knowledge about wines. They are drawn less by the desire to test their refined palates than by the social experience and atmosphere of wine tasting.

This study has helped the Michigan Department of Agriculture and Rural Development (MDARD) incorporate the importance of wine tourism in its planning. McCole's team is now working to replicate and validate this study in Minnesota and Wisconsin. Furthermore, MDARD has requested that the study be conducted again next year to provide an update.

Photo: MSU Communications & Brand Strategy

- **Michigan is home to more than 200 wineries and nearly 3,000 acres of wine grape production.**
- **The wine industry contributes $300 million annually to the state's economy, ranking 10th in the nation.**
- **Michigan wineries attract over 2 million tourists each year.**

Photo: ©iStock.com/Shaith

Expanding the hop and barley industry in Michigan

With the continued surge of interest in craft brewing as both a hobby and money-making opportunity, Michigan brewers are increasingly seeking out locally sourced ingredients. MSU has helped both hop and barley growers meet this increased demand through research-based education and outreach. In the past 10 years, Michigan has grown from producing virtually no hops to being the fourth largest hop producer in the United States. On the barley front, demand for a Michigan-grown product renewed interest in a long-dormant 1916 MSU cultivar Spartan barley. Now, MSU AgBioResearch plant breeders are working to bring it into production.

MSU Extension hosts the annual Great Lakes Hop and Barley Conference to provide new and experienced hop and barley growers, processors and brew masters with the latest in growing and processing techniques to meet the needs of a rapidly expanding brewing industry.

The event:

- **Drew 344 registrants and more than 380 total participants.**
- **Held three concurrent educational sessions: Hop Introductory Track, Hop Advanced Track and Malting Barley Track.**
- **Met the needs of attendees with 41% attending the Hop Introductory Track, 30% attending the Hop Advanced Track and 29% attending the Malting Barley Track.**

Fighting turf diseases with advanced cultivars

Dollar spot, a foliar disease named for the silver dollar–sized dead patches and silvery film it leaves behind, is the most common and costly disease of turfgrass in the Northeast and Midwest United States. It is particularly problematic for golf courses in those regions that rely on creeping bentgrass and annual bluegrass for their greens and fairways.

MSU researchers released Flagstick, the first turfgrass cultivar that shows resistance to the fungal pathogen that causes dollar spot. A variety of creeping bentgrass, Flagstick grows well in a range of different soils, is among the most winter-hardy turfgrasses available and maintains good coverage even when mowed to less than 0.1 inches.

- **More money is spent worldwide on the chemical control of dollar spot than any other turf disease.**
- **20,000 pounds of Flagstick seed were produced to ensure the supply could meet the high demand for the 2016 season.**
- **Flagstick will reduce the environmental and financial impact of fungicides on golf courses wherever dollar spot is a threat.**

Helping nurseries get the most out of their water

MSU scientists Tom Fernandez, Bert Cregg and Bridget Behe combine technological, pathological and marketing expertise to create a system for container plant nurseries to purify and recycle water and fertilizers.

The team conducts experiments on nursery beds to determine the efficiency and impact of various irrigation techniques. In addition, they test subsurface bioreactor systems – layers of organic material such as woodchips or bark – deposited beneath the growing surface to naturally cleanse runoff water of chemical impurities. They examine the impact of recycled water on plant growth and the potential impact of fertilizer or pesticide chemicals it might carry.

The team studies how consumers incorporate information about the water usage and sustainability of greenhouse and nursery products into their purchasing decisions. They use eye-tracking technology to determine how consumers read plant displays that highlight water use information.

- **Approximately 75% of nursery crops are grown in containers.**
- **Nursery plants account for a $1.2 billion industry in Michigan.**
- **During the peak growing season, a container nursery could require between 14,000 and 19,000 gallons of water per acre per day.**

Photo: MSU Communications & Brand Strategy

Joseph Vargas, Plant Soil And Microbial Sciences

Partnering with county treasurers to keep people in their homes

Strong homes make strong communities, and strong communities make a stronger Michigan. Unfortunately, many homeowners are experiencing financial adversity and face the possibility of foreclosure. Many MSU Extension staff members are Michigan State Housing Development Authority–certified counselors who work one-on-one with homeowners who have fallen behind on their property taxes or mortgage.

In 2016, MSU Extension partnered with Macomb County treasurer Derek E. Miller to provide counseling to more than 150 Macomb County residents who are struggling to pay their property taxes. This collaboration between MSU Extension and government office was born of the common goal that ensuring long-term community sustainability is dependent on the financial health of each home.

- **Treasurer Miller is committed to giving Macomb County residents every option they can to save their homes, and he recognizes MSU Extension as a vital knowledge resource connected to the community that can help homeowners be successful.**
- **The one-on-one counseling includes educating homeowners on their individual situations and the options they have, connecting them to crucial financial assistance programs, and helping them implement a plan of action toward financial recovery and stability.**

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Training Michigan's next Master Gardeners

Nearly 70 percent of Michigan households engage in some type of gardening: 6.7 million Michigan gardeners are putting their green thumbs to work. However, without science-based gardening information, Michigan gardeners might not enjoy the full fruits of their efforts. More importantly, their lack of knowledge could negatively affect Michigan's water quality, food security, soil health and pollinators such as bees and butterflies. MSU Extension's Master Gardener Program addresses those potential issues through trusted, research-based gardening education.

In 2015, 609 Michigan residents from 44 counties attended MSU Extension Master Gardener basic training courses. Additionally, six public webinars took place to discuss a variety of topics ranging from "Protecting the Power of Pollinators" to "Gardening in Urban Soils."

- **2,832 MSU Extension Master Gardeners (EMGs) from 75 counties provided 162,818 volunteer hours and reported an additional 336,449 contacts with Michigan residents in 2015.**
- **54% of applicants said friends and family informed them of the Master Gardener program, indicating strong word of mouth and satisfaction throughout Michigan communities.**
- **Webinars resulted in 760 live views by 680 EMGs plus an additional 3,817 recorded views by EMGs across the state.**

Forever Flint: Helping a community rebound from tragedy

When reports of lead-contaminated water in Flint first hit, support surged into the area from across the country in hopes of helping the once-thriving city repair damage done from months of neglect. Michigan State University was one of the first on the scene – not because it ran faster than other organizations, but because it was already there.

"MSU Extension has a 100-year history of working with the people of Flint," said Jeff Dwyer, director of MSU Extension. "Our staff already had close relationships in the community because they are part of the community."

While organizations, public and private entities, and even celebrities raised money and awareness, and shipped in tons of bottled water, MSU Extension staff knew their role was not to provide short-term relief but long-term solutions and long-lasting education.

"Our big advantage is that we didn't have to start from scratch," Dwyer said. "We came together and determined where to deploy our staff already on the ground in Flint, whom to bring into the city to help bolster our efforts, and how our existing education could be used and modified to help address the families dealing with the water crisis."

An early decision was to make Deanna East MSU Extension's point person on the ground. East, an MSU Extension health and nutrition specialist, worked with staff based in Genesee County to coordinate outreach efforts and work with other organizations inside and outside of Flint that wanted to help but didn't have the local connections or infrastructure of MSU Extension.

"We worked tirelessly to connect the dots, and it wasn't just my responsibility," East said. "Our entire staff went above and beyond. They worked so that smaller efforts could be brought together and have a huge impact on the community."

While the immediate response was to ensure that the health and safety of Flint's residents was being addressed, particularly that of young children, the lead-tainted water was not just a health crisis. It was an infrastructure crisis, a public policy crisis, a nutrition crisis and a crisis of faith in public institutions.

Photos Pages 18-19: MSU Communications & Brand Strategy

Because MSU Extension staff members were embedded in these neighborhoods working to solve local issues long before this crisis hit Flint, and because they would be there long after the spotlight turned elsewhere, they knew they had to do all they could to help the people of Flint.

MSU Extension's efforts included:

- Health and nutrition staff tailored existing Supplemental Nutrition Assistance Program–Education outreach to hard-hit neighborhoods, focusing on mitigating the harmful effects of lead with good nutrition.
- Health and nutrition staff partnered with Hurley Children's Hospital to offer cooking classes at the Flint Farmers' Market that focus on foods high in iron, calcium and vitamin C, which can help mitigate the harmful effects of lead.
- Youth educators helped Michigan 4-H organize a 4-H SPIN (special interest) club involving water filtration and helping people understand the science behind and the importance of drinking filtered or bottled water. Educators also concentrated on how learning and play could boost the development of youth who might have been exposed to lead.
- Agriculture educators worked with commodity organizations statewide to think beyond supplying water and understand the value of donating nutritious foods to the people of Flint with the help of the Food Bank of Eastern Michigan.
- Community food educators used existing partnerships, including working with Edible Flint, a community group focused on growing and providing healthy foods, to furnish water filters and hose filters as well as supply and facilitate soil tests.
- The MSU Extension Center for Local Government Finance and Policy organized the Michigan's Municipal Water Infrastructure conference, attracting top Michigan researchers not only from MSU but also from Eastern Michigan University, Grand Valley State University, Oakland University, the University of Michigan and Wayne State University. A number of Michigan legislators and public works officials also attended.
- MSU Extension supported food hub planning meetings and helped organize the FoodWorks incubator kitchen at the Flint Farmers' Market. The kitchen acts as a food hub, helping to facilitate the business management, aggregation, storage, processing, distribution and marketing of locally produced food products. This allows plentiful and healthy food options, improving healthy food access in hard-hit neighborhoods.

Since July 1, 2015:

- **More than 8,000 people have attended lead-specific events held in Genesee County.**
- **More than 26,000 visitors from Genesee County have visited the MSU Extension website.**
- **More than 58,000 unique pages were viewed on the MSU Extension website from Genesee County visitors.**
- **More than 9,000 pages were viewed on lead-specific news, resources, programs and events on the MSU Extension website.**

Energy Production & Conservation

Photo: ©iStock.com/robert van beets

Powering Michigan agriculture with renewable energy

Michigan farms, the state's economy and the environment all stand to benefit greatly from both improved energy efficiency and increased capacity for renewable energy generation. Farms that implement energy conservation practices and renewable energy technologies recommended by a certified agricultural energy efficiency audit are helping to significantly reduce overall farm energy consumption throughout the state.

"Energy accounts for approximately 34 percent of a farm's total expenses," said Charles Gould, MSU Extension educator specializing in agricultural bioenergy and energy conservation. "Implementing energy conservation practices and renewable energy technologies can significantly reduce energy consumption and expense."

Agricultural production represents approximately 6.7 percent of Michigan's total energy consumption. At best, only 0.5 percent of Michigan farms have completed a certified energy efficiency audit for their operations.

"Energy audits are extremely important for any renewable technology project," Gould said. "These audits qualify improvements for funding assistance from utility companies, the U.S. Department of Agriculture and the state."

Completed certified energy efficiency audits are required before farmers can access utility rebates, and government grants and loans to help pay for recommended energy conservation practices and renewable energy technologies. From 2010 to 2015, 306 Michigan farms implementing recommended energy conservation practices reported an average reduction in energy expenses of 41 percent. Much larger energy reduction amounts – 68 percent – were reported by 147 farms utilizing renewable energy technologies.

To help Michigan farmers learn how they can save money and increase energy efficiency, MSU Extension hosted the Powering Michigan Agriculture With Renewable Energy Conference in March 2016 in East Lansing. Attendees learned what renewable energy technologies are available, how to identify which solutions meet their energy management goals and where to obtain the resources and tools necessary to implement these technologies. Speakers and a farmer panel addressed issues related to on-farm energy use efficiency and renewable energy generation. Attendees also learned more about federal renewable energy and energy conservation perspective from Sean Babington, a staff member representing Sen. Debbie Stabenow's office.

"I found answers for every question I had at this conference," said poultry producer Nate Wortz of Central Grace Farm in Quincy. "It was a great conference and I will be coming again next year."

While at the conference, Wortz met representatives from Consumers Energy and talked with them about energy conservation practices that could be implemented on the farm. This conversation resulted in the farm receiving a $5,000 rebate for having implemented recommended energy conservation practices. He has since qualified for another $5,600 rebate payment to implement additional energy conservation measures.

As a result of the conference, Tom Mertz, a beef producer from Dexter, plans to install a solar array on his farm and is actively seeking more information on solar installation. Fifty-four percent of conference attendees said they planned on implementing a renewable energy technology on their farms within 12 months of the conference.

A postconference attendee survey noted an 81 percent increase in overall understanding of renewable energy technologies with 94 percent of those surveyed saying they felt confident in choosing a renewable energy technology for their farms.

Investigating algae's full potential as an efficient renewable energy source

Blue-green algae could be one of the catalysts for developing the bioeconomy of the 21st century, including renewable energy sources that fuel the future. The algae, also known as cyanobacteria, use photosynthesis to convert light energy from the sun into chemical energy. MSU structural bioengineering professor Cheryl Kerfeld and her team (photo below) have been studying how cyanobacteria protect themselves from too much light. Cyanobacteria have antennae that are used to capture light energy. A protein in the cyanobacteria, known as the orange carotenoid protein (OCP), changes from orange to a protective reddish color when it detects too much light. In this activated state, the protein helps the cyanobacteria dissipate excess light energy as heat. The molecular structure of the activated state and the cause of the protein's color change were previously unknown.

- **A paper published in Science details the structure of the activated form of the OCP and reveals an unexpected movement of the carotenoid. Kerfeld's team is the first to see this behavior.**
- **Cyanobacteria are also being tested for viability as a chemical precursor for plastics in addition to fuels. Nearly all precursors in the chemical industry are currently petroleum based, so sustainability and environmental impacts are concerns.**

Photo: MSU Communications & Brand Strategy

Photo: MSU AgBioResearch

Inventorying U.S. forests to determine complete carbon removal capacity

As a way to address climate change, the United States seeks to reduce its carbon emissions by 80 percent by 2050. For carbon that does enter the atmosphere, the planting of trees and the prevention of deforestation can help. Carbon, in the gaseous form of carbon dioxide, is taken in by trees and thus removed from the environment. MSU AgBioResearch scientist David MacFarlane has been working to measure the amount of carbon in trees, hoping to learn the capacity of these natural resources as carbon-removal mechanisms. The U.S. Forest Service enlisted six universities across the country, including MSU, in a five-year project to collect data on various tree species and their carbon content.

- **An inventory taken on a network of permanent sample plots across the country helps researchers estimate the number of trees, the timber volume of various species, the speed of growth and other valuable information describing U.S. forests.**
- **Mathematical equations are being developed and fine-tuned to determine carbon content.**
- **In December 2015, MacFarlane traveled to Portland, Oregon, to the National Forest Inventory Symposium. MacFarlane and his colleagues presented on testing existing equations with new data, as well as new models for improving estimation.**

Environmental Quality & Natural Resources Management

Partnering to protect the pristine beauty of the Upper Peninsula

When Michiganders and visitors think of the Upper Peninsula (U.P.), they likely think of the blue waters of our Great Lakes including the clear – and cold – waters of Lake Superior, and the beauty of natural sites such as Tahquamenon Falls, Pictured Rocks National Lakeshore and the Seney National Wildlife Refuge. The U.P. is a magnet for drawing people who appreciate our state's natural resources.

Managing these natural areas to keep them beautiful, sustainable and economically viable is a critical job. MSU Extension is pleased to be a key partner with so many projects surrounding environmental quality and resource management.

This year, we have expanded our efforts and, in partnership with Lake Superior State University (LSSU), added a Michigan Sea Grant Extension educator to serve in the eastern U.P. Elliot Nelson will be based in Sault Ste. Marie at the LSSU campus and will provide education and outreach programming related to commercial, tribal and aquaculture fisheries; coastal community development, including tourism and Great Lakes commerce; water quality; and coastal ecosystems.

"LSSU already promotes many of the objectives of Michigan Sea Grant, and with an office now located on campus our partnerships and impacts will only continue to grow," Nelson said.

The Michigan Sea Grant College Program helps foster economic growth and protect our coastal Great Lakes resources through education, research and outreach. A collaborative effort between the University of Michigan and MSU, it is part of the National Oceanic and Atmospheric Administration's National Sea Grant network of 33 university-based programs and receives key matching funds from the State of Michigan.

Promoting safety for visitors and residents alike has long been a part of Michigan Sea Grant's mission in the U.P. In 1998, after a young man drowned, educator Ron Kinnunen began his quest to help inform the public about dangerous currents and provide safety equipment at key locations.

While even one drowning death is one too many, the good news is the Great Lakes Dangerous Currents educational efforts are working. Statistics compiled by the National Weather Service show fatalities keep declining. In 2012, 102 fatalities related to Great Lakes dangerous currents occurred and this declined to 68 in 2013, 54 in 2014, and 40 in 2015.

"The more we can educate the public on how to stay safe while swimming in the Great Lakes, the fewer tragedies we'll have to report," said Kinnunen.

In addition to safety while in the water, Kinnunen provides important training for those who make their living on the water by helping commercial fisheries ensure safe food-handling processes and also find new opportunities for business growth. Economic growth and sustainability of commercial ventures is critical for U.P. businesses and the state. Kinnunen estimates about 100 jobs are sustained annually because of Seafood Hazard Analysis Critical Control Point training.

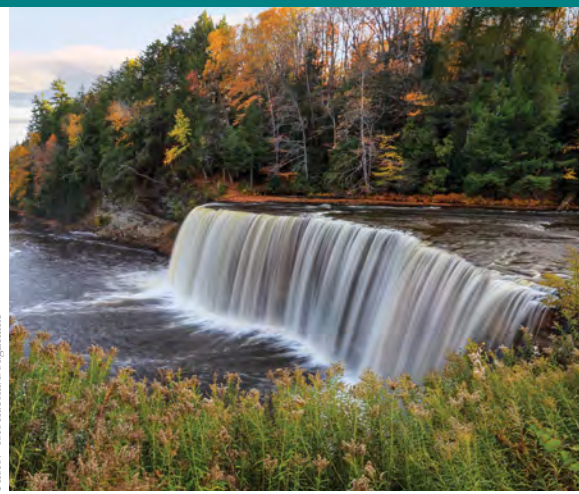


Photo: ©iStock.com/DougLemke

This year, Kinnunen also has provided important Drill Conductor safety training for 73 state- and tribal-licensed commercial fishery personnel, in addition to four Coast Guard personnel. The training is required by the U.S. Coast Guard. Kinnunen spent two weeks in Alaska being put to the test in order to become a certified teacher – the only one in the Great Lakes region. His efforts give commercial U.P. fishers accessible and affordable training for this required course, helping to sustain jobs.

MSU Extension is proud to work closely with partners and stakeholders on so many projects that help improve environmental quality and manage our natural resources.

Photo: ©2009 Thomas Gennara

Studying air pollution in rural environments

MSU toxicologist Jack Harkema (photo left) is studying the impact of air pollution on rural populations. Agricultural regions see some of the highest airborne concentrations of particulate matter due to dusty conditions. With longtime collaborator Robert Brook of the University of Michigan, Harkema reports that brief exposures to real-world coarse particulate matter in a rural community can cause elevations in heart rate and blood pressure. These effects on the cardiovascular system were similar to those found in human subjects after short-term exposure to fine particles in urban industrial communities. Such particle-driven health effects could have detrimental consequences in people suffering from chronic heart disease.

Brook and Harkema's recent findings on particulate air pollution will help the Environmental Protection Agency set the air quality standard for particulate matter that aims to protect the health of susceptible populations.

- **Air pollution is linked to approximately 3.7 million premature deaths annually.**
- **The majority of air pollution in rural areas is composed of coarse particulate matter, measuring between 2.5 and 10 microns, 30 times smaller than the diameter of human hair.**
- **In many regions, coarse particulate matter accounts for 50% to 70% of the total particulate air pollution.**

Preventing invasive threats by keeping an eye on Michigan's forests

Michigan forests are under attack from many exotic invasive pests and diseases. The Michigan Eyes on the Forest team, consisting of scientists and researchers from the MSU Department of Entomology as well as past and present MSU Extension forestry professionals, created a sentinel tree program designed to enlist the public to identify and increase awareness of three invasive threats that could cause widespread damage to Michigan's forests.

With a grant through the Michigan Invasive Species Grant Program, volunteers can register a "sentinel tree" on the Midwest Invasive Species Information Network (MISIN) to help keep a lookout for the Asian longhorned beetle, hemlock woolly adelgid and thousand cankers disease of black walnut. Volunteers help monitor and protect Michigan's forest resources against potential invasive threats by reporting unusual tree decline or dieback, and identifying the presence of invasive pests not known to be established in Michigan.

- **Roughly 150 people have signed up for MISIN, and more than 40 events have raised awareness.**
- **MSU Extension hosted four sentinel tree volunteer training sessions and 19 outreach events.**
- **Eyes on the Forest provides materials, displays and online content as ready-made vehicles for others to share. Over a six-month timespan, various events reached nearly 2,000 people.**

Photo: ©iStock.com/LukeLuke68

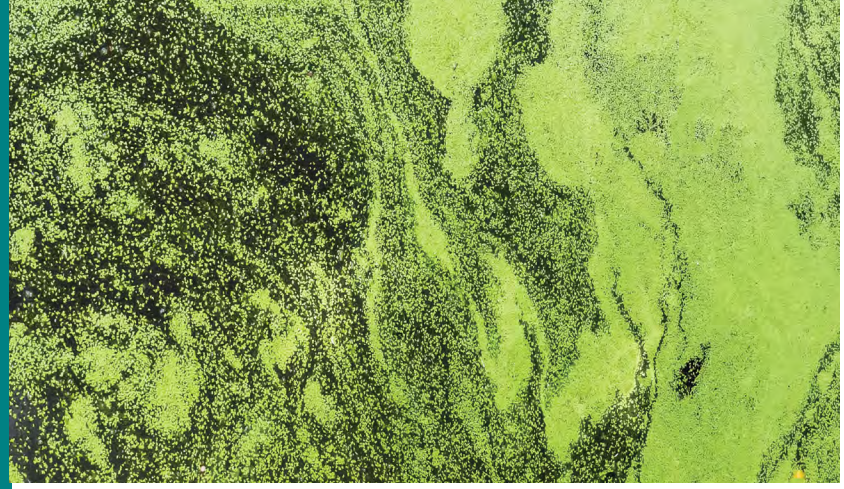


Photo: ©iStock.com/Kenneth Schulze

Preventing algal growth in the Western Lake Erie Basin

Lake Erie is especially susceptible to harmful algal blooms because of its shallow depth, warm waters and excessive input of nutrients from the surrounding land areas.

In partnership with Michigan farm and commodity groups, watershed councils and conservation districts, the MSU Extension Western Lake Erie Basin (WLEB) Initiative provides Michigan agricultural producers with critical information for minimizing phosphorus losses from farms fields. Sources such as storm water, animal and pet wastes, lawns, tributaries to the lake, septic systems, wastewater treatment plants and dredged sediments all contribute phosphorus to Lake Erie.

The MSU Extension WLEB Initiative raises awareness and provides trusted, science-based information through outreach efforts including targeted webinars, articles, media releases and field days. This practical information connects field-level application with emerging research-based knowledge.

Staff in the WLEB Initiative:

- **Work with farms to perform edge-of-field monitoring.**
- **Conduct in-field research to determine optimum phosphorus rate for field crops.**
- **Host field days focusing on how cover crops can be used to protect water quality and how nutrients can be best incorporated into fields.**
- **Attend popular public events such as Breakfast on the Farm to explain farming best management practices for water quality in an easy-to-understand format.**

Curtailing environmental harm through efforts in conservation criminology

In an effort to decrease environmental harm, MSU AgBioResearch scientist Meredith Gore (photo below) has been working in the area of conservation criminology, a joint effort between the university's Department of Fisheries and Wildlife and the School of Criminal Justice. The MSU Conservation Criminology program was established in 2008 and is the only one of its kind in the world. Graduate students can earn a certificate by taking three courses that integrate conservation, natural resources management, criminal justice, and risk and decision sciences. These fields also shape Gore's research, including a project in Michigan that aims to improve management of furbearing animals. Michigan has a long history of furbearer hunting and trapping, and a substantial economic industry.

- **The Michigan Department of Natural Resources (DNR) indicates that the state is third in the nation in hunter participation, with nearly 800,000 licensed hunters and $28 million of economic impact.**
- **The DNR uses a comprehensive dataset to inform its management policies. Gore wants to better inform the DNR's models by accounting for noncompliance with rules.**
- **Gore also documents important considerations, speaking to families with a culture of hunting and trapping that is passed down through generations.**

Photo: MSU Communications & Brand Strategy

Examining internal and external factors affecting pathogenic loads and 'supershedders'

More than 60 percent of all human infectious diseases originate in animals, and within the past century, an unprecedented number of diseases have emerged that pose significant risks to wild and domestic animal and human populations. Many of them originate in wild birds.

MSU professor Jen Owen is working to assess variation in the pathogen load in virus-infected birds. She is particularly interested in "supershedders," the ones in a population that, for unknown reasons, are responsible for most of the pathogen load.

Knowing more about the basis for pathogen load variation and the reason why some individuals shed much larger amounts will provide information to develop more realistic epidemiological models that lead to cost-effective, targeted prevention and control strategies.

Through research, Owen has found that:

- **Waterfowl infected with avian influenza virus exhibit significant within-species variations in how much virus they produce or shed, that is, how infectious they become.**
- **Unexpectedly, healthy birds shed more disease organisms than unhealthy birds.**
- **Regardless of environmental conditions, 20% of birds within a population shed 80% of the virus. These are "supershedders."**

Studying signaling and gene regulation in bacteria

To discover ways to break down and fend off infectious bacteria, scientists must understand how cells integrate signals from one another and the environment, and how they respond by changing gene expression, metabolism, motility and morphology. Unraveling how these mechanisms work will likely spur advancements of medical, agricultural and environmental importance.

Photo: MSU AgBioResearch

MSU AgBioResearch scientist Lee Kroos (photo right) is conducting basic research on soil bacteria that are model organisms for understanding cell-to-cell signaling and changes in gene expression that cause cell differentiation. His goal is to establish new paradigms based on these well-documented bacteria that can be applied to other more difficult-to-work-with and less well understood microorganisms.

Kroos and his team:

- **Discovered that there are two coordinated signaling pathways responsible for prompting the cells to change shape.**
- **Isolated a stable form of the enzyme, which is responsible for signaling between the forespore and mother cells, along with its substrate to create the first data-based model of its kind.**
- **Realize the limited understanding of how microbes control complex behaviors in response to one another and their environment impedes our ability to harness them for pollution and climate control, and for increased bioenergy and food production.**

Working together in and around Detroit on water

For over 10 years, Michigan Sea Grant has been working to restore fish spawning habitat for lake sturgeon, lake whitefish and more in Lake St. Clair and the Detroit River. In 2016, the latest reef was completed. Sturgeon spawning has been confirmed on four of the five constructed reefs.

Each year, Michigan Sea Grant's Great Lakes Education Program and Summer Discovery Cruises teach thousands about the environment while boating on the Detroit River and lakes St. Clair and Erie. Coupled with a classroom curriculum and hands-on activities, students learn to be stewards of the Great Lakes.

Green infrastructure is an important way for local governments to manage stormwater issues. Through workshops, Michigan Sea Grant and partners in southeastern Michigan help public officials understand and mitigate water resource management issues.

The impact on the Detroit area:

- **Projects contribute to river-wide reef restoration efforts with real benefits for communities.**
- **Most previously participating teachers have included more Great Lakes or ocean science content in their classrooms, and all felt a greater responsibility for the Great Lakes and to contribute to Great Lakes literacy.**
- **86% of those surveyed said their community would support updating local codes and ordinances to facilitate implementation of green infrastructure.**

Food Safety & Security

Addressing global food security with Spartans Will

Across the globe, millions deal with food insecurity. In fact, one in nine people on the planet do not have enough to eat, making hunger and insufficient nutrition one the leading threats to health globally. Stepping up to find solutions to these pressing issues are extraordinary Spartans from MSU Extension and MSU AgBioResearch. From increasing crop yields in third-world countries to inspiring future generations to end global hunger, these individuals are using Spartans Will to combat one of the world's most crippling and complex challenges.

For more than 30 years, University Distinguished Professor James Kelly (photo above left) has been performing bean research that spurred major agricultural advances in many developing countries. One of the most nutritionally dense crops, beans are a staple in the diets of many Latin American and sub-Saharan Africa populations and an integral part of substance farming operations. In total, Kelly has developed and released 46 new bean varieties, bred to be both more productive and of higher nutritional quality.

Though many of Kelly's beans are grown in North America, more than a dozen of his varieties are intended for the semiarid highlands of Latin America where drought and disease often threaten crop production. In one region of Mexico, Kelly's elevated pinto bean increased yields by more than 50 percent. His research has also benefited the people of war-torn Rwanda, where bean consumption is the highest of all African countries: farmers who have adopted Kelly's white, red and red-mottled climbing beans have seen their yields increase sixteenfold.

"The work of Dr. Kelly, along with other Legume Innovation Laboratory scientists here at MSU, is making significant advancements that are helping not only to improve food security globally, but that also have applications here at home as well," said Douglas Buhler, director of MSU AgBioResearch.

While Kelly's research is making strides against global hunger today, MSU Extension's work is paving the way for future progress on the issue. Michigan FFA and MSU's College of Agriculture and Natural Resources, MSU Extension and Michigan 4-H have teamed up to host the World Food Prize (WFP) Michigan Youth Institute (MIYI), a program for young people in grades 8 to 12. At the event, youth from across Michigan come together to share their global food security ideas with MSU experts and other young people while learning how members of the MSU community work to address world hunger. Since its inception, more than 40 youth have attended the WFP MIYI, which seeks to inspire them to pursue careers related to global food security and empower them to make an impact in their communities today.

Surveyed participants from the 2016 WFP MIYI illustrated the event's ability to do just that. Seventy percent left the WFP MIYI feeling like they could apply knowledge in a way that solves problems, compared to just 34 percent pre-event; and 74 percent said they can make a difference in their communities, a 44 percent increase from before they attended. For Michigan 4-H'er Francine Barchett who attended in 2015, the WFP MIYI was the start of her quest to end world hunger: she is now doing research in India as she pursues a degree in international agriculture.

"It was inspiring to hear so many passionate and brilliant speakers," said Barchett, who also attended the WFP Global Youth Institute. "By meeting them and hearing their stories, I realized that someday I could be in their shoes."

Though obtaining her degree at a different college, Barchett is just the first of many who will find their passion for addressing food security at MSU's WFP MIYI – making them honorary Spartans at heart. As they pursue their goals, these young people will join leading experts like Kelly, and countless others, who will show the world how to combat hunger with a Spartan's will.

Photos L-R: ©iStock.com/AndreyGorulko; MSU Communications & Brand Strategy

Reducing foodborne illness through education of individuals, small businesses

The National Institutes of Health estimates that every year, 48 million people in the United States become ill and 3,000 die from pathogens in food. Causes range from outdated home food preservation practices to unsafe sanitizing practices at public events and small businesses. Since 2013, MSU Extension food safety and preservation programs have taught almost 10,500 Michigan residents safe food handling, food preservation and methods to reduce foodborne illness.

Participants include youth, nonprofit organizations that prepare food for the public and food preservers who want to create safe products for their small businesses.

Through face-to-face and online learning, Michigan communities receive high-quality, research-based education using U.S. Department of Agriculture guidelines for safe food preservation.

- **95% of participants report they will follow research-based and tested recipes for home food preservation.**
- **86% of youth participants gained knowledge about food spoilage organisms and learned how the organisms' growth can be slowed or prevented.**
- **85% of participants can correctly list strategies for cross-contamination prevention.**
- **91% know correct methods of cleaning and sanitizing surfaces.**

Photo: ©iStock.com/Zuberka

MSU Extension Communications

Creating national standards in food safety

Regulating a formerly unregulated industry is a daunting task that includes accounting for the public's needs as well as the professional knowledge and needs within that industry. As the Federal Food and Drug Administration (FDA) implements the Food Safety Modernization Act (FSMA), it has searched for food safety programs to model. The success of the Safe Food Risk Assessment created by MSU Extension and the Michigan Agriculture Environmental Assurance Program (MAEAP) attracted the attention of the FDA and is being used as a model to emulate for national implementation.

MAEAP's three-phase approach of educational training, self-assessment with guidance and third-party verification proved to be the model the FDA chose for national FSMA implementation. After testing is complete, national rollout of these standards of food safety compliance is estimated for March 2017.

- **MSU Extension was integral in the development of MAEAP's Safe Food Risk Assessment tool.**
- **The FSMA will impact every fresh produce grower in the United States.**
- **MSU Extension and Extension partners in New Jersey, North Carolina and Florida; the National Association of State Departments of Agriculture; the FDA and the Produce Safety Alliance are working to create the on-farm readiness review self-assessment and develop the training for FSMA reviewers.**

Reevaluating how food is stored

MSU food scientists Elliot Ryser (photo right), Eva Almenar, Janice Harte and Randy Beaudry are studying the impact and increasing the efficacy of sanitizers and gases used in packaging fresh-cut produce.

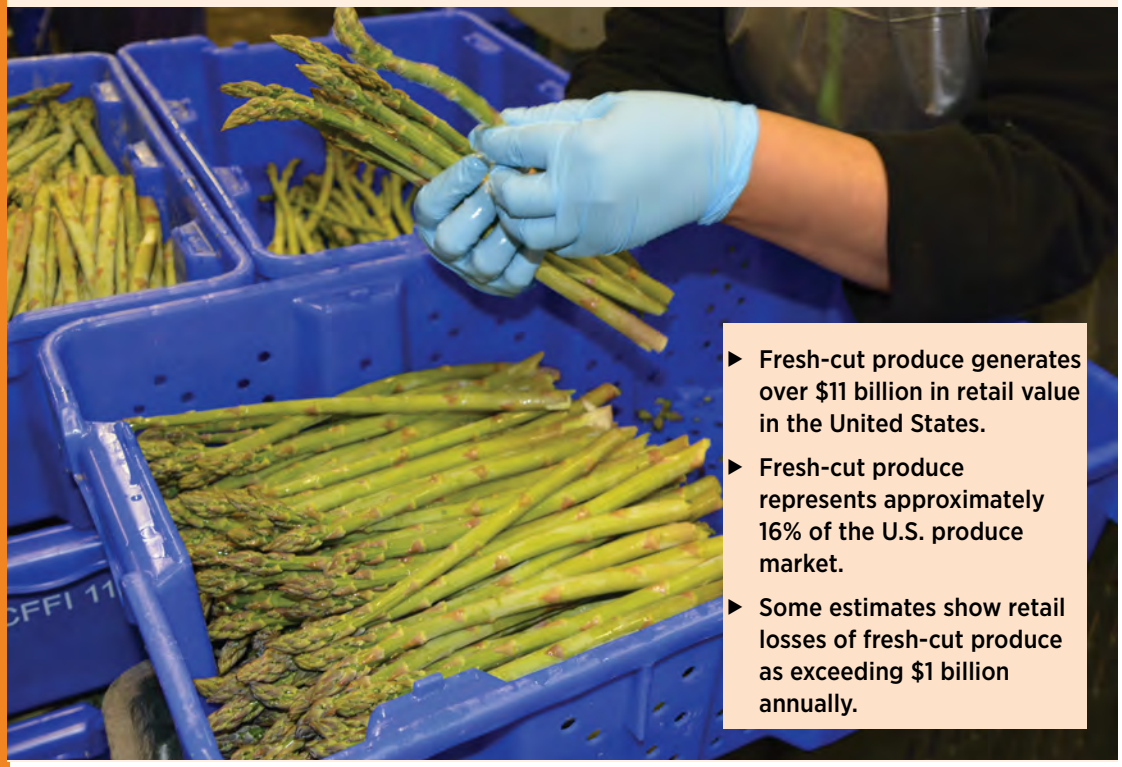
Controlling the temperature at which produce is stored is critical to controlling pathogen spread. The produce can undergo significant temperature fluctuations during transportation from the field to the store. Often vegetables are briefly kept in warmer areas such as loading docks or unrefrigerated rooms for cleaning, during which time pathogens, which may have been present in nonharmful quantities, can rapidly proliferate.

In their research, the team also evaluated the in-package gases used to inhibit microbial growth in produce. They found that specific gas mixtures

Photo: MSU Communications & Brand Strategy

in conjunction with the right sanitizers can result in safer produce while maintaining the fresh quality that consumers desire.

The research has resulted in a series of safer produce packaging protocols without sacrificing the freshness that makes fresh-cut produce an important part of a healthy diet.



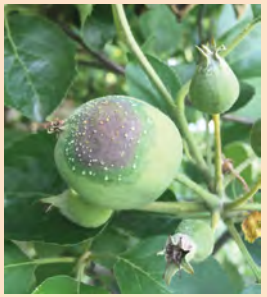
- **Fresh-cut produce generates over $11 billion in retail value in the United States.**
- **Fresh-cut produce represents approximately 16% of the U.S. produce market.**
- **Some estimates show retail losses of fresh-cut produce as exceeding $1 billion annually.**

MSU Extension Communications

Adapting human medical technology to predict plant diseases

MSU researchers Martin Chilvers, Brad Day and Evangelyn Alocilja have joined forces to adapt the latest technology for tracking and predicting the next major plant epidemic. The team aims to provide point-of-contact plant disease diagnosis, which will facilitate rapid disease management decisions to minimize crop losses and improve grower profitability. The data they collect will also aid in long-term management solutions. For the public and globally, this will translate to increased food security.

The team combined a biosensor originally developed for detecting pathogens in humans with the plant diagnostic tool MultispeQ to create a system that will allow for quick screenings of plants in the field and early warnings of impending outbreaks. By uploading data to the plant health data network PhotosynQ, the system will provide a worldwide perspective on growing plant diseases. Early detection will give farmers additional time to take steps to protect their crops.



- **Plant pathogens cause an estimated $60 billion in losses each year.**
- **Early detection could prevent disastrous losses, such as the $42 million damage by a 2000 fire blight outbreak in Michigan apples or $50 million by a 2014 outbreak of white mold in Michigan soybeans.**
- **PhotosynQ currently has over 1,100 users worldwide.**

Family & Youth Development

Providing tools to help families beat obesity, better prepare for school

Addressing issues related to healthy family and youth development continues to be a top priority of MSU AgBioResearch and MSU Extension.

More than one-third of adults and one in six children in the United States are obese, according to the Centers for Disease Control and Prevention. Obesity is linked to a multitude of health problems, such as heart disease, stroke, diabetes and many types of cancer. Estimates of the annual medical cost of obesity in the U.S. top $147 billion.

Individuals who come from low socioeconomic backgrounds may be more likely to struggle with their weight for several reasons, including a lack of access to nutrition information. Kami Silk, the associate dean of research for the College of Communication Arts and Sciences at MSU, is examining the beginning stages of life. She is studying the relationship between obesity in infants and their mothers' access to information on appropriate feeding practices. Working with Mildred Horodynski, a professor in the MSU College of Nursing and an expert on childhood nutrition, Silk has created the Tools for Teen Moms project.

Photo: ©iStock.com/dkdesign021

The initiative is aimed at 80 first-time teen moms living in low-income situations. A technology platform developed by Gary Hsieh, a former MSU assistant professor in telecommunications now with the University of Washington, delivers daily text messages to the teen mothers over six weeks.

Information is collected from surveys with mothers, analytics from the web platform and anthropometric measures such as the baby's height and weight at baseline, three months and six months. Researchers analyze the data and compare the growth of infants whose mothers received the nutrition information with those in the control group whose mothers did not.

Mothers were recruited from four counties in Michigan – Genesee, Ingham, Jackson and Kent – with assistance from the Maternal Infant Health Program (MIHP) in Michigan. MIHP is Michigan's largest program for Medicaid-eligible pregnant women, with 150 locations statewide that promote healthy pregnancies and infants. The organization provides home visitation to mothers and coordinates care through Medicaid.

Additionally, MSU Extension is helping youth better prepare for school readiness and academic success during early childhood. In 2015, these programs were delivered to more than 3,000 parents and caregivers who influence nearly 45,000 children and youth on a daily basis. Of those surveyed:

Photo: ©iStock.com/ Susan Chiang

- 90% said they increased their knowledge of techniques that help young children learn and promote school readiness.
- 85% indicated an increase in knowledge regarding basic concepts of early childhood development.
- 80% reported an increase in knowledge of how to keep children safe physically, emotionally and socially.
- 40% indicated the program would help reduce the number of times they do not know what to do as a parent.

The future of the Great Lakes State depends on the success of its children and MSU is deeply committed to helping to develop early competency and better prepare for future prosperity.

Photo: MSU Extension Communications

Growing true leaders

With innovative ideas, exuberant energy and the ability to look beyond preconceived obstacles, youth have the capacity to change the world. However, many lack the skills and confidence to empower these assets into motion. They need experiences and training that help them to feel ready and capable to lead.

Michigan 4-H helps to prepare current and future leaders by offering numerous opportunities for leadership development. From the club experience to statewide youth councils, all youth have the chance to serve in a leadership role. Those experiences and various leadership trainings provide youth with skills to last a lifetime and empower them to stand up today as true leaders in their families, schools and communities.

In the past year:

- **25 youth formed the Michigan 4-H State Youth Leadership Council, becoming statewide champions for 4-H.**
- **32 youth were trained as teen leaders in the 4-H Ag Innovators Experience. These youth cultivated important leadership skills as they delivered programming to 1,200 of their peers.**
- **40 youth learned how to become advocates for themselves and 4-H through the 4-H Teen Spokesperson training; 86% of those surveyed indicated they feel confident in standing up for issues that are important to them.**

4-H GROWS HERE

Teaching mental health coping skills to at-risk youth

According to the World Health Organization, mental health is the No. 1 disability in the world. In the United States alone, it is estimated that one in every five adults experiences some type of mental illness in any given year.

Ironically, mental health is rarely talked about in public despite its widespread prevalence. Joanne Riebschleger of the MSU School of Social Work is working to change that, especially for children of parents with mental illnesses.

Riebschleger has developed Youth Education and Support (YES), a mental health literacy program for seventh- and eighth-graders in Waverly Community Schools in Lansing. Participants have parents or other family members with mental illnesses, substance abuse issues or co-occurring disorders. The program has a 90 percent retention rate. Emerging data shows that children who have been through a session are doing significantly better three months afterward.

Goals of the YES program are to:

- **Prevent or delay the onset of the participant children's development of mental health disorders.**
- **Increase youth knowledge of mental health disorders and recovery, as well as improve coping skills.**
- **Breakdown stigmas associated with mental health disorders.**
- **Teach participants how to build a crisis plan in the event they ever need one.**

Building communication skills for a lifetime

Communication is an essential element of every aspect of life – personal and professional. Whether it is written, spoken or visually represented, the way we express ourselves makes a big impact on our daily lives at home, work and play. Youth who practice and enhance their communication skills in adolescence will find these skills to their advantage in future employment and adulthood.

To help young people develop this important life skill, MSU Extension's Michigan 4-H has made communication an aspect of nearly every area of its programming. Youth are required to record their progress on projects, verbally report their activities and illustrate their understanding in a number of ways. Some Michigan 4-H programs make communication a major focus, further allowing youth to cultivate and enhance these critical skills.

In 2015:

- **40 youth attended the 4-H Teen Spokesperson workshop; 78% of those surveyed indicated they feel comfortable sharing their thoughts and feelings with others.**
- **32 teen leaders taught more than 1,200 fellow young people the Water Windmill Challenge as part of the 4-H Ag Innovators Experience.**
- **Nearly 350 youth participated in 4-H meat and livestock judging programs where they verbally validated their class evaluations.**

Teaching parents how to create a solid foundation for kids

Photo: ©iStock.com/pixelheadphoto

A child's most formative years are those from birth to age 8. Building a solid foundation of social, emotional and academic skills during this critical time is of utmost importance for ensuring the future success of the child. However, many parents lack the knowledge and skills to provide this foundation – an issue that can be further compounded when families face the numerous financial and socio-economic stressors that add pressure to family life for so many Michiganders.

To support Michigan's working families, MSU Extension provides trainings for parents of children newborn to 3 years old. Now in its second year, the Building Early Emotional Skills (BEES) series* helps adults develop the skills needed to support the social and emotional development of their children while reducing parenting stress. As a result, parents are better equipped to provide their children with a solid foundation that allows them to more easily adapt in school and form successful relationships throughout life.

In 2015-2016:

- **MSU Extension offered 14 BEES workshop series to more than 130 families.**
- **Preliminary data from program participants showed a positive increase in their quality of parenting, emotionally supportive parenting skills, knowledge about social-emotional development and overall parental functioning.**

* This material is based upon work supported by the USDA NIFA under award No. 213-41520-20939.

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Helping kids understand global issues

Even in today's globally connected world, it can be difficult to remember that not everyone enjoys the same luxuries as many Americans. This can be especially true for youth who may assume international audiences they engage with online are an accurate representation of all life outside the U.S. It can be hard for some to conceptualize places where neither the internet nor necessities such as safe food and water are readily accessible.

MSU Extension strives to help youth understand these global issues, as well as their role in addressing them, through global and cultural education programs. Through interactive opportunities such as 4-H Youth Leadership and Global Citizenship Spectacular, and 4-H international exchanges, youth have experiences that involve hosting people from another culture in their homes and taking part in real-life global hunger awareness simulations. As a result, youth increase cultural competencies and become more engaged global citizens.

In 2015-2016:

- **More than 100 youth attended 4-H Youth Leadership and Global Citizenship Spectacular; 93% indicated they learned things that will help them make a difference in their communities.**
- **Nearly 200 people engaged in the 4-H exchange program with Japan. Afterward, 100% of those surveyed said they cared about people different from themselves.**

Health & Wellness

Providing a prescription for better health

Photo: ©iStock.com/michaeljung

Healthcare professionals can diagnose what is ailing a person and recommend lifestyle changes to improve a patient's health, but making sure patients fully understand these recommendations and are able to follow them is more difficult. Most patients know what they need to do but don't know how to make it happen. MSU Extension's Rx for Health bridges this gap.

Developed through a partnership with the MSU College of Human Medicine and MSU Extension, Rx for Health connects patients with free and low-cost, community-based, health education programs that they can take advantage of to reduce their risk of chronic disease and reach their health goals. It offers practical solutions and points of contact for people who might have never explored a healthy lifestyle change before.

MSU Extension's Rx for Health begins with a tear-off pad, personalized with the contact details of a local MSU Extension educator. Healthcare providers can make recommendations from 10 different categories related to health risks, including diabetes, stress, obesity and healthy relationships.

Diabetes and prediabetes affect 86 million Americans. The total estimated economic cost of mental, emotional and behavioral disorders among youth in the United States is approximately $247 billion per year.

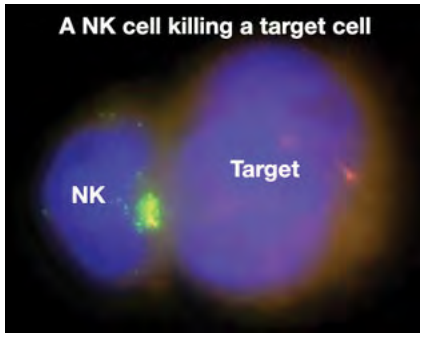
By providing a patient with an Rx for Health pad tear-off sheet, healthcare providers connect patients to MSU Extension's trusted, research-based health education programs available in local communities that have a history of delivering proven results. For example, they can effectively connect patients to programs such as MSU Extension's Stress Less With Mindfulness where over 75 percent of participants successfully learned to use mindful awareness when eating and developed techniques to manage daily stressors.

Other available programs include the National Diabetes Prevention Program delivered by MSU Extension. MSU Extension's exceptional delivery of the program has received full recognition from the Centers for Disease Control and Prevention, a distinction only awarded to organizations that deliver consistent evaluation data related to participant weight loss, physical activity and attendance.

Rx for Health supports the work of Michigan healthcare providers on two levels. It makes it easier for providers to connect their patients with health education programs and at the same time, makes it easier for providers to build or maintain a patient-centered medical home (PCMH) model of care. Offering a PCMH model of care allows healthcare providers to coordinate patient treatment through primary care physicians, helping to ensure that patients receive care when and where they need it and in a way that is appropriate both culturally and linguistically. This offers healthcare providers a number of benefits including improved patient outcomes and increased patient satisfaction.

Rx for Health strengthens the mission of healthcare providers and MSU Extension by helping providers become more effective at helping their patients and helping MSU Extension reach more Michigan residents in need.

Fighting influenza with higher calorie diets



MSU nutritional immunologist Elizabeth Gardner is developing a novel approach to reducing the impact of influenza on those with a calorie-restricted diet: during flu season, slacken dietary restrictions and eat more calories.

Gardner's lab has been conducting studies on mitigating the effects of the flu on calorie-restricted subjects. Researchers in the lab fed calorie-restricted mice a higher calorie diet for two weeks prior to inoculating them with the flu virus. Natural killer (NK) cells, a type of white blood cell critical in the early phase of an infection, are known to perform poorly under reduced-caloric conditions, and Gardner hoped that by increasing calorie intake, she could bolster their effectiveness.

The mice that were given more expansive diets prior to infection showed NK cells in higher numbers and with greater efficacy, increasing their chance for survival.

- **Each year, 250,000 to 500,000 people die from and 3 to 5 million are hospitalized by influenza worldwide.**
- **Influenza costs U.S. businesses approximately $10.4 billion and affects up to 20% of the U.S. population.**
- **Increasing calorie intake by 10% during flu season ensures those on a calorie-restricted diet have sufficient resources to fight influenza.**

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Photo: ©iStock.com/Jovannandic

Evaluating role diet plays in women's blood pressure from pregnancy to later in life

Statistics show that one in every three American adults has high blood pressure. The costs of treatment are estimated at some $46 billion each year.

Two MSU researchers are taking a closer look at how diet during pregnancy may affect a woman's likelihood of developing high blood pressure later in life. Claudia Holzman of the MSU Department of Epidemiology and Biostatistics, and Jenifer Fenton of the MSU Department of Food Science and Human Nutrition, are collaborating with Janet Catov of the University of Pittsburgh.

The researchers found that women with the lowest quality diets had higher blood pressure, on average, at follow-up. Also, among women who had moderately elevated blood pressure during pregnancy, those with a low-quality diet at follow-up (seven to 15 years after pregnancy) were more likely to be pre-hypertensive or hypertensive.

The research:

- **Focuses on middle-aged women from Michigan followed over an extended period of time, beginning in pregnancy.**
- **Reveals that a high-quality diet during pregnancy might lessen risk later in life.**
- **Will be more closely examined to determine if there is a specific component in the high-quality diet that may be linked to lower blood pressure.**

Using molecular-level mapping to show how cells repair damaged DNA, safeguard genetic information

Photo: MSU Communications & Brand Strategy

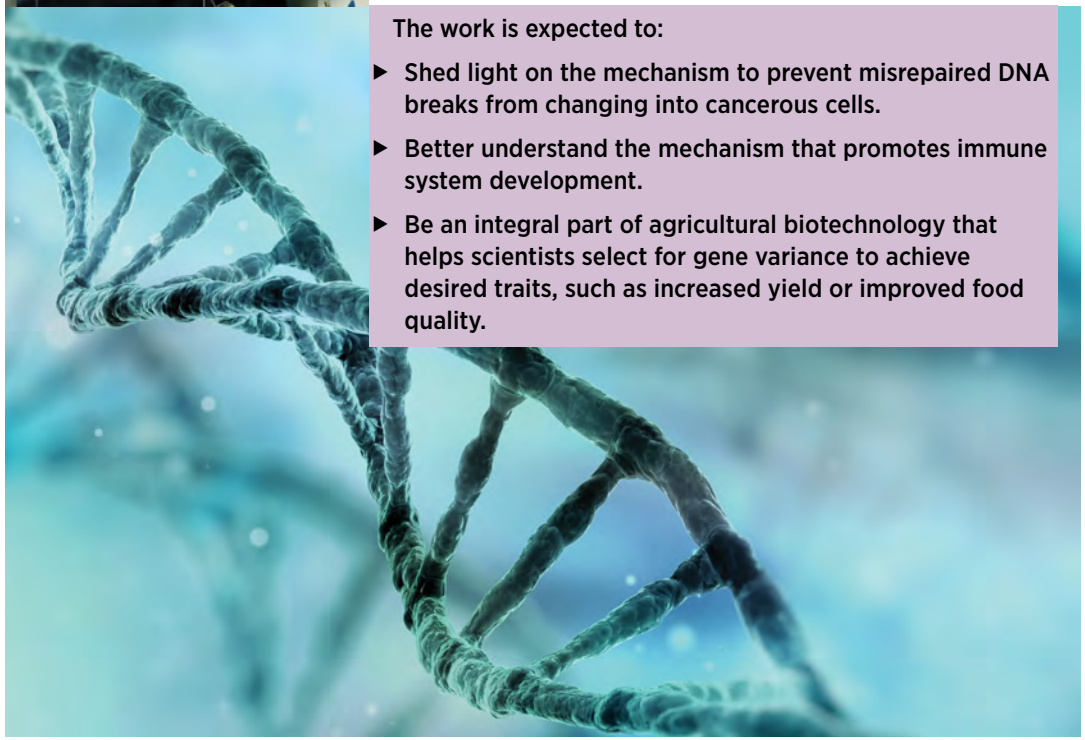
Cell division takes place in the human body several million times per day. With each split, DNA molecules – because of their inherent instability – are highly susceptible to damage, which can lead to genetic mutations. Add in external factors such as ultraviolet radiation and carcinogenic substances, and the odds of DNA damage increase even further.

MSU AgBioResearch immunologist and molecular geneticist Katheryn Meek (photo left) has been studying DNA repair for more than three decades. She studies how DNA double strand breaks (DSBs), which can lead to cancer, are repaired.

Meek focuses on a large enzyme called the DNA dependent protein kinase (DNA-PK) that repairs DSBs in all organisms. She is particularly excited about her recent discovery of how T and B lymphocytes prevent genetic mutations by using protein factors to help guide how these intentional DNA breaks are repaired.

The work is expected to:

- **Shed light on the mechanism to prevent misrepaired DNA breaks from changing into cancerous cells.**
- **Better understand the mechanism that promotes immune system development.**
- **Be an integral part of agricultural biotechnology that helps scientists select for gene variance to achieve desired traits, such as increased yield or improved food quality.**



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Providing better understanding of bacteria's potential as a probiotic

In the world of bacteria, *Lactobacillus plantarum (L. plantarum)* is as versatile as they come. The microorganism produces a large amount of lactic acid and with the help of an enzyme can interconvert between its two forms, L-lactate and D-lactate. But *L. plantarum* is not just impressive on the molecular level – it has many applications on a much grander scale, including in the area of human health.

Studies on *L. plantarum* as a probiotic — live bacteria that can be helpful in digestion and immune system function — have been promising. Consumers have responded well to the growing scientific support for a wide range of probiotic supplements, foods and beverages, making it an industry worth more than $28 billion per year.

- **In a paper published in Science, researchers defined the structure of the lactate racemase enzyme and its cofactor, something never seen before. Seeing the makeup of the enzyme will help researchers understand how it helps *L. plantarum* and other bacteria function.**
- **Researchers saw that the cofactor they found contains an organic and inorganic component. The discovery marks the first instance of this unique configuration, known as a pincer complex, in biology. Inorganic chemists work with pincer complexes regularly.**

Improving nutrition and increasing physical activities in Michigan communities

Limited income and poor nutrition affect quality of life and can increase healthcare costs. The Centers for Disease Control and Prevention reports that more than 30 percent of Michigan adults are considered obese, and one out of every three deaths in Michigan is caused by cardiovascular disease, influencing the quality of life and adding billions of dollars each year in economic burden.

MSU Extension delivers affordable, relevant, evidence-based education to help residents in urban and rural communities stay healthy throughout their lifespans. Programs teach participants how to buy and prepare nutritious, budget-friendly foods and increase physical activity. In 2015 alone, these programs reached more than 112,000 adults and youth across the state in over 1,600 different locations.

- **79% of youth participants improved their abilities or gained knowledge about how to choose foods according to Federal Dietary Guidelines.**
- **79% of adult participants made a positive change in at least one nutrition practice, such as preparing foods without adding salt, or using the Nutrition Facts labels to make food choices.**
- **73% of adult participants made a positive change in at least one food resource management practice, such as planning meals in advance or comparing prices when shopping.**

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