



Douglas D. Buhler
Director,
MSU AgBioResearch

We hope you enjoy reading this latest report outlining how Michigan State University (MSU) Extension and MSU AgBioResearch continue to make Michigan thrive as an excellent place to live, raise a family and conduct business.

With more than 300 scientists in seven MSU colleges, MSU AgBioResearch provides scientific advancements in the areas of food, energy and the environment. This legacy began in 1888 when it was founded as the Michigan Agricultural Experiment Station and charged with conducting research and development projects on behalf of farmers. While the breadth and depth of the research has broadened over the years, MSU AgBioResearch remains focused on balancing our investment in new faculty with rebuilding infrastructure.

MSU AgBioResearch and Extension continue to work to build upon industry partnerships such as supporting the creation of the Michigan Tree Fruit Commission, which growers passed earlier this year, and working with the animal agriculture commodities to strengthen our long-term success. These collaborative efforts are vital to our investments in key research initiatives and to meet infrastructure needs that will keep Michigan farmers on the forefront. These partnerships help to maintain state-of-the-art labs and research centers so we can continue to attract new, young scientists with a passion for Michigan agriculture. The quality of our facilities is also imperative to securing external grant funding in what has become a highly competitive process.

MSU Extension faculty and staff members translate the scientific information gleaned from MSU AgBioResearch into real-world applications – something they've been doing for 100 years. Throughout the history of the Cooperative Extension Service, founded through the Smith-Lever Act of 1914, MSU Extension has worked hard to support an environment of collaboration where innovation and creativity can flourish. We continue to extend our reach by connecting with more and more residents each year.

This report presents the evidence of our successes.
Sincerely,

Douglas D. Buhler
Director,
MSU AgBioResearch

Margaret (Maggie) Bethel
Interim Director,
MSU Extension
Sept. 1 to Dec. 31, 2014

Raymond Hammerschmidt
Director,
MSU Extension
As of January 1, 2015



Margaret (Maggie) Bethel
Interim Director,
MSU Extension
Sept. 1 to Dec. 31, 2014

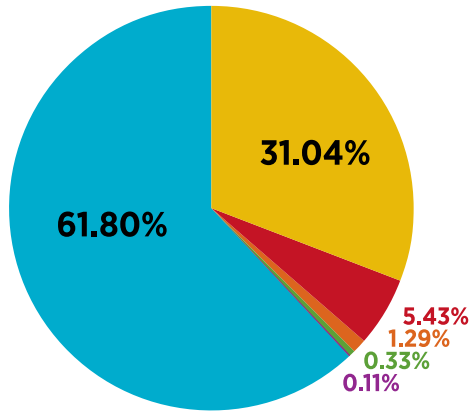


Raymond Hammerschmidt
Director,
MSU Extension
As of January 1, 2015

FUNDING

MICHIGAN STATE UNIVERSITY | AgBioResearch

FUNDING FISCAL YEAR 2013-2014



State Appropriations
\$30,243,900 31.04%
FY Oct. 2013–Sept. 2014

Federal Hatch
\$5,292,474 5.43%
FY Oct. 2013–Sept. 2014

Federal Hatch Multistate
\$1,257,924 1.29%
FY Oct. 2013–Sept. 2014

Federal McIntire-Stennis
\$317,246 0.33%
FY Oct. 2013–Sept. 2014

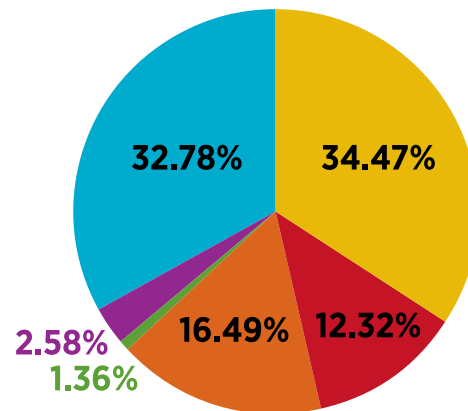
Federal Animal Health
\$108,856 0.11%
FY Oct. 2013–Sept. 2014

Grants
\$60,205,637 61.80%
FY July 2013–June 2014

TOTAL: \$97,426,037

MICHIGAN STATE UNIVERSITY | Extension

FUNDING FISCAL YEAR 2013-2014



State Appropriations
\$26,044,800 34.47%
FY Oct. 2013–Sept. 2014

Federal Cooperative Extension
\$9,310,904 12.32%
FY Oct. 2013–Sept. 2014

County Investments
\$12,457,116 16.49%
FY Varies

MSU General Fund
\$1,033,962 1.36%
FY July 2013–June 2014

Federal Special Projects
\$1,948,042 2.58%
FY Oct. 2013–Sept. 2014

Grants
\$24,765,935 32.78%
FY July 2013–June 2014

TOTAL: \$75,560,759

Photo: MSU Communications & Brand Strategy

MEASURING OUR IMPACT

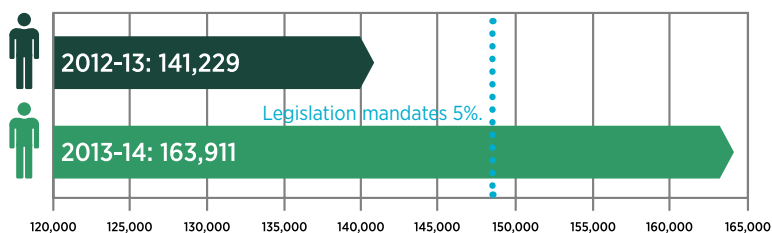
Connecting with residents

MSU Extension personnel actively collect data to track the organization's progress toward programming goals. Our educators and specialists reach people through face-to-face trainings, online webinars, social media, website interaction and electronic newsletters. Combined, MSU Extension made nearly 5 million connections with Michigan residents in 2013-14.

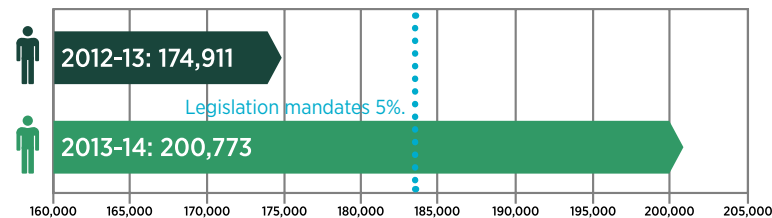


- » Nearly 164,000 adults and more than 200,000 youth participated in MSU Extension programming. This is an increase of 15 percent for adults and 16 percent for youth.

15% Growth in Adults Participating in MSU Extension Programs



16% Growth in Youth Participating in MSU Extension Programs



MSU Extension's Expanded Digital Reach



2 million visitors viewed more than 4 million pages



560,000 topic newsletters distributed to more than 8,500 email addresses



Nearly 2,000 Facebook and more than 1,700 Twitter followers

MSU Extension is dedicated to meeting people where they are with research-driven education. That includes a strong digital presence.

- » From July 1, 2012, to June 30, 2013, nearly 2 million visitors viewed more than 4 million pages of rich, science-based content on the MSU Extension website (msue.msu.edu). Of those, 76 percent were first-time visitors. Search engine rankings make msue.msu.edu one of the most visited Cooperative Extension Systems education sites in the country.
- » MSU Extension distributes a series of electronic newsletters that cater to residents' interests. Each month nearly 560,000 topic-specific newsletters are distributed to more than 8,500 email addresses.
- » MSU Extension uses social media channels to reach people with educational content. Currently, Extension professionals in Michigan enjoy nearly 2,000 Facebook followers and more than 1,700 Twitter followers.

In total, MSU Extension increased their number of connections from 2012-13 to 2013-14 by 78 percent.

Leveraging state funding

The state's **\$56.3 million** investment in MSU AgBioResearch and MSU Extension generated more than **\$867 million** for Michigan residents in 2014.

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

LEVERAGE of an additional **\$2.06** in federal funds and external contracts, grants and other revenues to serve Michigan residents.

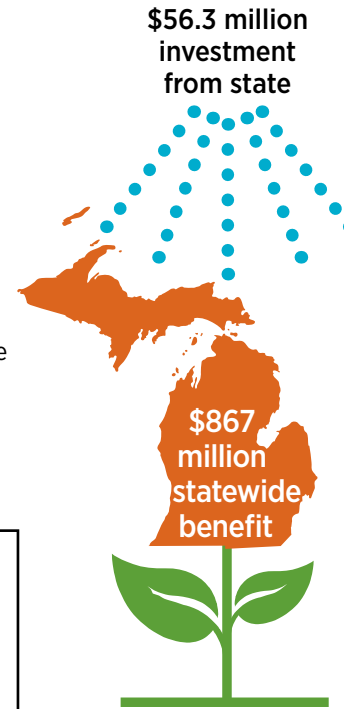
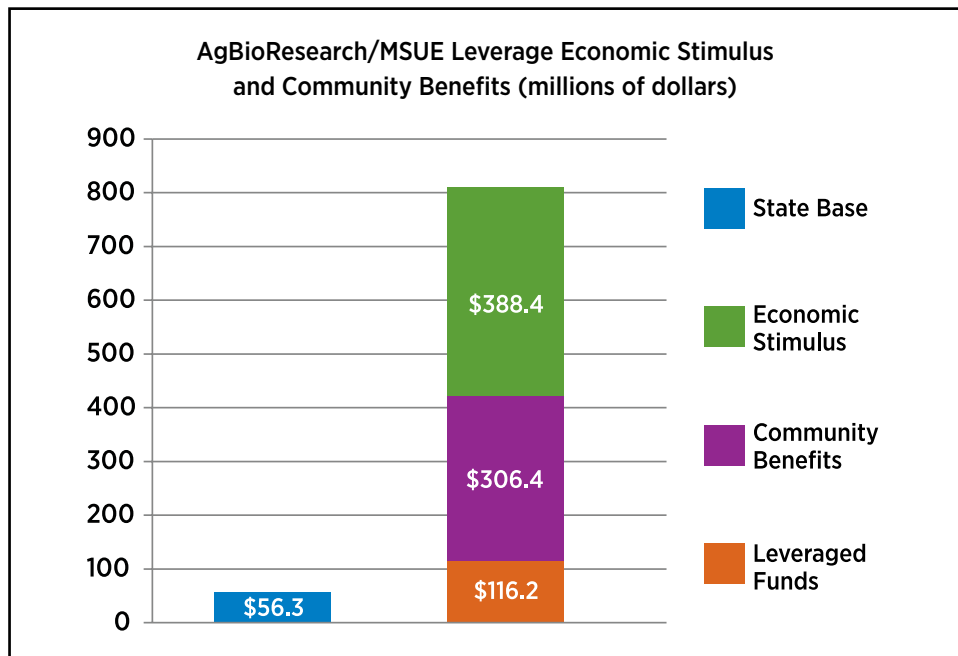
COMMUNITY BENEFITS worth an additional **\$5.44** to the state and nation.

When the leveraged funds and community benefits are added to the initial investment, they yield a net **ECONOMIC STIMULUS** valued at more than **\$388.4 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 **15:1**.

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

AgBioResearch/MSU Extension Leverage Economic Stimulus and Community Benefits (millions of dollars)



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

MSU Product Center: Food and agriculture leaders hopeful about industry, state economy

Leaders in Michigan's food and agriculture industry remain optimistic about their businesses, and their confidence in Michigan's overall economy continues to climb. Those were the results of the third installment of the Michigan Agriculture and Food Index (MAFI), released in July 2014.

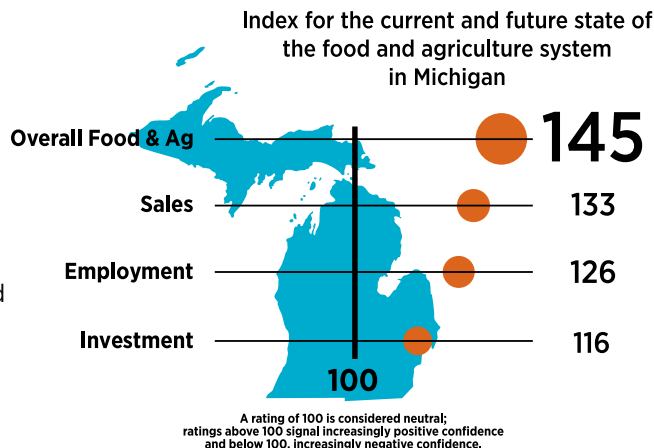
The MAFI gauges the current business climate of the state's food and agriculture system by surveying 100 influential players in food and agriculture businesses. A rating of 100 on the index is considered neutral; ratings above 100 signal an overall positive outlook, and below 100, an overall negative outlook.

The MAFI for the overall state of food and agriculture has remained steady at 145 or higher since the initial survey was conducted in April 2013. The index rating for the overall state of Michigan's economy continues to grow – from 115 in April 2013 to 120 in January 2014, all the way up to 133 in the most recent survey.

In addition to the two overall scores, the MAFI rates three aspects of the food and agriculture system in Michigan. The current sales outlook is up slightly to 133; the job outlook hung steady at 126; and the investment outlook rebounded to 116 after dropping to 107 in January 2013.

In an open-ended portion of the survey, researchers ask respondents what keeps them up at night. The top three issues remain the same as in previous surveys: government regulation and policy, various risk management concerns and labor. However, concerns about infrastructure – specifically roads and rural Internet access – made their debut in the most recent survey.

The MSU Product Center has been conducting the survey every six months since April 2013. Results are compiled, and the MAFI results are released semi-annually in March and July.



Fueling the economy

A 2012 MSU Product Center Food-Ag-Bio report shows that Michigan's food and agriculture system contributes **more than \$91.4 billion** to the state's economy and continues to grow.



The MSU Product Center is a clear demonstration of how entrepreneurs can successfully work with university professionals to identify markets, innovate new products and make critical decisions from product concept to launch.

In 2013-14, MSU Product Center professionals conducted **4,947** counseling sessions with **589** clients, resulting in:

- » 72 new ventures launches.
- » More than \$3 million in total capital formation, including more than \$2.8 million of owner investment in Michigan businesses.
- » 208.5 jobs created or retained.

18% Growth in MSU Product Center Clients Served

2012-13



2013-14



PRODUCTION AGRICULTURE

Using app technology to prevent dairy disease

Due to the metabolic stress brought on by birthing a calf and beginning milk production, dairy cows are most vulnerable to infectious diseases such as mastitis in the three weeks before and several weeks after giving birth. Studies show that cows that fall ill during this period never reach full milk-producing capacity. MSU veterinarian Lorraine Sordillo is collecting data to develop an app for smartphones, tablet computers and other mobile devices that can detect early warning signs of disease susceptibility.

The team will design the app to allow farmers to input a series of variables, such as herd size, feed sources, housing, climate and individual cow health. The app will then recommend adjustments to prevent disease. It will also be used to help train the next generation of food animal veterinarians and on-farm consultants.

Bridging the gap between farm to fork

Breakfast on the Farm (BOTF) bridges the gap between Michigan's farmers and consumers who often have little idea where the food on their plates comes from. BOTF invites the public to enjoy a delicious farm-fresh breakfast on a working farm and educates them on the farm-to-fork process. BOTF is an open door for the community to learn about modern food production and build trust with and appreciation for local farmers. An online survey showed that 88 percent of participants told others they should attend a BOTF event.

In 2014, three BOTF events took place. There have been 26 events held since the program's launch in 2009. A total of 12,687 adults and children attended five BOTF events held in 2013.

- » Approximately 75 percent of dairy herd disease occurs within the first month of milk production.
- » The app developed by MSU is expected to be the most comprehensive available in terms of the number of variables and levels of farm analysis.
- » Reducing disease will improve production, sustainability and security of the Michigan dairy industry, which annually generates more than \$1.5 billion in cash receipts.

A 2013 survey asked BOTF participants about their experience. The results showed:

- » 53,552 children and adults have attended Breakfast on the Farm events since the program's launch in 2009.
- » 80 percent left with a positive impression about modern dairy farms.
- » 61 percent said farmers are doing a good job caring for their animals.



Using high-fructose corn syrup to increase herbicide activity

MSU plant, soil and microbial scientist Donald Penner has focused much of his career on improving the use of chemical herbicides to help farmers protect their fields and eliminate weeds. His work with herbicide adjuvants – substances added to herbicides to increase their effectiveness – has spanned three decades, advancing pesticide technology and producing one of the most valuable patents in MSU history. Today, Penner continues to expand on that technology, hoping to extend his patent and its benefits.

Since his research began in 1980, Penner's high-fructose corn syrup adjuvant technology has become a staple of modern weed control programs, allowing farmers to improve crop yields while limiting the amount of herbicide needed to impede the spread of undesirable plants in fields. **By adding high-fructose corn syrup to herbicides, his adjuvant technology:**

- » Has been tailored to combat three of the most prevalent and costly weeds in agriculture: giant foxtail, velvetleaf and common lambsquarters.
- » Ensured that farmers need less herbicide to gain the same benefits, reducing both their financial burden and the environmental impact.
- » Was applied to tens of millions of agricultural acres last year, improving crop yields across the country.

Meeting the needs of Michigan craft brewers

Consumers are eager to purchase made-in-Michigan products, and craft brewers in Michigan are attempting to meet this demand by using all Michigan-made ingredients in their suds. Michigan's growing craft beer industry, made up of dedicated small business owners, is improving the economy and instilling a sense of local pride in regions throughout Michigan, which are seeing their locally made brews get national attention.

Michigan brewers are looking for high-quality, affordable malt and hop products with consistent quality and availability. If these needs are met, then the craft brewing industry will continue to grow to support positive economic development for local communities. MSU Extension has educators and specialists supporting the growing hops and craft brew industries. **It is working to help farmers and brewers meet their biggest challenges going forward:**



Photo: morguefile.com

- » Currently, there are only two small malt houses in the state with more needed to keep up with demand.
- » Farmers will have to learn to produce high-quality malting barley and hops both in and out of the traditional growing season.
- » Return on investment for farmers will need to be competitive with other available crops.
- » Start-up costs are high and there is a lack of key control measures.

Combating soybean aphid with genetic technologies

A 2008 survey found that 89 percent of the 63.6 million acres of U.S. soybean fields had been exposed to the soybean aphid, a devastating insect pest. Female soybean aphids are born already pregnant, with new generations taking only five days to produce. Up to 15 generations of aphids can be found on a single unchecked plant, and an infestation of the insects can reduce crop yields by up to 50 percent.

From a sample of 2,000 soybean germplasms – collections of an organism’s genetic material – MSU plant, soil and microbial scientist Dechun Wang developed SPARTA, a set of soybean genes that confer resistance to the soybean aphid. Soybean seeds derived from SPARTA yield plants with a natural resilience to the costly pests, improving yields, profits and the agricultural environment.

New iterations of SPARTA have been released almost every year since 2007 in an effort to continually improve its resistance to the soybean aphid.

Improving regional beef production economics

Continued dependence on a handful of meat distribution companies in the U.S. can lead to sustenance problems in the future. MSU assistant professor of beef cattle and forage utilization Jason Rowntree is examining ways to interject beef production systems into local communities in Michigan. Challenges such as energy prices, climate change and devastating weather events can impact food production.

Rowntree has developed a local food-system model in the Lake City area that includes 20 local cattle producers providing 10 steers each to the project. Three of the participating producers are working to convert more than 1,000 acres to a pasture-based model, and two obtained Michigan Department of Agriculture and Rural Development (MDARD) grants to develop on-site packing and processing facilities. Rowntree is finding ways to link local producers with local consumers to lower input costs while adding value to the system.

- » Traditional soybean aphid management costs between \$10 and \$12 per acre in pesticides.
- » Farmers use less pesticide with SPARTA soybeans than they do with other soybeans, reducing financial costs and economic impact.
- » By 2012, every major domestic soybean seed company was using SPARTA in developing their products.



Photo: MSU AgBioResearch

- » The 200 steers are expected to equal \$500,000 of local economic impact.
- » The USDA estimates that farm-level value of local food sales in 2008 totaled \$4.8 billion, about 1.6 percent of the U.S. market for agricultural products.
- » A 2012 national survey of restaurants showed that locally sourced meat and seafood was the No. 1 food trend.

Fighting back against emerging pests

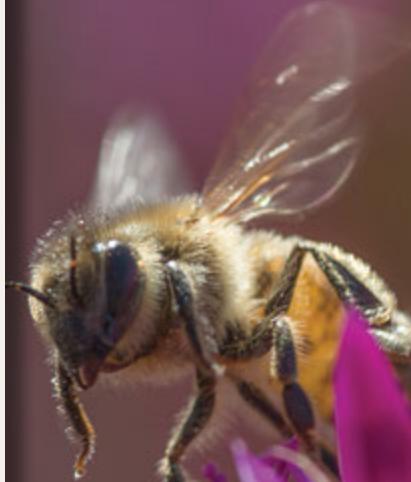
The spotted wing drosophila and the brown marmorated stink bug are two invasive pests that pose the biggest threats to Michigan's fruit production. Michigan growers will likely have to implement new management programs to control these pests from harming their fruit crop.

The spotted wing drosophila has an optimal developing temperature of 65 to 70 degrees Fahrenheit, normal conditions during a Michigan growing season. This makes early detection information vital to activate pest management programs that prevent rapid population increases and potential infestations.

MSU Extension partners with farmers and statewide agencies to monitor these pests. Working together to eliminate these invasive species will be essential to lessen the loss of the Michigan tree fruit crops in the future.

Growers need to monitor for both the spotted wing drosophila and the brown marmorated stink bug because:

- » Spotted wing drosophila feed upon and lay eggs in ripe fruit.
- » Spotted wing drosophila can produce many generations in a relatively short amount of time.
- » The brown marmorated stink bug has a host range of more than 300 known plants, including fruits grown in Michigan.
- » In other states, brown marmorated stink bug populations reached high numbers causing substantial damage in tree fruits.



Improving crop pollination through alternative bee species

As Colony Collapse Disorder continues to plague honeybee colonies, MSU researchers are leading national efforts to study alternative pollination strategies and the effect of utilizing wild and alternative domesticated bees through the Integrated Crop Pollination Project (ICPP).

Led by MSU entomologist Rufus Isaacs, the ICPP team is working to identify the most effective non-honeybee pollinators and to determine how producers can take advantage of wild bee populations by attracting them to orchards. They are working to quantify the effectiveness of companion plantings – in this case plantings of wildflowers in an orchard – on drawing in wild bees to pollinate for producers. They are also studying the abilities of alternative bees, such as bumblebees and those belonging to the genus *Osmia* to determine which give the best pollination results.

The ultimate goal is to provide growers with a variety of pollination options to meet their unique situations.



Photo: Bill Shane, MSU Extension

- » Colony Collapse Disorder has affected nearly one-third of American honeybee colonies since it was first reported in 2005.
- » Bumblebees are better capable of pollinating in Michigan's cooler spring temperatures than honeybees.
- » A two-acre wildflower planting adjacent to a 10-acre blueberry field can increase yield by nearly 25 percent.

Aiding apple industry success with discovery of new genetic pathway

Bumper crops of apples are beneficial to Michigan apple growers as long as they can be properly stored for marketing throughout the year. However, preserving the apple's firmness, taste and aroma can prove challenging.

MSU horticulturist Randy Beaudry has discovered a genetic pathway that plays an important role in producing apple aroma profiles, key qualities that help Michigan-grown apples remain competitive. Flavor, a combination of taste and aroma, is one of the most important characteristics of food.

To get a better understanding of how apples synthesize aroma-producing esters, Beaudry searched for genes that were expressed at the same time apples synthesize ester compounds. He found one gene that eventually led to the identification of an undiscovered plant pathway: the citramalate pathway, which contributes to the formation of branched-chain acids and branched-chain esters.

Showing municipalities the value of composting

Composting dead animals is a regular part of work for today's farm operators. However, municipalities rarely use this method despite its being a good solution to disposing of animal carcasses.

Proper animal composting works well as a way to deal with road kill, as an alternative disposal method for animal control units and as a disaster response when livestock and other animal mortalities require disposal. Composting is a dynamic process, enclosing an animal carcass in a mixture of plant or fiber-rich materials such as wood chips or used compost. Microorganisms in the mixture use moisture, carbon and oxygen to break down the carcass tissues while releasing heat that kills harmful bacteria.

During the 2014 Ag Expo, MSU researchers provided a demonstration for local municipality representatives of animal mortality composting, recommending it as a safe, biosecure and economical method of road-kill disposal.

- » 30 million bushels of apples were harvested in Michigan in 2013, a state record.
- » For more than half a century, MSU researchers have refined the controlled atmosphere storage of apples.
- » The \$700 million annual economic impact of the apple industry makes it Michigan's largest and most valuable fruit crop.



Photo: ANR Communications, MSU

- » Composting is an effective and safe way to deal with all animal mortalities, regardless of species.
- » Composting works well on farms and can be used by municipalities for road kill or for animal control centers.
- » Composting is a viable solution for disaster relief response teams in situations involving a high number of animal mortalities.

Finding eggs-actly the right solutions for hen housing

The potential of banning conventional types of housing for egg-laying hens has become an issue in the United States. This is in part because of laws in parts of Europe requiring commercial eggs to be produced in free-range barns or enriched cages. Several U.S. states have passed similar legislation.

The Coalition for Sustainable Egg Supply is studying housing alternatives for egg-laying hens in the U.S. to provide egg producers and legislators with scientific research-based options. The project involves researchers from five universities, including MSU animal scientist Janice Siegford, as well as food industry and egg supplier representatives.

Researchers studied three types of hen housing: conventional caged housing, enriched colony systems and cage-free aviary systems. All three systems have strengths and weaknesses. Additional research is necessary to determine how hens function in the systems.

Reducing impact of extreme temperatures on turkey development

Commercial turkeys are born in temperature-controlled hatcheries, but within a day or so, most are transported to farms where they grow until maturity. During the journey, the newly hatched turkeys are exposed for the first time to the ambient temperature of the outdoor environment. MSU food science and human nutrition researcher Gale Strasburg is working to help determine how young turkeys might better cope with the temperature spikes expected to come along with climate change.

As the first step in developing an adaptation strategy for the birds, Strasburg and his team will study how hot and cold temperatures impact the development of recently hatched turkeys. Temperature extremes have the potential to negatively impact the growth of breast tissue, the most economically valuable part of the animal. By helping turkeys adapt to the temperature extremes, the research is expected to improve the ability of turkey farmers to meet increasing global demand in a changing environment.



Photo: ANR Communications, MSU

- » 240 million turkeys were raised on U.S. farms in 2013.
- » The national turkey industry generates \$5 billion in revenue annually.
- » Turkeys bred to withstand challenging temperatures will be more productive and profitable.

- » The \$6 million commercial-scale, scientific hen housing study likely will impact Michigan's annual \$230 million chicken egg industry, which ranks 11th in the nation.
- » Michigan operators produced 3.46 billion eggs with nearly 12 million egg-laying hens in 2012.
- » Hen housing systems can impact the environment, animal health and well-being, as well as food affordability.

COMMUNITY & ECONOMIC DEVELOPMENT

Providing valuable work experience to young professionals

MSU Extension encourages Michigan's young people to envision a future career path that can help them positively impact their communities and build valuable professional skills. A new internship program creates a link between campus life and future career success. Started in 2013 with seven interns, the program has been expanded in 2014 to 13 interns because of its initial success.

The internship program has been popular with communities, MSU Extension educators and, most importantly, with the students, who have shown growing interest. In 2013, the program was piloted in regions in Michigan with a focus on agriculture. It provided students with a valuable networking opportunity with farms and within the agriculture industry, and allowed them to gain important skills in vital areas of agriculture.

In the internship program's first year, interns worked on:

- » Improvement of air quality around swine production facilities through an investigation of various plant species for use as vegetative environmental buffers.
- » Basic equine health and body condition as well as safe handling of horses.
- » Pork quality assurance and site assessment.
- » Forage management for sheep and goat production.



Photo: ANR Communications, MSU

Studying the effectiveness of the new concept of food hubs

As demand for local and regional food grows, many small- and medium-sized farms and food businesses are turning to food hubs to cooperatively bring products to market. To better understand this new business model, MSU agricultural economist Brent Ross is studying how organizations within the food systems of Michigan and Missouri can collaborate through food hubs to take advantage of entrepreneurial opportunities. Food hubs collect the products of growers and distribute them to a broader market.

Researchers will develop a series of case studies that examine how each food hub was developed, the role each member plays within the organization, the kinds of services provided by each organization and how each of those factors evolve over time. They will also examine the social network of each food hub, determining how members are connected and how those connections play into the organization hierarchy. **The study aims to:**

- » Help determine the viability of food hubs as a business model and decide whether their formation should be promoted.
- » Ascertain the factors that make a food hub successful.
- » Examine the economic drivers behind the formation of food hubs, which are experiencing growth across the nation.

Attracting talent through placemaking

Placemaking, a strategy led by local governments and planning commissions, can be a cornerstone of Michigan's economic recovery. As the state moves to be more competitive in the New Economy, it focuses on attracting and retaining educated people by making communities rich in physical and cultural amenities, and making it easier to forge partnerships between businesses, governments and nonprofits.

The Michigan Placemaking Curriculum is a comprehensive training program covering the latest research on the economics of placemaking, the role of urban form in creating a sense of place, and tools and techniques for engaging the public in placemaking.

The Michigan Placemaking Curriculum was prepared as part of the MPlace Partnership and was written under contract with the Michigan State Housing Development Authority (MSHDA) through a grant to the MSU Land Policy Institute.

- » As of July 2014, more than 10,000 people have received the Michigan Placemaking Curriculum via educators or trainers.
- » More than 70 trainers across the state have been trained by Mark Wyckoff and other MSU Extension educators and specialists.
- » Allegan, Alpena, Dearborn and Sault Ste. Marie piloted PlacePlans, an effort to help communities design and plan for specific transformative placemaking projects.



Photo: cc-flickr-Michael Patterson

Assessing financial health and recommending fiscal improvements for the future of Michigan's municipalities

As Michigan looks to rebound from recent fiscal difficulties and become stronger and more fiscally sound in the future, MSU Extension has been a valuable partner in educating the public as well as legislators.

Whether it is helping to explain the ramifications of Detroit's bankruptcy to the public or assisting legislators in understanding alternative sustainable funding options, MSU Extension specialist Eric Scorsone and other MSU Extension educators and specialists have served as a valuable resource of educational, unbiased information.

In the past year, Scorsone has served as an adviser to or been a member of the Lansing Financial Health Team, the Flint Blue Ribbon Committee and the State Treasurer's Municipal Finance Reform Task Force, which all focused on assessing fiscal health and recommending changes to maintain or improve the financial future of Michigan and its cities.

Scorsone and his team have released white papers that:

- » Calculated Michigan has \$12.7 billion in unfunded other post-employment benefits (OPEB), primarily driven by health care costs.
- » Calculated that Detroit alone has \$4.9 billion in unfunded OPEB liability.
- » Examined 108 municipalities, taking actuarial valuations and exploring commonalities including retirement package design, service requirements, benefit provisions and cost sharing.

Managing wildlife diseases with bioeconomics insights

Since 1975, the Michigan Department of Natural Resources (MDNR) has worked to eliminate bovine tuberculosis (bTB) from free-ranging white-tailed deer populations. This disease, caused by *Mycobacterium bovis*, can spread from infected deer to humans and other animal species, especially cattle.

Because bTB can affect Michigan livestock industries as well as deer management decisions, baiting guidelines and livestock trade flows, the MDNR and the Michigan Department of Agriculture and Rural Development have taken measures to reduce disease prevalence in endemic areas of the state. Collectively, the two agencies have invested more than \$86 million in surveillance, control and testing activities to reach and maintain a relatively consistent level of success for more than a decade.

MSU economists Richard Horan and Christopher Wolf are developing a bioeconomics decision theory to help wildlife and livestock managers better understand the economic, ecological and epidemiologic trade-offs of various disease management actions.

This decision theory will:

- » Help lifestyle managers take the most cost-efficient means of controlling or eradicating bTB in livestock herds.
- » Thwart significant economic damage from lost productivity, imposed herd depletions and trade bans associated with bTB outbreaks.
- » Result in economic savings by making disease surveillance efforts more targeted.
- » Grand Rapids Public Schools serves 15,000 lunches each school day.
- » Grand Rapids Public Schools serves lunches in more than 70 schools.
- » In 2013, Michigan produced more than 83 million bushels of soybeans, valued at more than \$1 billion, making it one of Michigan's most valuable commodities.



Photo: Michigan DNR, David Kenyon

Getting local foods into school cafeterias

MSU Extension works every day to forge and strengthen partnerships in communities to help Michigan and its residents become stronger, healthier and more resilient. For several years, MSU Extension has worked with Amy Klinkoski, nutrition services coordinator for the Grand Rapids Public Schools, to get healthful, Michigan-grown vegetables into more school lunches.

This farm-to-fork emphasis is important to Klinkoski, who grew up on a bean farm in Shiawassee County. She spent much of 2013 working to get more Michigan soybeans into Grand Rapids lunchrooms.

MSU Extension worked with Klinkowski and Zeeland Farm Services so that the school system could switch from olive oil to soybean oil for cooking and in salads. Much of the soybean crop comes from farms in and around Kent County. The school system also began purchasing roasted soybeans produced and marketed by Bur Oaks Farm in Ann Arbor and is making them available at its salad bars.

ENVIRONMENTAL QUALITY & NATURAL RESOURCES MANAGEMENT

Assessing fish habitat health to improve rivers

A report titled “Through a Fish’s Eye: The Status of Fish Habitats in the United States 2010” reveals that about one out of every four streams in the lower 48 states is at a high or very high risk of current habitat degradation. The National Fish Habitat Partnership (NFHP) was started to provide information and resources to enable volunteers to go to these degraded waters and conduct work to improve them.

MSU fisheries and wildlife scientist Dana Infante is one of the principal investigators on the NFHP project, which is scheduled to be completed every five years. Her work provides an overall picture of the U.S. fish habitat conditions. She is working in coordination with the U.S. Fish and Wildlife Service, the U.S. Geological Survey, the Nature Conservancy, the World Wildlife Fund, Trout Unlimited and the U.S. Forest Service, among others.



Photos: MSU Communications & Brand Strategy

- » 36,000-plus miles of rivers and streams run through Michigan.
- » Since the adoption of the Clean Water Act in 1972, river health has improved due to reduced impacts from point-source pollutants.
- » Hundreds of downloads of Infante’s data from fishhabitat.org have provided direction on what needs to be done to improve valuable river health.

Connecting paddlers to a Pure Michigan experience

With more than 3,000 miles of Great Lakes coastline and 36,000 miles of rivers and streams, Michigan is rich in water trail opportunities. While popular canoeing or kayaking areas often have well-developed access and launch points, communities often struggle with attracting paddlers to downtown or commercial areas or other community amenities such as lodging and restaurants. Water trails supply residents and visitors adventures along urban waterfronts or remote Great Lakes coastline as well as provide communities with economic development opportunities.

Michigan Sea Grant Extension offers expertise to coastal communities and partners interested in developing and enhancing water trails. Planning for a water trail focuses on linking paddling recreation opportunities with other community amenities to enable water resource-based economic development strategies within regional and statewide contexts.

Sea Grant has worked with state and federal agencies and numerous partners throughout the state on the development of contiguous water trails and other trails along Michigan's Great Lakes coasts, resulting in:

- » The establishment of the Michigan Comprehensive Trails Plan in 2013.
- » Michiganwatertrails.org, an online resource linking regional water trails forming a statewide water trail system along nearly every mile of Great Lakes shoreline.
- » The Pure Michigan Trail Network, established by the Michigan Legislature.



Photos this page: freeimages.com

Enhancing, expanding fishery ecosystems, coastal aquatic recreational opportunities

Nearly 40 percent of Michigan's population lives in the southeast region along lakes Huron, St. Clair and Erie. Historically, this region, including the St. Clair and Detroit rivers, supported a diverse and productive fishery, as well as multiple other uses. Years of intense development and use resulted in six areas with severely degraded environmental conditions designated by the Great Lakes Water Quality Agreement as Areas of Concern with specific beneficial uses impaired.

Michigan Sea Grant Extension delivers research, education and outreach that address needs and priorities identified by stakeholders in coastal counties. In the urban, southeast region, Michigan Sea Grant staff engaged partners on projects designed to foster science-based decisions that promote vibrant, livable communities that offer opportunities for economic growth while preserving our natural resources. **These programs:**

- » Led to the delisting of the beneficial use impairment for tainting of fish and wildlife flavor.
- » Helped bring about successful lake sturgeon, walleye, lake whitefish and other native fish spawning occurring on the four habitat reefs constructed.
- » Provided leadership to Michigan's Statewide Public Advisory Council.

Helping Michigan residents become better stewards of our inland lakes

Michigan's has more than 11,000 inland lakes, which are among its most beautiful and precious resources. To marshal all of the passion and energy so many people and organizations have regarding Michigan's lakes, MSU Extension helped organize the first Michigan Inland Lakes Convention, where hundreds of enthusiasts, professionals, government officials and others gathered for an intensive three-day convention.

The convention helped participants learn how to become better stewards and better protect Michigan's inland lakes, and it boasted more than 25 educational opportunities. Sessions included such topics as youth and volunteer education, aquatic invasive species, plant identification, algae blooms and water quality.

The convention was a partnership between MSU Extension, the Michigan Department of Natural Resources, the Michigan Department of Environmental Quality, the Michigan Lake and Stream Associations, the Michigan Natural Shoreline Partnership, the MSU Institute of Water Research and the Michigan Chapter of the North American Lake Management Society.

- » 372 people attended the Michigan Inland Lakes Convention.
- » More than 66 percent represented nonprofit agencies or were riparian landowners.
- » More than 75 percent reported increased leadership, confidence and stewardship.
- » More than 90 percent reported they gained information that will assist them as professionals or volunteers.

Researching health risks at toxic waste sites

MSU toxicologists John LaPres and Timothy Zacharewski are part of a multidisciplinary team that is using \$14.1 million in funding from the National Institute of Environmental Health Sciences to understand the health risks from chemicals, primarily dioxins, found in hazardous waste sites.

The goal is to understand why these chemicals are toxic and to identify the human health risks associated with exposure to them. LaPres studies the relationship between a toxic reaction and the amount of poison involved in causing it. This will help to understand the relationship between chemical exposure and illness.

Zacharewski's research focuses on the effects of exposure to toxic chemical compounds and accumulation of fat in the liver, which can progress into more complex diseases. Zacharewski is using mouse models and human liver cells to look for changes that would be consistent with fat accumulation in the liver.

- » More than 1,200 hazardous waste sites, commonly known as Superfund sites, are located in the United States.
- » Michigan is home to 67 Superfund sites.
- » Over the past 20 years, MSU scientists and other researchers have analyzed thousands of contaminants at these sites, aiding in the cleanup and protection of people and the environment.

Making an impact at legislative level through 4-H

Under current Michigan legislation, home heating oil tanks do not have to be inspected before being refilled. This increases the chance of leaks and spills, negatively affects residential safety and increases other liabilities. In an attempt to protect the environment and Michigan residents, the Michigan 4-H Youth Conservation Council (M4-HYCC) proposed broader jurisdiction over home heating oil tanks to the Michigan Senate Committee. The council's recommendations would protect the environment, residents and the welfare of private industries.

MSU Extension provides programs such as the M4-HYCC to tap into the desire of Michigan's youth to get involved and become community leaders on subjects they are passionate about, but also to show them how to be engaged in the legislative process.

Research conducted annually by teens involved with M4-HYCC has:

- » Influenced the passing of a Senate bill that reduces the amounts of phosphorus permitted in dishwasher and laundry detergents.
- » Introduced a bill in the state Senate that directed the Michigan Department of Natural Resources to include information in its boating safety course on proper marine fueling techniques and marine fuel spills.
- » Introduced a bill that promoted the development of the Michigan Heritage Water Trails program.



Photo: ANR Communications, MSU

Developing models to monitor black bear populations

The Michigan Department of Natural Resources (MDNR) manages Michigan's American black bear populations. The agency, however, has grappled with indices, estimators and costly survey methods that provide conflicting projections of how these populations have changed over time.

When paired with other research and education activities, these population projections are critical to balancing bear ecology, creating recreational opportunities for hunters and nature enthusiasts, and encouraging peaceful cohabitation between bears and people. The survey methods currently employed to make these projections requires a significant field effort to distribute and monitor baits; this translates into large investments of time and estimates of \$50,000 to \$75,000 each year.

Two MSU fisheries and wildlife researchers, James Bence and Scott Winterstein, and an MDNR research biologist are developing supplemental, cost-efficient methods to monitor bear population dynamics and help the MDNR assess hunting license quotas. **These new methodologies will:**

- » Provide another data set to the MDNR to base recommendations on bear hunting and licenses.
- » Make better use of auxiliary data and reduce resources spent on conducting bear population surveys.
- » Produce detailed estimates of mortality variations, resulting in better projections of how Michigan bear populations are affected by different management actions.



Photo: Michigan DNR, David Kenyon

Guiding natural resource management with 'Big Data'

In Michigan, forests play an important role in the state's economy as a valued natural resource and as a source of employment and recreation. The United States Environmental Protection Agency is concerned that climate change will affect forest growth and productivity by altering the frequency and intensity of forest disturbances such as insect outbreaks, invasive species migration, wildfires and storms.

In an effort to understand more about the effects of climate and other ecological changes, the National Science Foundation launched the National Ecological Observatory Network (NEON), a \$434 million initiative that will create an open-access infrastructure that can be used to map, explore and predict changes in the nation's ecosystem.

MSU statistician Andrew Finley is collaborating with other NEON scientists to develop important statistical models, overcome technology challenges and educate future researchers who will use the observatory's "Big Data" to manage the state's natural resources. **His collaboration with NEON will:**

- » Create transdisciplinary educational opportunities for undergraduate students in statistics, ecology and other natural resource disciplines.
- » Enrich education in 23 southwestern Michigan K-12 schools in collaboration with the MSU Kellogg Biological Station.
- » Result in statistical and software tools next-generation researchers will use to process "Big Data."

FOOD SAFETY & SECURITY

Teaching residents about food safety

From the farm to the kitchen table, food safety is an important issue. Foodborne illness outbreaks occur crossing all socioeconomic lines from production and consumption to preservation of foods. Foodborne illness costs the U.S. economy billions of dollars each year in lost productivity, hospitalization, long-term disability and even death. The Cottage Food Law took effect in July 2010, allowing home-processed foods to be sold to the public, emphasizing the need for food safety education.

MSU Extension Cottage Food Law workshops supply Michigan residents with up-to-date, scientifically backed information on food safety. In 2013, nearly 4,000 Michigan residents learned about preserving food and preparing safe food for public consumption. Food consumers can have increased confidence when buying food products sold by someone with an MSU Extension food safety certificate related to producing cottage foods.

Participants in MSU Extension's Cottage Food Law workshops reported:

- » 46 percent will now sanitize surfaces before preparing food, in addition to 54 percent who already practiced this.
- » 46 percent of participants learned how to properly prevent food cross-contamination; 54 percent were already using safe food cross-contamination practices.
- » Participants documented that, because of MSU Extension food safety workshops, they are careful to wash their hands and to keep countertops clean when preparing foods.

Finding new ways to get local products to consumers

The MSU Center for Regional Food Systems (CRFS) is working to see that more of the 12 to 15 billion pounds of food annually consumed in Michigan are sourced, processed and delivered within the state. Using Michigan's diverse agricultural products, the center focuses on projects that build sustainable and profitable local food systems.

One project, coordinated with assistance from the Michigan Department of Agriculture and Rural Development (MDARD), is the continued development of food hubs, centrally located facilities that ease the collection and distribution of food from small and midscale farmers to points of sale. Michigan is home to food deserts, places where people don't have convenient access to fresh produce.

To support growth of food hubs, MDARD has provided grants to projects in Detroit, Ann Arbor, Lansing, Traverse City and the Upper Peninsula. The CRFS is helping to establish additional hubs throughout the state.

- » The average American meal travels about 1,500 miles to get from farm to plate.
- » 550,000-plus Detroit residents live in areas defined as food deserts.
- » Michigan is the second most diverse agriculture state in the nation with an agriculture and food industry that provides \$96 billion in economic impact.



Photos this page: freeimages.com

Helping feed the UP with new MSU incubator farm

Most of Michigan's Upper Peninsula is considered a food desert, an urban or rural area lacking convenient access to fresh, healthy and affordable food. The region faces high costs of importing supplies and food, low-quality soils and a cool northern climate with a short growing season.

To respond to these challenges, the U.S. Department of Agriculture has awarded MSU community sustainability scientist Matt Raven a grant worth almost \$500,000 to establish an incubator farm at the MSU Upper Peninsula Research and Extension Center in Chatham.

The incubator farm will create an educational hub focused on local, nutrient-dense food and technologies relevant to its production. Research and education efforts will also stress sustainable practices that improve soil through conservation agriculture. Raven and his team will examine food systems, soil health and season-extension practices for vegetable production to improve the food security of Upper Peninsula communities.

- » The incubator farm will educate local producers in sustainable agriculture, soil health improvement and season-extension technologies such as hoopouses.
- » The diversified farming techniques pioneered at the farm will increase the availability of nutrient-dense food in the U.P.
- » Greater food security will improve overall economic sustainability of the U.P.

Reducing foodborne illnesses

Food preservation is both a popular hobby and a small business opportunity, but people who preserve food without following scientifically proven food preservation techniques increase the risk of foodborne illness. A survey conducted by the National Center for Home Food Preservation in 2005 found that many food preservers still follow the out-of-date practice of open kettle canning. Because of the risk of foodborne illness, including botulism from failure to use safe home-canning techniques, it is important to continue to provide up-to-date guidelines for safe home food preservation.

In 2013, MSU Extension taught more than 90,000 Michigan residents about safe food practices. As a result of MSU Extension food safety programs, individuals now use safer food handling, preparation, storage and preservation techniques. This reduces medical expenses, reduces food recalls and contributes to the financial stability of food businesses. This benefits other community members by decreasing the economic costs of foodborne illnesses, estimated at \$6.9 million in 2000.

Participants in MSU Extension safe food preservation workshops reported:

- » 97 percent said they will properly use processing techniques to safely can foods.
- » 93 percent said they will select high-quality foods for preservation.
- » 89 percent said they gained knowledge on how to properly can food.

Ensuring safety of low-moisture foods

Salmonella outbreaks in low-moisture foods are an emerging issue for ingredient manufacturers, including low-moisture food sectors in Michigan, from flour mills to cereal producers.

MSU biosystems engineer Bradley Marks is improving validation methods to ensure the safety of low-moisture foods in collaboration with the U.S. Food and Drug Administration, Washington State University and several industry groups. This research is focused on generating tools and models that can be generalized and applied to a range of products to ensure their safety.

While it's nearly impossible to run tests with every low-moisture food, it is imperative to identify the characteristics that could have the greatest effect on a process's validity. Processors must go beyond adopting practices that reduce salmonella contamination and prove the process accomplishes this goal.

- » A 2009 salmonella outbreak in low-moisture peanut products caused nine deaths and cost the industry \$1 billion.
- » The time-temperature combination necessary to kill salmonella bacteria can be 100 times greater in low-moisture foods than in high-moisture foods.
- » MSU will soon become home to the Center for Research on Ingredient Safety, which will provide training and analysis on the safe use of chemical ingredients in consumer packaged goods.

ENERGY PRODUCTION & CONSERVATION

Anaerobic digester turns organic waste into energy

An anaerobic digester, developed by the MSU Department of Biosystems and Agricultural Engineering, is helping to meet Michigan Gov. Rick Snyder's goal to double the recycling rate to 30 percent by 2016. The digester is re-using waste from MSU farms and dining halls to create energy for several buildings on campus.

Anaerobic digesters are sealed tanks, deprived of oxygen, in which organic waste is degraded at an elevated temperature. This allows the waste material to decompose quickly and in the process, produce methane that can be captured and used as fuel.

Dana Kirk, an MSU assistant professor who oversees the digester project, says the organic material the system uses includes cow manure from the MSU Dairy Teaching and Research Center; food waste from campus dining halls; fruit and vegetable waste from the Meijer Distribution Center in Lansing; and fat, oils and grease from local restaurants.

Studying *Nannochloropsis* as a biofuel source

The search for sustainable sources of clean biofuels has taken scientists into the depths of the ocean, where oil-producing algae have offered new possibilities. One particular algae genus that holds promise is *Nannochloropsis*. The ability to generate high quantities of lipids, naturally occurring fats and other molecules used for energy storage, coupled with rapid growth rate, have made *Nannochloropsis* an ideal biofuel candidate. One particular species, *Nannochloropsis oceanica*, is being studied by MSU biochemist Christoph Benning as an example of algae's biofuel potential.

With approximately 12,000 genes, its compact genome is smaller than other algae, which makes it easier to study. This genetic simplicity also renders it more malleable, a characteristic Benning plans to use to increase the already-high oil production. He has produced a draft of the algae's genome, and is now refining it in order to unlock its full potential.

- » The anaerobic digester uses 17,000 tons of organic waste to generate 2.8 million kilowatt hours of electricity per year.
- » The system is the largest, by volume and energy output, on any U.S. college campus.
- » The \$5 million project is expected to pay for itself within 15 years.

- » Estimates show that if algal biofuels replaced petroleum fuel in the U.S., only 15,000 square miles of space would be required.
- » Advances are expected to yield benefits for agriculture as the high-oil-producing genes may be applicable in biofuel crops.
- » *N. oceanica* can also be genetically reassembled into a cancer treatment drug.

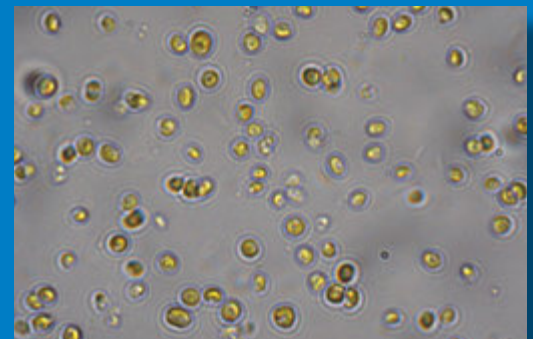


Photo: MSU AgBioResearch



Converting woody biomass into coal alternative

Research in the past two decades has identified the byproducts of burning coal to be damaging and detrimental to the environment. This has led to an increased demand for a substitute. MSU is working to find an alternative renewable energy source to coal. Research is attempting to convert woody biomass grown on campus into a coal alternative.

MSU biosystems and agricultural engineering and forestry scientist Christopher Saffron and his team are working to transform woody biomass into an alternative to coal. They've designed a densification system to transform the torrefied biomass chips into compact forms that can be economically transported.

The first step in converting the biomass into a renewable energy source requires heating the biomass in an oxygen-free environment at 250 to 350 degrees Celsius for up to 40 minutes. The ground biomass is then densified until it is affordable to transport.

Turning agricultural residues into feed and fuel

MSU chemical engineer Bruce Dale has devoted much of the last 30 years to developing a process to turn cellulosic biomass – agricultural waste such as corn husks and wheat stems – into an economical source of biofuel and animal feedstock.

Ammonia Fiber Expansion (AFEX) allows for the conversion of cellulose-rich plant matter into animal feed and biofuels such as ethanol. The process, which was invented by Dale and scaled up for commercial use by MBI, a wholly owned subsidiary of the MSU Foundation, renders the biomass into a slightly sticky substance that can be easily compressed into pellets. Reducing the material is an important key to making AFEX economical. Pellets are easier to transport and store, and are expected to be more digestible for animals.

Dale is continuing to scale up the process for commercial use, starting with a pilot plant on the MSU campus.



Photo: MSU AgBioResearch

- » The first pilot burn of the torrefied biomass took place at the T.B. Simon Power Plant this past spring with promising results. Further test burns are slated this year.
- » The MSU energy transition plan strives for 15 percent reliance on renewable energy sources by 2015 and 40 percent by 2030.

- » Cellulosic biomass is a sustainable biofuel that does not compete with food crops such as corn for agricultural space and creates a use for crop byproducts.
- » Commercial-level AFEX plants could be capable of producing 200 tons of pellets daily.
- » AFEX would be useable by those seeking either animal feed or biofuel products.

FAMILY & YOUTH DEVELOPMENT

Supporting school and student success

To ensure the future success of the Great Lakes State, Michigan schools are charged with improving educational outcomes for the state's youngest minds. Yet, they must do this with fewer resources than ever. MSU Extension youth educators partner with schools to provide innovative and economical enhancements to in-school learning as well as work to supply custom solutions to school challenges.

From once-a-month family workshops and in-school science lessons to after-school technology training and classroom gardening, MSU Extension supplies Michigan schools and the families they serve with the support they need to be successful.

Because of these unique partnerships, Michigan youth benefit:

- » 196 children and their parents attended science workshops through Bay County Schools. Of the children surveyed, 100 percent reported finding science to be fun and interesting.
- » 94 youth in Macomb, Muskegon, Oakland, Ottawa and Wayne counties received technology training and education through the 4-H Tech Wizards program. Due to their

- involvement in the program, 87 percent of those surveyed report doing better in school.
- » 47 youth in a Berrien County school participated in 4-H Science Blast in the Class lessons. After two years with 4-H activities, the school's Michigan Educational Assessment Program (MEAP) scores improved by 12 percent.

Strengthening Michigan's financial capacity

When individuals and families in Michigan are financially healthy, it creates an environment for sustained community prosperity. MSU Extension's financial literacy and housing education programs help families and individuals at any stage of their lives make smart money decisions and work through the homeownership process. These courses help reduce mortgage defaults through counseling new homebuyers as well as homeowners going through the foreclosure process.

Widespread efforts by MSU Extension have led to a significant increase in knowledge gained and behavioral changes across Michigan. Since July 2013, MSU Extension's foreclosure counseling has aided 601 participants spanning 18 counties, across all income levels. As a result of receiving this counseling, a higher percentage of homeowners are able to better communicate with their mortgage servicers, obtain loan modifications and in more than half of the cases, keep their homes. **As a result of financial and homeownership education, 444 participants reported:**

- » 84 percent pay their mortgage on time.
- » 80 percent now save money for home maintenance costs.
- » 86 percent maintained or increased their knowledge of predatory lending practices.
- » 54 percent of foreclosure clients were able to keep their homes.



Photo: ANR Communications, MSU

Supporting Michigan's military families

Families of military personnel face unique challenges: frequent relocations, deployments, changing family roles, reintegration after deployment and more. These dynamics can be especially difficult for more than 200,000 children in military families throughout Michigan.

To support to these families already sacrificing so much for our state and country, MSU Extension offers a range of programming to Michigan's military families and their children. This includes social, recreational and educational opportunities to connect military families with local resources and support, as well as predictable, safe and nurturing environments for military youth to unite with others facing the same challenges.

In the past year, MSU Extension's Operation: Military Kids, 4-H Military Partnerships and other general Extension and 4-H programming supported military families across Michigan, including:

- » Hosting 24 military-focused events for 454 military youth and 672 military adults in 34 counties.
- » Engaging 619 youth and 132 volunteers from military families in 67 counties in 4-H programs to develop critical leadership, organizational and technical skills that will benefit them throughout their lives.

Helping Michigan make smart health insurance decisions

In 2013, many Michigan individuals, businesses and families were facing important health insurance decisions that they had never had to consider before. The passage of the Affordable Care Act not only opened up the health insurance market to hundreds of thousands of additional people and many small businesses, but also changed the insurance landscape for the previously insured.

With confusion about new health insurance laws, requirements and the launch of the Health Insurance Marketplace in Michigan, MSU Extension conducted targeted outreach to both uninsured and underinsured residents as well as small businesses and farm owners to increase knowledge, understanding and confidence in the ability to purchase health insurance.

MSU Extension educated through weekly webinars and through social media and other online outreach for uninsured and underinsured individuals and families as well as gave on-site presentations throughout the state for small businesses and farm owners.

From November 2013 to April 2014, MSU Extension:

- » Presented 59 direct education sessions reaching 987 consumers.
- » Made 328 one-on-one contacts via email and phone to answer questions.
- » Provided 14,467 indirect educational outreach activities via social media, website page views, educational news articles, email newsletters and other media.
- » Made 854 referrals to local health insurance enrollment counselors.



Photo: ANR Communications, MSU

Supporting STEM careers through youth programming

The future of Michigan lies, in part, in the hands of its students' abilities to excel in science, technology, engineering and mathematics (STEM). Science literacy among school-aged youth in Michigan is below the national average, directly impacting college readiness. In the U.S. today, many job openings for STEM-related position go unfilled due to a lack of qualified applicants.

MSU Extension provides resources aligned with Michigan science education standards to teach confidence, leadership and responsibility related to STEM. Michigan 4-H encourages youth to participate in programming during the summer to continue to develop skills in unique, out-of-school settings. **Program results include:**

- » 100 percent of 4-H Animal & Veterinary Science Camp's 30 participants want to learn more and 97 percent plan on applying the skills learned in camp to real-world settings.
- » 77 percent of 4-H Great Lakes & Natural Resources Camp's 67 attendees are more knowledgeable about careers in environmental science-related fields as a result of participating in the camp.
- » 73 percent of 4-H Renewable Energy Camp's 45 participants reported being more likely to pursue a career in bioenergy-related fields as a result of attending camp.
- » The Great Lakes Education Program has reached more than 7,600 participants teaching economic growth and protection of coastal resources.



Photos this page: ANR Communications, MSU

Youth influencing community decisions with support from adults

More than 20 percent of the U.S. population is between the ages of 5 and 19. These youth look to adults for guidance in various situations. As youth become more involved, whether in academic or community settings, they search for ways in which their voices can be heard. Youth voice is a resource that often goes untapped in communities. MSU Extension provides training through Michigan 4-H for internal and external groups to consider the value of youth-adult partnerships in the decision-making process.

Youth are gaining life skills such as leadership, planning and teamwork, while adults are gaining information about the needs, concerns and issues that pertain to youth.

Local 4-H councils and committees are encouraged to seek out, listen to and enact youth ideas in their program planning. **As a result of youth-adult partnerships:**

- » Communities learn about the resources and creativity youth have to solve critical problems.
- » Trainings offered in nine Michigan counties promote the importance of youth inclusion.
- » 50 youth and 100 adults from across the state have attended educational events such as the 4-H Teen Leadership and Community Change Conference and the 4-H Volunteer Forum.

Preparing children for academic success

Youth who are not proficient readers by fourth grade are 68 percent more likely to drop out of high school. Research shows that young children who develop literacy skills prior to entering kindergarten are better prepared to learn to read. In Michigan, there is an educational standard to ensure children from birth to 8 years old have access to learning and development programs.

Children's school readiness improves when parents and caregivers are taught methods that increase early childhood science and reading literacy, and ways to prepare children socially and emotionally. Programming provided through MSU Extension and other organizations prepare children for academic success by giving parents and caregivers the tools they need to help their children succeed in school. MSU Extension is also making learning to read more accessible by putting books into the hands of thousands of children in families living in low-income situations.

- » To date, 250,000 books have been distributed to more than 2,500 children through programs sponsored by MSU Extension and its partnership with the Molina Foundation.
- » As a result of MSU Extension trainings and workshops, adults indicated an increase in knowledge of concepts of early childhood development and techniques that promote school readiness and academic success.



Photos this page: ANR Communications, MSU

HEALTH & WELLNESS

Working to improve social and emotional health

Many negative factors affect social and emotional health, including ongoing and toxic stress that may result from situations including abusive relationships, bias, damaging coping behaviors and relationship violence. Across the lifespan, people faced with these situations and settings are at risk for a wide range of physical, psychological, social, emotional, cognitive, financial and spiritual health challenges. The United States spends an estimated \$425 billion in direct and indirect costs of violence each year.

RELAX: Alternatives to Anger is designed to actively engage adult learners to increase knowledge and skills around anger management and give them constructive ways to deal with anger. In 2013, MSU Extension collected 712 RELAX evaluations from participants.

Consistently, more than half of program participants leave RELAX with improved knowledge or new skills designed to promote social and emotional well-being with others in their lives and immediate social environments.

- » 54 percent increased effort to talk things through until a solution is reached.
- » 55 percent increased effort taking time to understand how others feel.
- » 56 percent increased effort working hard to be calm and talk through issues.
- » 56 percent increased effort that if they do get upset, they try to end conflicts on a positive note.

Fighting obesity through education

Michigan has the 11th highest adult obesity rate in the United States, according to the Centers for Disease Control and Prevention. More than 30 percent of adults are obese, and 35 percent are overweight. Nearly 80 percent of adults and youth do not consume enough fruits and vegetables.

MSU Extension delivers affordable, relevant, evidence-based education to serve the needs of adults, youth and families in urban and rural communities. Topic areas include nutrition, physical activity, food safety and food resource management. Programs focus on helping participants gain the skills needed to buy and prepare nutritious, budget-friendly foods; increase their physical activity; breastfeed their babies and stretch their food dollars.

MSU Extension reached more than 87,000 adults and young people across the state through programming. **Through the program outreach:**

- » More than one-third of youth decreased their intake of sugary drinks.
- » Nearly one-third of youth increased their level of physical activity.
- » Nearly half of adults increased their daily vegetable and fruit consumption.
- » More than two-thirds of adults increased time spent being physically active, including three-quarters of older adults.
- » More than two-thirds of adults reported improved ability to make their food dollars go further.



Photo: ©iStock.com/fulvalue

Helping Michiganders prevent diabetes

Michigan ranks 15th in the nation for prevalence of diabetes, with an estimated 10 percent of Michigan adults aged 18 and older having been diagnosed with diabetes – about 758,300 people. An additional 250,200 Michigan adults are estimated to have diabetes but are currently undiagnosed.

Through the National Diabetes Prevention Program, MSU Extension helps participants to learn ways to change their lifestyles and improve their health. A trained lifestyle coach leads 16 core group sessions weekly. Participants learn to make modest lifestyle changes. Groups then meet monthly for six post-core sessions. The program provides participants with both a lifestyle coach and a valuable support system.

Illuminating science addresses TB threat to global human health

The Centers for Disease Control and Prevention (CDC) describes tuberculosis as “one of the world’s deadliest diseases.” In 2013, the agency labeled *Mycobacterium tuberculosis* (MTB) a serious threat in the struggle to control antibiotic resistance. MTB has two forms: an active, lung-targeting state and a symptomless latent state. Latent TB can live silently in the human body for decades, only becoming active once the immune system is compromised.

The CDC estimates that more than 2.3 billion people are infected with latent TB – that’s one-third of the global population. The disease is a growing burden to both the United States and countries abroad as more people contract antibiotic-resistant strains of the disease.

MSU microbiologist Robert Abramovitch is leading an innovative approach to develop a new drug that could help prevent the spread of TB. **To date, Abramovitch has:**

- » More than 2,400 Michigan residents participated in MSU Extension disease prevention and management classes in 2013.
- » Participants have lost a total of 695 pounds, which is 6 percent of their total body weight, through the National Diabetes Prevention Program delivered by MSU Extension.
- » Participants report being active an average of 150 minutes per week, significantly decreasing their risk of developing Type 2 diabetes through the National Diabetes Prevention Program delivered by MSU Extension.



Photo: MSU Communications & Brand Strategy

- » Developed a green-glowing fluorescent protein biosensor to better understand the bacteria’s disease mechanism.
- » Screened 273,000 pharmaceutical compounds in search of potential drug candidates that inhibit a key MTB virulence mechanism; he identified several he will attempt to move to market.
- » Furthered basic biological understanding by exploring MTB’s disease pathways.

Teaching valuable healthy-eating skills

In 2011, 17.5 percent of people in Michigan were considered to be living below the poverty level. More than 1.7 million Michigan residents receive Supplemental Nutrition Assistance Program (SNAP) benefits.

MSU Extension's Supplemental Nutrition Assistance Program - Education (SNAP-Ed) programs including Cooking Matters, Project Fresh, Healthy Harvest and Show Me Nutrition teach adults how to make the most of their food dollars, by developing skills such as menu planning, understanding recipes and keeping food safe. Participants learn about the nutrition and health benefits of foods to feed their families in healthy ways.

In addition, MSU Extension will be able to provide 5,000 nutrition program participants in Wayne County with nutrition education items that will help reinforce the education they received, including measuring cups, cutting boards and vegetable scrub brushes.

MSU Extension nutrition education programs have:

- » Reached 80,366 Supplemental Nutrition Assistance Program - Education (SNAP-Ed) participants from 82 of Michigan's 83 counties in 2013.
- » In the next year, targeted program participants will receive more than 72,000 nutrition education reinforcement items, including measuring cups, cutting boards, strainers and more from MSU Extension nutrition educators.
- » These items are expected to have a direct and indirect impact on more than 12,000 individuals and families in Michigan.



Photo: USDA

Understanding threats posed by antibiotic resistance

Administering antibiotics when they are not needed can lead to the development of antibiotic resistance. Every time someone misuses or overuses an antibiotic, he or she increases the risk of developing a resistant infection. A significant decline in development of new antibiotics over the past few decades has also added to this problem.

Aggressive action is required to keep new resistance from developing and to prevent the resistance that already exists from spreading. The Centers for Disease Control and Prevention released a report in 2013 explaining the extent of the seriousness of threats posed by the antibiotic-resistant germs and the implications on human health.

MSU researchers are studying antibiotic resistance from the standpoint of human medicine, animal health, plant agriculture and the environment.

- » MSU professor of large animal clinical sciences Daniel Grooms is helping veterinarians and livestock producers prepare for a U.S. Food and Drug Administration guideline to end the practice of feeding antibiotics to healthy livestock for gains in growth and productivity.
- » MSU plant pathologist and Extension specialist George Sundin is working to find alternatives to antibiotics in fighting fire blight in organic fruit production.

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