2019 Annual Report of Accomplishments and Results

Ohio
The Ohio State University
Ohio Agricultural Research and Development Center
Ohio State University Extension

I. Report Overview

The NIFA reviewer will refer to the executive summary submitted in your Plan of Work. Use this space to provide updates to your state or institutions as needed.

1. Executive Summary (Optional)

The College of Food, Agricultural, and Environmental Sciences (CFAES) is the third largest college of the 18 schools and colleges that make up The Ohio State University (OSU). CFAES is comprised of faculty and staff professionals working across departments on a mix of basic and applied research coupled with efforts to translate research into useable knowledge. Through efforts in teaching, research, and extension, our three campuses across Ohio (Wooster, Columbus, and Statewide) are united by our mission: We sustain life.

2019 saw the continued execution of many multi-year long projects which developed from the refreshed strategic planning and alignment initiative that began in 2017. Since 2017, CFAES has completed more than $15 million worth of projects relating to infrastructure. The college has also made a significant long-term commitment to its future by investing more than $100 million in its infrastructure with 18 new projects being started in the past year. With more than 800 buildings and facilities, 11,000 acres of land across the state, 3,700 graduate and undergraduate students, 400 faculty members, and 1,400 staff members keeping up with technology and infrastructure is a necessary responsibility. “The investment in the projects started in 2019 signals our momentum moving forward and our intent to be a thriving and dynamic college of the future,” said Dean Cathann Kress.

CFAES has had many accomplishments to celebrate over the last year. In October, the University kicked off its sesquicentennial celebration, a special milestone for the college which is known as “the cornerstone college” of The Ohio State University. The Department of Food, Agriculture, and Biological Engineering (FABE) increased in ranking from 11th to 9th in the biological and agricultural engineering category in the U.S. News and World Report 2020 edition of America’s Best Graduate Schools. The 57th annual Farm Science Review exceeded recent years’ attendance numbers attracting 114,590 people over three days. A CFAES second-year student majoring in agribusiness and applied economics, Koleson McCoy, was elected the 2019-20 National FFA Organization President – McCoy is only the third Ohioan to hold FFA’s top leadership position.

Our researchers have also been recognized for their excellence. Distinguished University Professor of Soil Science in CFAES’ School of Environment and Natural Resources, Rattan Lal was awarded the 2019 Japan Prize which is considered one of the most prestigious awards in science and technology. Lal won the award for his research on sustainable soil management and its role in improving global food security and mitigating climate change. Dr. Larry Madden, an

internationally renowned Plant Pathologist and a professor in the CFAES department of Plant Pathology, was given the Award of Distinction, the highest honor awarded by the American Phytopathological Society (APS), of which only 15 others have earned in the 111 year history of the society.

In accordance with the strategic planning and alignment goals and Dean Kress's priority of assigning key leadership appointments, many new positions in the college were filled or added in the past year. Dr. Teresa McCoy joined the team as the Director of Learning and Organizational Development. Dr. Kirk Bloir was named the Ohio 4-H State Leader. Keith Didonato was brought on as the Chief Advancement Officer. Associate Dean and Director of OSU Extension, Roger Rennekamp stepped down, and has been replaced in the interim by Dr. Jacqueline Wilkins. OSU Extension Department Chair and Associate Director of Programs, Dr. Ken Martin, stepped down and has been replaced by Dr. Greg Davis. Dr. Davis has been replaced in his former role of OSU Extension Assistant Director of Community Development in the interim by David Civittolo. Director of International Programs in Agriculture, Dr. J. Mark Erbaugh, also retired and was replaced in the interim by Dr. Luis Canas. Dr. Tracy Kitchel was appointed Associate Dean for Faculty and Staff Affairs. Currently, a search is underway for the Professor and Chair of Agricultural Communication, Education, and Leadership (ACEL), which is considered an essential leadership position in the college.

Dr. Dave Benfield retired in late 2019 and was succeeded by Dr. Anne Dorrance as the Associate Dean and Director of the Wooster Campus. Dorrance has been a member of the faculty in the CFAES Department of Plant Pathology since 1997. "Ensuring that the university continues to produce high quality agricultural research and emphasize our unique ability to serve as a gateway for careers in agriculture is critical for the continued success of the campus," said Dr. Dorrance. Currently, a committee is being formed to explore opportunities to increase collaborations between the college and industry.

Over the past summer CFAES launched the Water Quality Initiative. The goal of the new program is to expand the college's impact on Ohio's critical water quality issues. Leading the charge is Ms. Heather Raymond, who joins CFAES as the new Director of the Water Quality Initiative, from the Ohio Environmental Protection Agency where she was a harmful algal bloom coordinator and lead hydrogeologist. Some of the goals for Raymond and her team include coordinating with other water quality-related programs at OSU, strengthening relationships with water quality programs in Ohio including agencies and other universities, and translating the research being conducted at the college into applications that have a positive impact on water quality.

To aid the efforts of the Water Quality Initiative six new county Extension associates have been hired to work specifically on water quality. Partial funding was obtained from USDA-NRCS. The new water quality team members will assist in deciphering research findings into practical recommendations for OSU and for the communities which we serve. A new Water Quality Consortium is also being developed. The goals of the consortium will be to "foster collaborative research and information-sharing and providing a unified voice on water quality." The Consortium will be comprised of various water quality related groups, researchers, and practitioners within and outside of the college. The Ohio State University Stone Laboratory, located on Lake Erie, will receive a new research building and equipment in order to support the efforts to improve water quality. With approximately 140 researchers contributing to projects focused around water quality, CFAES is demonstrating its commitment to finding solutions to clean up and protect Ohio's waterways.
Over the past year much of the strategic planning process was completed, goals were communicated with stakeholders, and action steps were defined around the four Grand Challenges that were outlined in 2017:

- **Sustainability** – a simultaneous focus on viable agricultural production, food security and safety, and environmental and ecosystem sustainability.
- **One Health** – the intersection or interaction of human, animal, plant, and environmental health.

- **Rural-Urban Interface** – exploration of the tensions and opportunities created in the communities, industries, policies, economies, and communications between rural and urban residents.
- **Leadership** – preparation of the next generation of scientists and leaders.

Priority has been placed on refreshing infrastructure and improving physical environments. In late summer 2019 CFAES entered a new phase of Strategic Alignment and Planning. A Master Planning group visited the Wooster campus to begin crafting a plan for future Wooster campus facilities, enhanced connectivity across the campus, and increased utilization of current buildings. The goal of the Strategic Alignment and Plan is to develop a shared vision for the Columbus, Wooster, and Statewide campuses and to map out immediate and future facilities investments. While the plan will have a college-wide vision, there will be specific focus placed on the Waterman Agricultural and Natural Resources Library in Columbus, the Columbus Mid-West Campus, and the Wooster Campus. Some major project updates that took place in 2019 include:

- Completion of the $5.5M Kunz-Brundige Franklin County Extension Building in Columbus, Ohio. Groundbreaking on the new $35M Controlled Environment Food Production Research Facility and the $5.4M Multispecies Animal Learning Center is expected to take place in the spring of 2020, which will begin the final phases of the immediate updates planned for the Waterman Agricultural and Natural Resources Laboratory in Columbus, Ohio.
- A groundbreaking ceremony took place on May 3, 2019 for the new, 60,000-square-foot, $33.5M Science Building on the Wooster campus. The new building will house entomology research space, undergraduate teaching labs, multifunctional space, collaboration space, a café, and a bug zoo. This building will provide a space for both OARDC and ATI researchers to come together which is aligned with the vision of the college and the strategic plan.
- Construction is nearing completion on the $4.6M Wooster Farm Operations Building and Beef Facility.
- A new 1M walkway project was initiated to increase connectivity across the two major areas on the OSU Wooster campus. This was a major goal of the ATI Re-Envisioning plan to help promote the one Wooster campus philosophy.

By prioritizing a refresh of infrastructure, along with recruiting and retaining diverse talent, increasing student engagement and inclusion, and actively improving relationships with communities and partners CFAES is taking action to address the grand challenges and transform the college to be a highly effective, relevant, efficient, and innovative leader in the nation.

In the fall of 2019, CFAES was able to bring closure to a three-year long project. The National Council of University Research Administrators (NCURA) completed a review in 2016 to assess how our college was promoting excellence and creativity in research. Results of the review suggested reducing the administrative burden on faculty members and streamlining the grants process would be crucial steps toward optimizing the college's research enterprise. First steps toward implementing the review recommendations included bringing on Dr. Gary Pierzynski as the Associate Dean for CFAES Research and Graduate Education, who has led the efforts, and forming a Research Advisory Committee in 2018. Accomplishments of the undertaking include:

- An assessment of the grants process from start to finish.
- Expectations and roles were outlined for pre-award responsibilities of the college and post-award responsibilities of the departments.

- A plan to expand the Office for Research and Graduate Education was developed and five new positions were filled.
- Standard Operating Procedures were created relating to research conducted in our college.
- The CFAES Annual Research Conference was redesigned.
- SEEDS: The CFAES Research Competitive Grants Program was enhanced and a new topic was introduced.

The Sustainability Institute (SI) at Ohio State was launched in the spring of 2019 and is a prime example of OSU's dedication to developing and expanding strategic partnerships. The team draws expertise from 15 internationally recognized centers for sustainability research with 600 faculty and researchers representing 8 different colleges and 41 academic departments. More than 30 CFAES faculty members are involved in this new venture and Dr. Elena Irwin, a professor in the CFAES department of Agricultural, Environmental, and Development Economics, serves as the institute's Faculty Director. SI will advance efforts related to sustainability and resilience research, teaching, and outreach across Ohio State by providing an opportunity for exploration and innovation through interdisciplinary research and strengthening relationships with partners to institute sustainable solutions.

In the past year, OSU also launched The Knowledge Exchange (KX). This website serves as a platform in the College of Food, Agricultural, and Environmental Sciences at OSU for sharing research with the public in an unbiased and interactive format. For researchers, KX exists as a space to share findings and to spark collaboration with new partners and with the outreach arm of the college. KX supports researchers by developing and disseminating new communication materials and data visualization products. KX is also valuable for Extension, allowing partners and educators to contribute data and tools aimed at increasing understanding amongst diverse audiences. Regarding the public and decision makers, KX offers a centralized location for obtaining world-class research while simultaneously developing mutually beneficial relationships with the university community.

Another noteworthy example of partnership at OSU can be found at the Center for Foodborne Illness Research and Prevention (CFI). CFI has roots as a nonprofit and had been facilitating research and educating communities since 2006, before joining the OSU CFAES department of Food Science and Technology (FST) in 2019. The mission of the center is to, "advance a more scientific, risk-based food safety system that prevents foodborne illnesses and protects public health by translating science into policy and practice," said Barbara Kowalcyk, Director for CFI.

The center will be a hub for resources and research from various OSU colleges and departments including: the College of Public Health, the John Glenn College of Public Affairs, The College of Veterinary Medicine, the College of Education and Human Ecology, and of course, the College of Food, Agricultural, and Environmental Sciences. CFI also works with external industry partners, consumer food safety groups, other academic institutions, and government agencies. The World Health Organization estimates that 600 million illnesses and 420,000 deaths are caused annually by 31 foodborne hazards worldwide. In the United States serious foodborne bacteria, viruses, and fungi can cause an estimated 48 million illnesses, 128,000 hospitalizations, and 3,000 deaths each year conservatively causing $77.7 billion in medical costs and lost productivity. Bringing the center to OSU will allow CFI to expand their network of experts and resources to better respond to current and future food safety challenges.

CFI has developed a reputation for their commitment to food safety, not only in local communities, but around the world. In November of 2019 Kowalcyk was awarded a $3.4M, four-year grant from the Bill and Melinda Gates Foundation and the United Kingdom Department for International Development to improve food safety in Ethiopia, where illness from unpasteurized milk and raw meat is commonplace. This study will investigate best practices for improving

the safety of these products in this environment and will be sustained in the long-term by building capacity at Ethiopian regulatory institutes and academic institutions with the help of Ohio State's One Health Summer Institute held annually in Ethiopia.
Another trending topic of interest in Ohio is the recent legalization of growing and processing hemp. As a direct response to the difficulties in planting traditional crops last year, many farmers have taken a special interest in hemp, as even with its upfront costs, hemp can be a profitable choice. While OSU educators do see the potential hemp holds for Ohio farmers, they are also warning farmers to do their due diligence before going all in on this new opportunity.

In order to best serve the Ohio farmers interested in growing hemp, OSU has been actively making fact sheets, offering trainings, and even scheduled a day-long workshop on the OSU Wooster Campus for late January, 2020 titled, "Growing Hemp in Ohio: Separating Fact from Fiction," which will offer 10 sessions from 18 speakers.

CFAES uses federal and state capacity funds to leverage additional funds from a variety of sources. During the 2019 fiscal year, CFAES managed more than 970 extramural awards valued at over $56 million, an increase of 16.7% over 2018. In addition, CFAES has 22 Invention Disclosures, 37 New Inventors, and 4 new patents issued.

From the National Institute for Food and Agriculture

In support of the research enterprise, a few selected competitive grants, research support, and cooperative agreements were awarded in 2019 to OSU researchers, including:

- Combination mechanical shear and moderate electric field treatment for production of safe, nutritionally enhanced liquid foods and beverages, $928,662
- Reducing the off-site movement of nutrients in the western Lake Erie Watershed, USDA-NRCS $620,000
- Development of a separation system for efficient fermentation of mixed substrates and in situ recovery of hydrophobic bulk chemicals, $457,122

Commodity Specific

- $3.9 million in new awards to support soybean research and extension projects.

National Science Foundation

- Processing-body dynamics and mRNA regulations in plants $1,200,000
- How do viruses evict close relatives, and why? $400,000

Private Foundations

- The assessment and management of risk from non-typhoidal salmonella and diarrheagenic Escherichia coli in raw dairy and beef in Ethiopia (TARTARE). Bill & Melinda Gates Foundation, $3,391,063
- To research the development and evaluation of pathways to net-zero emission agriculture and cropping systems, Sloan (Alfred P) Foundation, $1,494,969

II. Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Process	Updates
1. The Merit Review Process	In May of 2019 the college underwent a civil rights review from USDA-NIFA. Since this has concluded, we are excited to announce that the search for an Assistant Dean for Diversity, Equity, and Inclusion has ended with the appointment of Dr. Patrice Dickerson, effective July 1, 2020. Dr. Dickerson will serve as a change management agent leading, overseeing, and managing the college's DEI efforts that support strategic goals of the college. The DEI office has also been restructured to better allow for collaborations across the college and to encourage greater opportunity for DEI initiatives, both internally (with staff, faculty, and students) and externally (with our stakeholders, public audiences, and potential students). Issues of diversity, equity, and inclusion are very important to our mission and will continue to build upon recent successes.
2. The Scientific Peer Review Process	Please refer to Plan of Work document; no major updates.

III. Stakeholder Input

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Stakeholder Input Aspects	Updates
1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation	Please refer to Plan of Work, with updates listed here. From interdisciplinary work within the university to work with nongovernmental organizations, business and industry, communities, and other universities CFAES has placed a great deal of importance on developing and strengthening strategic and collaborative partnerships. For example, last August CFAES hosted an inaugural Germinate International Film Fest to observe film and photography to tell the story of rural communities and their associated industries. The events in the series included options like a farm-to-table dinner, a stargazing workshop, and panel discussions to provide an open forum for conversations regarding agricultural, environmental, and rural community development topics important to the public. As a land-grant institution it is our responsibility to stay current on issues influencing our stakeholders and the communities we serve. Last year, farmers across the state were forced to work through the 2019 Farm Crisis. Unrelenting spring rainfall translated to the worst planting year on record, in Ohio. Alongside the unprecedented spring rain levels, farmers were also forced to deal with increased international tariffs on American goods, a spike in hay prices due to a statewide hay shortage, declining income and low commodity prices, and a lack of summer rain. To respond to the immense need, CFAES formed a Rural and Farm Stress Task Force aimed at offering assistance to Ohio farmers. The task force is composed of individuals who will be able to connect farmers with experts at OSU or within the community. In this effort, CFAES will be collaborating with the OSU College of Social Work to be able to provide the best support and resources related to emotional and psychological needs, such as sharing contact information for mental health providers, regardless of a person's location in the state. The task force will also help direct farmers to programs and other initiatives to help assist their businesses or to find additional work with the goal of reassuring and empowering Ohio farmers. An additional way CFAES responds to Ohio farmer needs is by holding an annual Farm Science Review (FSR). This year's 57th Farm Science Review, which is essentially a farm industry trade show, offered glimpses of the most innovative farm technology and equipment, educational talks related to overcoming challenges caused by the 2019 Farm Crisis, and a first-ever career fair. The FSR saw increased attendance over recent years bringing in 114,590 people over the course of three days. Some of the topics represented in the sessions

	included: producing malting barley, legal issues associated with growing hemp, the most common mistakes made by family-run farms, and tactics to reduce the risks of producing corn and soybeans. "During a challenging year, Farm Science Review provides a lot of optimism for those in the agriculture field," said Nick Zachrich, manager of FSR. "Here, farmers can enjoy themselves and also learn how to improve their operations."
2. Methods to identify individuals and groups and brief explanation.	Please refer to Plan of Work document; no major updates.
3. Methods for collecting stakeholder input and brief explanation.	Please refer to Plan of Work document; no major updates.
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	Please refer to Plan of Work document; no major updates.

IV. Planned Program Table of Contents

V. Planned Program Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). See Section V of the Guidance for information on what to include in the qualitative outcomes or impact statements. Add additional rows to convey additional accomplishments. You may expand each row as needed.

No.	Title or Activity Description	Outcome/Impact Statement	Planned Program Name/No.
1.	Regional integrated modeling of farmer adaptations to guide agroecosystem management in a changing climate	**Issue:** Climate change in the eastern Corn Belt Region (ECBR) of the United States is projected to bring higher temperatures, more variable and extreme levels of precipitation, and longer growing seasons. The changes will impact land use and management techniques, which depend on vastly different behaviors of individual farmers as well as conditions of the economy, policy, and technology in place. Stakeholders at household, firm, industry, community, and regional levels need more reliable information to understand implications of climate change so they are better prepared to make decisions. **What has been done:** A Stakeholder Advisory Team (SAT) was created and has met quarterly with researchers to identify likely adaptations, policies, and future scenarios. A survey was launched to assess what climate impacts are most likely to encourage specific changes. A multi-sector regional economic model was created to simulate land use and management patters across the ECBR under future scenarios, and optimal policies are being identified based on the uncertain future conditions. A plan to communicate results and key findings (climate trajectories, farmer profiles, agroecosystem impacts, and policy scenarios) with stakeholders has been outlined and includes development of an infographic, a 3-minute video, and fact sheets. **Results:** In year 1 the research was initiated and engagement with the agricultural community in Ohio was strong – including about 55 presentations made to approximately 2,500 participants during this reporting cycle. An event in July 2019 hosted an audience of 130 in London, Ohio and included the topics of weather and climate, price and production risk, soil health, lessons from other states throughout the region, as well a as farmer guided panel. Presentations were recorded to make the information available to a wider audience online. As the project continues the team plans to complete analysis of the climate data and publish findings in a scientific journal, finish survey data collection and analyze results and integrate findings into the model and continue to design optimal policies.	Climate Change/1

2.	Farmland Owner's Guide to Solar Leasing	**Issue**: While Photovoltaic (PV) solar energy production has a brief history in Ohio, "utility-scale" production is on the rise. As of November 2019, 12 large scale solar projects representing 1,900 megawatts (MW) of potential electric generation capacity were submitted to the Ohio Power Siting Board (OPSB). While OPSB application approval does not guarantee a project will ultimately be built, Ohio's PV solar capacity would increase by 904 percent if all 12 projects currently under review with the OPSB are constructed. The increasing development of utility-scale PV solar consumes massive tracts of land. According to the National Renewable Energy Laboratory, the average total direct land requirements for utility scale PV solar projects is 7.5 acres per megawatt. The 12 projects currently submitted to the OPSB have an average footprint of 1,750 acres each, yielding a combined total of 21,000 acres for solar development. As a result of the new development trends, farmers across Ohio are now being approached to lease large tracks of ground for solar development. Although solar energy is "green" and "renewable," large scale solar energy development is not without conflict. Leasing land for a solar energy development raises both positive and negative implications for the land, family, farm operation, and community. Typically, lease agreements between solar energy developers and landowners require a long-term legal commitment of 25 years or more. This long-term action can require changes in a farm operation, remove a generation from the land, affect farmland availability and reuse, and alter the character of a community's landscape. On the other hand, leasing farmland for solar energy can satisfy demands for renewable energy, create economic stability for farmland owners, and generate revenue for a community. **What has been done:** In order to help, OSU Extension Community Development produced resources for agricultural landowners faced with decisions about leasing land for solar energy development. Legal and energy experts have developed a technical guide titled *Farmland Owner's Guide to Solar Leasing*. Using the technical guide as a primary resource, a two-hour outreach and education workshop was developed to help disseminate this critical information to farmers throughout Ohio. These resources aim to help farmland owners understand solar energy development activity, the solar energy leasing process, and the language and terms they will encounter in a solar lease. The *Farmland Owner's Guide to Solar Leasing* publication was made available to the public in August 2019 as a free download on the OSU Extension Farm Office and Energize Ohio websites. The publication was featured by OSU CFAES News Tips and Ohio's Country Journal. **Results:** In just eight weeks, we were contacted to deliver four workshops on solar leasing, collaborate with OSU CFAES Marketing and Communications to create a video summary of the publication,	Sustainable Energy/2

		presented two "Ask the Experts" sessions at Farm Science Review, and distributed more than 200 copies of the publication.	
3.	BARRAL – Bioenergy, Advanced Biofuel, and Rubber Research Agricultural Linkages	**Issue:** Natural rubber is a critical natural resource used for countless numbers of products essential to modern life. The current natural supply of rubber comes almost exclusively from the rubber trees grown in Southeast Asia. As developing countries modernize and areas available for plant cultivation shrink, there is likely to be a shortage of natural rubber. The goal of the "Bioenergy Advanced Biofuel, and Rubber Research Agricultural Linkages" (BARRAL) project is to overcome barriers to the commercialization of an alternative natural rubber and industrial sugar crop Taraxacum kok-saghyz (TK) in the northern US. The BARRAL consortium is led by The Ohio State University (OSU) in collaboration with the University of Nebraska and Oregon State University. **What has been done:** The United States has a critical need for transportation biofuels and a domestic supply of natural rubber (NR). Excitingly, TK is being developed as a natural rubber and industrial sugar crop for the northern U.S. to address both needs. Field experiments began in fall 2018 in Ohio, Nebraska, and Oregon to examine how planting date, harvest date, plant density, irrigation rate, soil fertility, planting methods/seedbed preparation, harvest method, and weed control (herbicide testing) interact and affect root biomass and rubber/sugar (inulin) yield. Rubber and latex growth were investigated after harvest and TK rubber was extracted from TK roots using three different processes. **Results:** In the previous two years, planting of TK in western Nebraska failed, with no plants surviving germination. In the first year of BARRAL 13.3% of TK planted in Nebraska survived for five months after planting, and greater than 95% of transplanted TK survived. Progress was made in identifying optimal TK planting times. Results suggested that late-March through mid-April allowed for greater TK growth compared to later plantings. The ideal guidelines for the extraction of rubber and production of sugars from TK roots were determined. In order to share this research with interested communities and stakeholders, three peer reviewed publications have been released, alongside four newspaper articles a blog post, and an associated video about BARRAL.	Sustainable Energy/2
4.	Federal Nutrition Education Programs (EFNEP/SNAP-Ed)	**Issue**: According to the *State of Obesity* 2019 report, 12.4% of 2 to 4-year-old WIC participants and 17.1% of youth ages 10-17 were considered obese. Ohio is ranked 10th in the United States for overweight and obese youth aged 10-17.	Child Obesity/3

		What has been done: Since 1969, OSU Extension has implemented the EFNEP program and since 1996 it has been the sole implementing agency for the SNAP-Ed program. These two federal nutrition education programs are focused on teaching eligible audiences to choose and prepare foods of high nutrient value. Specifically, for youth obesity prevention, embracing comprehensive evidence-based strategies delivered through community-based education and public health approaches. **Results**: In 2019, 466,637 youth were reached through face to face nutrition education programs. Eighty five percent (85%) reported improvement in nutrition knowledge, 88% of youth report choosing water instead of sugar-sweetened beverages, 91% of youth report being physically active, and 85% of youth report using MyPlate to make healthy food choices.	
5.	Parental practices supporting positive eating behaviors during independent eating occasions among early adolescent children	**Issue:** It is necessary to further explore the impact of parenting choices on early adolescent eating behaviors when eating alone. By learning about the typical eating patterns of adolescents aged 10-13 years old and in coordination with parenting norms (specifically regarding their level of awareness of children's eating choices) we can better understand the relationship between parenting practices and adolescent eating habits. Findings will allow for realistic strategies and motivators to be identified, giving parents information to promote positive practices, and ultimately helping to prevent childhood obesity more effectively. **What has been done:** A study was conducted to find key parental practices that may impact 10-to-13-year-old children eating behaviors during independent eating, after which researchers interviewed 51 parent/early adolescent groups. Children were asked questions about foods they had eaten over a 24-hour period, and about parenting styles of their parents. Parents completed surveys to assess 1) whether they considered their efforts in encouraging their child to eat heathy foods when they were not present to be successful or if they needed improvement, 2) frequency of parenting practices such as role modeling, making foods available, and restriction and monitoring, and 3) general parenting measures. Parents were also asked to share what they, "say and do to get their child to eat healthy," during times when children ate alone. **Results:** Parent survey results showed that parents who claimed to be successful at getting their children to make healthy independent food choices used strategies of monitoring children's intake of sweets, high-fat-foods, and healthy calcium-rich foods. The most common practices reported by parents for influencing children's eating habits when eating along were setting expectations for intake of healthy foods, making healthy foods accessible, and teaching children about healthy	Childhood Obesity/3

		foods. Findings revealed that non-Hispanic black, overweight, or obese adolescents often ate alone. Further, adolescents who reported that fruits and vegetables were often/always available in the home, perceived that parents had expectations about fruit and vegetable intake, and agreed with parental authority to make rules about intake of junk food/sugary drinks were less likely to eat alone. Results of this study will inform the creation of communication materials to be shared with adolescents, parents, and nutrition professionals.	
6.	Food Preservation	**Issue**: Home food preservation remains an important and popular cultural activity. It is critical that those who practice preserving and processing foods at home have access to the most reliable information available concerning food safety and food quality. In 2019 the CDC FoodNet surveillance project reported 25,866 cases of domestically acquired foodborne illnesses. (https://www.cdc.gov/mmwr/volumes/69/wr/mm6917a1.htm?s_cid=mm6917a1_w) Understanding proper food preservation technique is critical to maintaining a safe home food supply. **What has been done:** OSU Extension's home food preservation workshops focus on the science behind home food preservation so that everyone who cans or freezes fresh fruits and vegetables understands why certain procedures must be followed precisely to ensure a high-quality, safe product that they and their family can enjoy. Hands-on classes are offered across the state and typically address: • Basic food safety principles • Water bath canner and pressure canner methods • Principles involved in canning tomatoes, pickling and making jams and jellies • Methods for freezing fruits and vegetables • Reliable, research-backed resources from the U.S. Department of Agriculture, OSU Extension, and others **Results:** In 2019, 550 community members took part in the OSU Extension Food preservation classes: 85% reported that they will always use current USDA and OSU Extension canning and freezing recommendations. Before the class, only 13% of participants reporting always using these guidelines.	Food Safety/4

7.	Ensuring food safety from harmful algal blooms and cyanotoxin risks	**Issue:** Almost all agriculture practices need safe freshwater to continue, such as growing fresh produce, aqua culture, and raising livestock. Unfortunately, more than 40% of lakes and reservoirs worldwide are now eutrophic, meaning they offer favorable conditions for algae blooms. Research has shown that cyanotoxins (produced by toxic algae) are harmful to human health when directly ingested, but there is an urgent need for research into how cyanotoxins may accumulate in foods (such as fresh produce) and to identify ways to mitigate health effects. **What has been done:** To determine food safety from the toxin algae, a study was completed with simulations of the contaminated crop production environments by irrigating with microcystin (MC-LR)-containing water and testing the presence of the toxin in the crops and soil. Another contamination source is from water treatment plants (water treatment residual, WTR), so a second study was conducted in a similar method. Using the findings from both studies, a rapidly deployed, on-site treatment strategy was developed using MC-absorbing plastics. **Results:** Results showed that about 50% of MC-LR accumulated in soil and the rest of the toxin ended up in fresh produce, the extent of which was different dependent on the type of crop. Though the irrigation water contained levels of the toxin in the environmentally acceptable range, the edible parts of crops accumulated enough toxin to be of moderate to high risk for both children and adults. Levels of toxin in the WTR infected crops and soil were also high. The tested treatment strategy (using the MC-absorbing plastics) saw a 70% reduction after a 6-day period at temperatures of 65°C. This inexpensive and easily implemented method can be applied in source waters, alleviating water treatment burden for treatment plants, lowering treatment costs, and reducing chemical usage during the high peak of HAB season.	Food Safety/4
8.	Combining metabolic labeling and proteomics methods to characterize proteins secreted by resistance-breaking soybean aphids (Aphis glycines)	**Issue:** Insect pests threaten agricultural production by harming plant tissues or stealing plant sap, ultimately lessening the crop yield. One way to protect crops from insect pests is host-plant resistance, which are plants that naturally repel insects. Soybeans, a major U.S. crop, are greatly impacted by insect pests such as the soybean aphid, which can reduce soybean yield by up to 40%. The aphid can be somewhat managed using host-plant resistance (where plants can tolerate or partially recover from injuries caused by insect populations), but some aphids have adapted to overcome the resistance. Our goal is to identify proteins secreted by aphids into plants during feeding that enable them to suppress plant defenses and overcome host-plant resistance. In doing so, we will inform pest management strategies and extend the durability of host-plant resistance in sustainable agriculture.	Global Food Security and Hunger/5

		What has been done: To identify proteins that are secreted by aphids into plants, a metabolic label must first be created. This label is used to identify the aphid proteins that are secreted by aphids into plants. An artificial diet method was researched and adapted to incorporate the metabolic label into the aphids (by adding dye). Lab research also identified genes that may be critical to aphids overcoming plant defenses. To test this, researchers silenced the suspect gene and then exposed the aphids to resistant plants. **Results:** It was found that the aphids with the silenced gene produced fewer offspring than the control aphids. This suggests that the gene may be important for insect survival on resistant plants and that the lab was successful in silencing an aphid gene and the method to do so can now be used to analyze the function of other genes, moving forward. Over the next reporting period it will be important to optimize the gene silencing method and to share the findings of this research at the annual Entomology Society of America conference and commodity organizations like the Ohio Soybean Board and the North Central Soybean Research Program. By identifying aphid genes and proteins that are important for aphids to overcome host-plant resistance, this work will benefit crop scientists who can use the knowledge created from our study to help generate insect-resistant plants.	
9.	River biodiversity and food-webs in changing forested landscapes	**Issue:** River ecosystems are important collections of biodiversity and form the principal source of renewable water supply for humans and freshwater ecosystems. However, rivers are under unprecedented stress worldwide and may be among the most endangered ecosystems on the planet. Among these stressors, urbanization and conversion to agricultural land cover represent globally common landscape changes. A valuable measure of biodiversity is food-chain length (FCL) which influences other critical aspects like species diversity and ecosystem function. Because land use has varying impacts, it is necessary to investigate the relationship between environmental change, biodiversity, and food webs in river systems along a land-use gradient (forest-urban-agricultural). **What has been done:** A study was conducted to investigate the effects of land use, land cover, climate, catchment physiographic characteristics, aquatic nutrients, streamflow regimes, and water temperature on river food webs in multiple regions. Findings from this project have provided important information relative to the conservation and management of river systems in forested landscapes. **Results:** In relation to insect communities, results showed that aquatic insects in estuaries (where the tide meets the sea in a river) do appear to be nutritionally valuable to riparian (on the bank of a river) consumers, despite their limited numbers and diversity compared with freshwater ecosystems.	Soil, Air, and Water (OARDC)/6

		Another finding suggests that an invasive pest, the Hemlock Woolly Adelgid, can strongly affect stream invertebrate communities which may have left latent effects on animals higher up the food chain. Research showed that natural physical factors have strong influences on food-chain length in rivers, but human changes can be important determinants for food-web structure in regulated rivers. For example, artificial lighting at night (like lighting from buildings and streetlamps) can alter the flows of energy between aquatic and terrestrial systems, causing an environmental disruption that can cross ecosystem boundaries. Researchers also found effects of wildfires on riparian food webs and streamwater chemistry, which were summarized and presented to wildfire and natural resource managers for use in their fire-management plans. Results of ongoing research will continue to be disseminated to the appropriate audiences to inform management decisions.	
10.	New Strategy for Eradication of Asian Carps	**Issue:** Invasive bighead carp, one of four species known in North America as Asian carp, are currently causing ecological damage in the Mississippi River Basin and are encroaching on the Great Lakes Region. If Asian carp invade the Great Lakes, significant ecological and economic damage is anticipated. This research was completed to better understand how to reduce populations of Asian carp in areas where they have already invaded, and hopefully prevent them from being introduced to new, vulnerable areas. **What has been done:** The goal of this project is to produce monosex, tetraploid offspring of bighead carp. When mated with wild-Asian carp, these carp would produce sterile offspring (thus reducing invasive populations). First, pilot tests were run to guide the development of desired Asian carp eggs. Separate experiments were conducted on juvenile bighead carp to monitor growth rate, gonad development, and fertility to better understand carp sex determination. A sperm storage experiment was run to determine how effective sperm is when fertilization is delayed. Lastly, researchers performed two sex reversal trials to determine how hormonal treatments and temperature may affect the sexual differentiation of Asian carp. **Results:** It was discovered that embryos subjected to heat shock had the highest potential of surviving as polyploid fish. Interestingly, testing yielded the first record of the ability of silver carp sperm to fertilize and develop zebrafish embryos, though none of the eggs survived to hatching. The study for optimal conditions for raising Asian carp concluded that deformities were high in the experiment, however this has been noted in similar experiments with grass carp. Over the next year the team will continue to monitor the bighead carp juveniles involved in the sex reversal trial to determine success. Techniques developed from this research can help to control the spread of Asian carp.	Natural Resources and Environmental Systems (OARDC)/7

11.	Change in forest ecosystems of Ohio: Assessing past trends and predicting future plant diversity and stand structural dynamics	**Issue:** Virtually all the forests of Ohio and the surrounding region have been affected by disturbance events such as high winds, non-native invasive species, insects, diseases, and climate change. Given the great importance of our forests, we need more information to help us understand the plant diversity and resilience, as well as how the complex structure of these forests are impacted by disturbance. **What has been done:** Researchers measured compositional shifts and successional trends by resampling plots that were originally set up between 1992-1995 in unglaciated southeastern Ohio. Using the data collected from the two time periods, models were made to predict changes in the forest ecosystem. **Results:** In Athens, Ohio the relative density of red maple large saplings increased by 25% on uplands after 22 years. Another unexpected increase was found in the relative density of American beech saplings on southwest-facing upper slopes. Overall, American beech sapling density nearly doubled between the two sampling periods, while both maple species (red and sugar) declined by more than half. In the models, the data suggest that red oak trees will become less common relative to white oak trees in mature, unmanaged forests as the result of higher mortality rates. These, and other trends may ultimately lead to shifts in the dominant tree species in unmanaged stands in the region. The research also suggests that forest ecosystems are being more greatly affected by new issues like pathogens, insects, drought, and invasive species likely exacerbated by climate change. These changes may result in unexpected shifts in future outcomes, however further research can help land managers to understand how changing forest dynamics may affect the health of a forest community.	Plant Systems (OARDC)/8
12.	Toxic Exposure and Effects in Bees	**Issue:** Honey bees are valuable contributors to U.S. agriculture through pollination of crops, but have experienced an unsettling disappearance in recent years. This is partially due to pesticide use, which can cause “Colony Collapse Disorder” and other negative effects. It is crucial to identify pesticides that are of greatest concern to bee populations and to understand the effect exposure has on different classes and life stages of honey bees. It will be equally valuable to learn why some pesticides are well-tolerated by bees and understand how natural tolerance could be used to choose the least harmful pesticides in the future. **What has been done:** Relation of effects among insecticides, fungicides, and a spray adjuvant applied to almonds during bloom were explored to simulate field spray exposure to adult worker bees. Similar combinations were applied to immature worker honey bees via feeding. Trials were also performed using 12 test compounds for possible use a pesticide to control the Varroa mite, a devastating parasite affecting honey bees.	Animal Systems (OARDC)/9

		Results: Both simulated sprays and feeding indicated that a combination of the insecticide (chlorantraniliprole) and fungicide (propiconazole) has the potential to kill bees in the field despite being the relatively safest of these products when applied alone. This effect is increased when a spray adjuvant was added. The insecticide diflubenzuron by itself also demonstrated the potential to kill both juvenile and queen honey bees. This information has been shared with almond growers in California, resulting in recommendation by the Almond Board of California to avoid insecticide applications to almonds while in bloom. Tests to identify acaricides to control Varroa yielded dose-response curves which were compared to find the most suitable compounds for further development and eventual application in test hives. By increasing our understanding of how these pesticides affect pollinator populations and finding safer alternatives, we can help protect insect populations while maintaining high agricultural production.	
13.	Ultra-Shear Treatment of Low-Acid Liquid Foods	**Issue:** Demand for minimally processed, clean label beverages in on the rise. The food industry attributes this to a consumer's desire for healthy products containing more nutrients and little to no synthetic ingredients. Through a combined application of elevated pressure, shear, and controlled time/temperatures, Ultra-Shear Technology (UST) can produce a variety of healthy beverages, juices, and sauces in response to consumer demand for healthier options that also meet or exceed food safety standards. **What has been done:** The research team has developed prototype UST equipment, and a sanitation protocol for said equipment, in collaboration with industry partner, Pressure Biosciences, Inc. (PBI). Tests were run on two different types of bacteria to determine food safety and quality. PBI is also leading efforts to build a pilot system and two different methods of food product isolation are in trials. **Results:** In the first year, development of the prototype equipment enabled the team to conduct experiments on the safety and quality of pressure-treated beverages. Initial food safety tests did not suggest a notable decrease of either strain of bacteria but results from the food quality test showed that the UST treatment under pressure led to the bottling of a more natural product. During the next reporting period the team will continue research, while anticipating the installation of pilot-scale UST equipment in the pilot plant to be used to evaluate further treatment effects on various beverages. Knowledge gained from this project will be shared with food industry professionals via webinars, short courses, and workshops as well as hangs-on boot camps.	Food, Agricultural, and Biological Engineering Systems (OARDC)/10

14.	Just Because Farmers Can, Should They? Research-Based Tools and Modules for Informed Agronomic and Economic Variable Rate Seeding Decisions	**Issue:** The majority of new crop planters are capable of highly accurate variable rate seeding (VRS) or planting different amounts of seed in predetermined zones within a field. Popularity of this technology has been severely limited due to a lack of information and a question of economic return. There is a critical need to improve stakeholder decision-making ability regarding VRS. This project aims to empower farmers to make sound decisions about VRS through tools and learning modules. **What has been done:** In 2018 field research trials examining VRS in corn and soybean were conducted in Michigan and Ohio. Additionally, three focus groups consisting of Ohio and Michigan farmers were developed and surveyed to better understand farmer decision-making regarding seeding rate selection. **Results:** Analysis of the data that was collected showed that the optimal seeding rates for soybean ranged between 247,000 and 445,000 seeds/ha depending on the site-year. Only one management zone out of more than 12 zones was seeded at the ideal rate. Farmer-selected management zones and seeding rates do not seem to be accurate, meaning that new ways of determining management zones are needed. The three farmer focus groups hosted a total of 50 farmers who completed the survey. Over the next year, a second round of data will be collected to complete the dataset which will inform the creation of the learning modules and improve the messaging in future focus groups. This information will be disseminated to help farmers better understand optimal seeding rates, ultimately helping them to improve their profitability.	Economics and Social Dimensions (OARDC)/11
15.	Optimization of Processing Methods for Producing Ready-to-Eat Meat Products	**Issue:** Consumers of meat products want convenient-to-prepare products, as well as products that are safe to eat and that taste good. Although generally assumed safe, there are questions of whether certain meat processing methods are completely safe for human consumption. The USDA Food Safety Inspection Service requires proof that processing methods are safe and working as prescribed, however, smaller meat processors often lack the resources to do the research that is required to support their method of processing. The goal of this project is to demonstrate the safety of new processes needed for making ready-to-eat and sous-vide meat products, while maintaining or improving the quality and safety of the final product. **What has been done:** Researchers are identifying types of molds growing on beef carcasses in small Ohio processing facilities to determine if any of these molds are pathogenic. About 12 mold samples have been collected and are being prepared for testing in an OSU lab. One compound, organic phosphate, has historically been an important ingredient in meat processing for its ability to improve water binding, protein functionality, and flavor stability. However, due to shifts in consumer	Human Health (OARDC)/12

		preferences, researchers are studying an alternative plant compound, phytate, which could potentially address the challenges of organic phosphate and be a healthier alternative for consumers. **Results:** Work has begun on using phytate in place of phosphates in cooked meat products, and a graduate student has been hired to start this research. A supplier of phytate has been identified and collaborative work has begun on using this ingredient in meat products. In the coming year, research will continue to determine whether there is a safer method to create traditional Italian salami, which is typically fermented and dried, but not heated enough at any point in the process to destroy pathogens that are normally present. By helping small scale processors determine the safest, reliable methods for processing meat, consumer confidence increases, while the chances of a recall due to human health impacts is reduced.	
16.	Community Economics: Ohio Business Retention and Expansion Program (BRE)	**Issue:** Communities that actively implement an on-going Business Retention and Expansion (BRE) program focusing local businesses will: • Improve the business climate of the community • Help to make local businesses remain competitive • Increase employment • Stabilize the local economy **What has been done:** The Ohio Business Retention and Expansion Program provides the resources, training, and tools to develop the capacity of the community to better understand its economy. In addition to enhanced community capacity to address critical community issues, other outcomes of such community engagement include a streamlined BR&E process that enables local leaders to focus on planning, action and results; a database of local information; and a more robust local economy. To help local leaders gain a better understanding of issues related to their economy, the Ohio BRE program provides a structured approach to assessing and addressing business needs. Community input was collected and compiled and formatted as a reference to better inform local decision making. **Results**: In 2019, there were six community surveys conducted. Combined, and as a result of the program, seven new business plans were developed, 142 fulltime jobs were created, and more than 3800 jobs were retained. One participant noted: '*We had a prospect who was looking into constructing a new building. However, he'd heard mixed reviews about our Planning Process. I showed him our most recent survey findings so he could see how our Planning Process was rated by the business*	Advancing Employment and Income Opportunities/13

		community. He indicated that the information was helpful and at this time it looks like he is going ahead with the project.' Participants also indicated an improved working relationship because of meeting more regularly to discuss community and economic development issues.	
17.	OSU Extension Small Farm Program	**Issue:** Across Ohio, many landowners are seeking ways to create income from new and small farms. Some will consider traditional farming enterprises while others are interested in pursuing the production of alternative and non-traditional land uses. The objectives of the "New and Small Farms College" program include enhancing the viability and economic livelihood of Ohio small farmers and ranchers by: 1. helping small farm landowners and farmers diversify their opportunities into successful new enterprises and new markets; 2. improving agricultural literacy among small farm landowners not actively involved in agricultural production; and 3. providing a learning environment that allows current, and perspective, landowners to network and share successes and challenges associated with small farm ownership." The program's target audience includes landowners seeking to diversify larger operations and to provide opportunities for easier transition to the next generation of farm managers. Small acreage owners looking for production practices conducive to small-scale production. **What was done:** In 2019, an "Opening Doors to Success" conference was held at OSU South Centers, Piketon, Ohio. Two "Small Farm Tours" were held in Clinton County as part of the 2019 Ohio Sustainable Ag Farm tour series. These tours focused on specialty crop production, marketing and production decisions. Two "Small Farm Colleges" were also held in Montgomery and Vinton counties. **Results:** As a result of attending one of the two Small Farm Colleges, post-program surveys indicated 59% of the participants developed or changed their farm use plan after attending these colleges. Eighty-seven percent (87%) indicated they received the necessary tools to develop a 'whole farm business plan'. Almost all (99%) of conference attendees indicated they learned something new from attending the conference and what they learned would help them to improve profitability of their enterprises. As a result of attending, 68% of the evaluation respondents indicated they would add an additional enterprise, increase production, enter into a new market	Enhancing Agriculture and the Environment/14

		such as a farmer's market or CSA, or buy/rent more acreage. Fifty-six percent (56%) of conference attendees indicated the conference information received would help them improve farm profitability.	
18.	eFields Program	**Issue:** In 2017, the Digital Agriculture team decided to initiate a new on-farm research effort that was named eFields. The twenty-person team included county Educators, Field Specialists, students and on-campus faculty. eFields is an Ohio State program dedicated to advancing production agriculture through the use of field-scale research. This program utilizes modern technologies and information to conduct on-farm studies with an educational and demonstration component used to help farmers and their advisors understand how new practices and techniques can improve farm efficiency and profitability. The program is also dedicated to delivering timely and relevant, data-driven, actionable information. **What has been done:** In 2017, a total of 45 studies were conducted in 14 counties with 39 partnering farms that also included 21 industry partners that supported various projects. The eFields project has expanded in 2018 and 2019. In 2019, the eFields report included 88 studies, 45 farm collaborators, 54 industry partners, and 64 Ohio State investigators. Projects covered seven focus areas: precision seeding, precision nutrient management, precision crop management, soil compaction, remote sensing, forages and data analysis and management. Results from all three years are provided to stakeholders as a printed report and also as an online publication available at https://digitalag.osu.edu/efields The annual report highlights how technology and input management decisions can improve Ohio crop production. The information from the 2018 eFields report was distributed through over 10,000 printed copies plus 12,195 interactions with the e-version. In 2019, 6071 printed copies have been distributed with 4413 interactions for the e-version. Distribution and viewing included over 40 US states and 24 additional international countries. **Results:** The eFields program has expanded on-farm research across the state and strengthened relationships between farm managers and Extension professionals. Key results included the soybean seeding rate studies and fertilizer management studies. The soybean seeding rate results indicated farmers could plant less seed while maintaining yield with an optimum soybean seeding rate between 120,000 and 140,000 seeds/ac. For corn seeding rate studies, there has been a trend that variable seeding of corn can provide additional profit versus fixed rates planting. Fertilizer results highlight the importance of application placement and timing. Feedback from farmers and consultants has been excellent with suggestions on how to improve future programs and what studies farmers would like to see completed by Ohio State.	Enhancing Agriculture and the Environment/14

19.	Farm Bill Training	**Issue**: Following the passage of The Agricultural Improvement Act of 2018 (The 2018 Farm Bill), multiple decisions relating to commodity programs and crop insurance faced Ohio's 231,274 registered Farm Service Agency Farms. Dairy producers could enroll in different coverage levels under the Dairy Margin (DMC) program and crop producers could select between the Price Loss Coverage (PLC) or two versions of the Agricultural Revenue Coverage (ARC) program. A thorough understanding of the programs was needed for producers to make wise business decisions and effectively mitigate production and financial risks associated with their operations. **What has been done:** Over the course of a nine-month period, curriculum was developed. More than 40 Extension professionals were trained to teach the curriculum, and more than 170 Farm Bill Education programs were delivered by OSU Extension reaching more than 6000 participants throughout the state of Ohio. **Results**: Voluntary program evaluations from 2141 participants indicated 98% of respondents felt the information presented will help develop a plan to utilize Farm Bill Programs to mitigate risk on their farms. A retrospective pre/post-test using a five-point Likert scale was used to measure knowledge gained in the following areas: • Overall knowledge of the Farm Bill – average gain: 1.6 points • Ability to decide between programs to manage risk – average gain: 1.7 points • Ability to locate and use decision tools – average gain: 1.9 points Through a six-question post workshop quiz designed to test material retention, program participants scored an average 83%.	Enhancing Agriculture and the Environment/14
20.	Nutrient Management	**Issue** A productive crop production system often requires the addition of inorganic or organic sourced nutrients to supplement the soil available nutrient pools. Yet nitrogen and phosphorus leaving the soil system, with excess precipitation through surface or tile drainage, can enter streams resulting in eutrophication of water bodies. Under some environmental conditions, the predominate eutrophication species are cyanobacteria that can produce harmful liver toxins which must be treated by water treatment plants before distribution. Economic considerations in	Enhancing Agriculture and the Environment/14

		nutrient management occur both at the farm where excess nutrients not used during the growing season can be an unrecoverable cost and to society where the ecosystem impacts of eutrophication have associated cost. Implementation of 4R nutrient management on the farm can mitigate soil nutrient exposed to offsite transport. **What has been done** Applied research projects have been conducted across the state to document the agronomic and economic outcomes of 4R practices at the local level with farmer cooperators and add to the Land Grant University (LGU) databases used to generate nutrient recommendations. Water quality outcomes of practices are being measured in cooperation with USDA-ARS, Soil Drainage Unit to document water quality impacts of 4R practices. Outreach programming has taken agronomic, economic and water quality impacts to the agricultural industry to promote better nutrient management practices. In 2019 the culmination of six years of field research will result in the publication of the "Tri-State Fertilizer Recommendations for Corn, Soybean, Wheat and Alfalfa, 2020" which provide lime, nitrogen, phosphorus and potassium recommendations covering rate, timing and placement. **Results** Applied research on 4R nutrient management was conducted on 34 on farm sites and 3 research stations with 69 field projects focused on evaluating 4R nutrient stewardship principals including rate, placement and timing using commercial fertilizers and manure sources. Agronomic, economic and water quality outcomes were shared through agronomy, fertilizer certification, nutrient management and other meeting formats to 13,125 participants. Additional nutrient management outreach occurs via printed outreach through the Crop Observation and Recommendation Network Newsletter distributed weekly to 5,100 by email weekly and has another 26,000 web visits monthly. Fertilizer Certification program participants were surveyed on changes they have made to phosphorus fertilization rate used on their farm compared LGU recommended rates. Survey respondents reported that 63% have newly adopting LGU rates of phosphorus fertilizer as result of the training (25% were already using LGU rates) resulting in 88% of participants now using LGU phosphorus recommendations.	
21.	Farm Succession Planning	**Issue (who cares and why)** Ohio producers farm over 13.5 million acres and farming is the top economic industry in the state. As the average age of farm operators increases, transferring the ownership and management of the family business to the next generation will become one of the most important issues farm families will face in Ohio. The average age of the principal farm operator in Ohio is 57.1 years (up from 56.8 in 2012). While many farmers dream of seeing their legacy passed on to the next generation, many postpone initiating a plan for the transition of their business for a	Enhancing Agriculture and the Environment/14

		variety of reasons. Transferring a family farm or farm business to the next generation can be a challenging task. Legal issues, tax laws, and personal differences between family members are a few of the issues families must confront when transferring the managerial and asset control of a family business. **What has been done?** Given the aging farm population and the importance of agriculture in Ohio, farm management specialists are working to provide educational assistance to farm families through educational workshops, individual farm consultations, and through educational materials. In 2019, OSU Extension offered two-day intensive "Passing on the Family Farm" workshops at targeted locations across Ohio. Additionally, the team provided shorter presentations at workshops, producer meetings and at state-wide conferences. Farm management specialists have authored farm transition publications including a "Farm Transition Matters" series for the National Agricultural Law Center funded by USDA National Agriculture Library. **Results** In 2019, the OSU Extension Farm Succession Team offered 33 farm succession workshops and presentations with 768 individuals learning critical farm succession and estate planning principles. One-hundred percent of the attendees indicated they had increased their knowledge of farm succession as a result of their attendance. Eighty-percent of the attendees at "Passing on the Farm" workshops did not have a farm succession plan with only 36% indicating that a successor had been identified. As a result of the workshop, 82.9% reported they would update their will as well as meet with an attorney. Only 12% of the farm families have held intergenerational family business meetings prior to attending the workshop. Over 74% indicated they will begin holding these meetings with an additional 16.3% indicating they may. 81.8% of the attendees indicated they would complete the OSU Extension "Getting Your Affairs in Order" document. Eleven factsheets were published as part of the "Farm Transition Matters" series.	
22.	Pesticide Safety Education Program (PSEP)	**Issue** Pesticide application businesses, public agencies, and farms need to manage pests safely and effectively. Employers need employees who are licensed, trained in best management practices, and current with state and federal regulations. The commercial and private pesticide applicators require continuing education to maintain their license and livelihoods. **What was done** PSEP provided technical training for 731 new commercial pesticide applicators and continuing education for 3738 commercial applicators to meet their requirements under Ohio pesticide law. More than 25 state extension specialists/ educators and 15 industry partners joined PSEP staff	Enhancing Agriculture and the Environment/14

		in providing research-based recommendations and best practices training for commercial applicators. PSEP also provided in-service training and teaching resources for county educators to help them prepare for recertifying approximately 4500 private applicators in over 100 county meetings. **Results** Commercial applicators attending recertification programs agreed they had learned how to control pests more effectively (89%) and were better informed how to comply with pesticide and environmental regulations (92%). For those attending county meetings, > 92% agreed they had learned how to apply pesticides more safely, had improved practices to protect the environment, and controlled pests more effectively. Each private and commercial applicator attending recertification programs in 2019 received an OSU extension publication with current pest management recommendations (approximately 8200 distributed).	
23.	Women in Agriculture	**Issue**: Annie's project is a six-week program designed to address risk management education for farm women, in Ohio, events are organized by the "Women in Ag" team. Its objective is to educate women entrepreneurs so that they are more prepared to make farm management decisions. While a large number of farm women own and operate farms, others play a major role in the decision-making process of farm operations for farm families. Annie's Project provides in-depth sessions on topics that are important for decision-making on the family farm. The program topics covered include human resources, legal risks, financial risks, marketing risks, and production costs and risks. Sessions are designed to be interactive between the presenters and the participants, with information tailored to the needs of the participants. **What was done:** In 2019, 200 participants signed up and attended the Women In Ag conference. Participants engaged with local legislators to discuss the importance of agriculture and the concerns of the community. The planning committee of 15 farm women and ag businesses planned the program, invited speakers, introduced speakers, and helped make the day a success. They spend approximately 30 hours each on this project. **Results:** Sixteen Northwest Ohio Counties were represented at this conference. Wood County had the most representation. Participant comments included " Keynote speaker was Awesome!" Her message resonated with me so much!" " Education is an investment- think outside the box!" " " This is my third year here and this has been the most educational year for me so far. Learning	Enhancing Agriculture and the Environment/14

		about where grain goes after harvest, how to plan the future of my business." " Whatever life throws at you the future is what matters not the past" " I learned I need to take more time for myself!" " Stay positive, and be a contributor to AG industry and feel good about it!" " I learned how to properly solve a conflict." "I learned about communication on the farm and within the family" More than half of the participants (n=115) completed program evaluations. Eighty-eight percent (88%) of respondents agreed the program will increase farm family communications; 68% agreed that the knowledge they gained will be applied to their farm operation; 94% of the participants agreed that the knowledge gained during Women In Ag will be applied to their personal life.	
24.	OSU Income Tax Schools / Tax Education	**Issue** A complex income tax code and associated income tax issues creates many educational opportunities in Ohio. The passage of the Tax Cuts and Jobs Act in 2017 has created additional need for income tax education. Tax practitioners including certified public accountants (CPAs), enrolled agents (EAs), attorneys and other tax professionals have ongoing continuing education requirements. The Ohio State University Income Tax School Program began 56 years ago as an effort to provide education for rural tax professionals, farmers and others affected by tax law. Continuing educational credits are offered for the majority of the programs and designed to meet requirements of clientele throughout Ohio with continuing education needs. Farm business owners have specific tax planning and filing needs which calls for specific tax education. Issues surrounding property tax, sales tax and estate tax call for extensive expertise in these areas. **What was done/products** OSU Extension offers two-day Tax Schools for Professionals at nine locations throughout Ohio designed for tax practitioners with some experience preparing and filing federal tax returns for individuals and small businesses. Instruction focuses on tax law changes and on problems that they face in preparing tax returns. Highly qualified instructors explain and interpret tax regulations and recent changes in tax laws. These two-day schools offer continuing education credit for attorneys, CPAs, EAs and CFPs, and other tax return preparers. An annual Agricultural Tax Issues Webinar is held for tax professionals and individuals interested in in-depth tax information focused on agricultural issues. The Agricultural and Natural Resources Income Tax Webinar is a six-hour live webinar geared for farm tax preparers and	Enhancing Agriculture and the Environment/14

		large farms preparing their own returns. This, too, offers continuing educational credits. Our Farmer and Farmland Owner Webinar is a two-hour webinar targeting farmers and farmland owners who prepare their own returns or want to know more about farm tax law. These webinars are recorded and available for playback to participants throughout the tax filing season. Tax professionals need continuing education credits in the field of Ethics, which is provided with our live Ethics webinars. Numerous Farmer Tax Schools and Policy and Outlook Meetings Our team provides one-one-one consultations with tax practitioners and individuals in the areas of income tax, property tax, sales tax, estate tax and other associated information. CFAES Faculty and Staff continue to work through professional development and research to meet the needs of clientele with difficult tax related questions. **Results** Attendance at the educational programs was 750 for the 2-Day Tax Schools for Professionals, 163 for the Ag Tax Issues Webinar, 277 for the Ethics Webinars, 67 for the for the Farmer and Farmland Owner Webinar and 61 for the Summer Income Tax Update. Attendees filed 229,554 federal tax returns in 2019 which included 9,662 farm tax returns. Participants were asked "whether they would attend again" ranked on a scale of 1 to 3 with 1 = Likely, 2 = Maybe and 3 = Unlikely. The average ranking was 1.13. Participants were asked if "stated learning objectives were met" ranked on a scale of 1 to 5 with 5 = highest. The average ranking was 4.54. The team taught 38 sessions for ag lenders and farm audiences through seminars, workshops and outlook meetings reaching over 1600 participants. Evaluation results showed substantial gains in knowledge by the participants. One hundred percent of the participants in the 2019 farmer workshops reported the workshop helped to increase their knowledge of the key provisions of the Tax Cuts and Jobs Act of 2017 and how it may impact their farm operations. In addition, 96.9% indicated they felt more confident in their ability to communicate with their tax professional about farm taxes.	
25.	Agricultural Lender Seminars	**Issue (Who cares and Why)** Ohio has 77,800 farm operations that manage 13.6 million acres of land producing 9.34 billion dollars in products sold annually. Farm operators need access to financial support and borrowing to purchase farm assets and to purchase annual operational expenses. Agricultural lenders across Ohio are part of the Federal Farm Credit System and include Farm Credit, Ag Credit, local community banks, local credit unions, and the USDA Farm Service Agency. The 2017 average farm equity (net worth) of Ohio major farms was $956,811 with $1,082,630 in farm	Enhancing Agriculture and the Environment/14

		assets and $125,819 in farm liabilities. Ohio farmers paid $584 million in interest expenses in 2018. Agricultural lenders provide products, service and, credit to Ohio's farmers and are strategically positioned to disseminate knowledge and resources from the land-grant university/cooperative Extension service. **What has been done** Ohio State University Extension established annual seminars specifically to educate professional agricultural lenders, USDA FSA loan offers and analysts. The planning is dedicated to identifying the needs of lenders and building a team of instructors to deliver current, relevant, and research-based information and tools. The information taught and relationships built with land-grant university Extension professionals adds value to Ohio's agricultural lending industry. One hundred fifty-nine professional ag lenders enrolled at three, one-day, regional seminars across Ohio. The seminars appeal to the professional development needs of lenders throughout their career. Attendance to the OSU seminars: first timers (31%), 2 to 10 times (37%), 11-20 times (19%), and 20+ times (13%). The audience was 72% male and 28% female, 3% veterans, and 6% with a self-reported disability. The percentage of the lender customers are grain farms (43%), dairy/livestock farms (10%), grain and livestock farms (19%), specialty crop farms (4%), small and beginning farms (11%), rural housing (6%), and agri-business (7%). **Results** Lenders reported knowledge gained with before and after, self-reported data that showed 14% to 31% increases in knowledge on topics and issues taught at OSU Extension Ag Lender Seminars. Knowledge gained will be used by lenders in three ways; directly by the lender with clientele, in-directly by the lender to process clientele applications and portfolio management, and as professional development for the lender. Most lenders will directly use these topics with clientele: grain outlook (65%), USDA Farm Bill and Farm Policy (70%), and forecasts on farm inputs, land values, and enterprise budgets (73%). Many lenders will also use these topics as professional development: Farm Stress (45%) and Labels on Food (62%). Lenders provide positive feedback and input to OSU Extension on developing future seminars and continuing with Extension tools and resources online and through the county extension office system. It is estimated that reaching 159 Ag Lenders in the OSU Extension seminars will have a multiplier reach to 15,741 farm clientele.	
26.	4-H CARTEENS Programming	**Issue**: Inexperienced adolescent drivers sometimes demonstrate risky driving behaviors that put themselves, their passengers, other motorists and personal property at risk. Educational programs are conducted for first time teen traffic offenders in the 4-H CARTEENS counties. Teens are assigned to the 4-H CARTEENS program through local court systems.	Preparing Youth for Success/15

		What has been done: 4-H CARTEENS is a traffic safety program for juvenile traffic offenders conducted by 4-H teen leaders and program partners, including local law enforcement officers. 4-H CARTEENS goals include: (a) reducing the number of repeat juvenile traffic offenders; (b) decreasing the number of teen traffic offenders; and (c) increasing teen awareness of traffic/ vehicular safety. The "CAR" in CARTEENS stands for "Caution And Responsibility", and "TEENS" refers to the teenagers who help prepare and present the program. CARTEENS program topics include excessive speed, driving under the influence, seat belt safety use, consequences of unsafe decisions, dealing with peer pressure, understanding traffic laws, and recognizing and reacting to traffic signs and signals. **Results:** Results from the retrospective pre-post assessment instrument show a positive change in knowledge and behavior from the pre to the post assessment, included the following percentages for the respective statements: • I know which Ohio laws govern teen drivers (52% increase) • I do not engage in distracting behavior while driving (35% increase) • I understand the relationship between vehicle speed and stopping distance (28% increase) • I think about my responsibility as a safe driver (34% increase) • I think about my behavior as a driver (32% increase) • I think about the consequences of engaging in risky driving behaviors (26% increase) • I adjust all things that might distract me (eating, cell phone, music) before I drive a car (39% increase) In addition, 91% of the teen participants stated that the 4-H CARTEENS program is "Very" (63%) or "Somewhat" (28%) Likely to change their driving habits, and 93% of the 4-H CARTEENS participants agreed with the statement, "I am less likely to be a repeat traffic offender as a result of attending this CARTEENS program."	
27.	Assuring Quality Care for Animals	**Issue:** Youth involved in food animal exhibitions are food animal producers. Knowledge of the science of genetics, nutrition, management, handling, and environment in relation to the youth's food animal projects plays a critical role in the success of producing safe and wholesome food products for consumers. By participating in learning activities designed to help ensure their food	Preparing Youth for Success/15

		animals are well cared for and that their products are safe for consumers, junior fair exhibitors and their families will understand the important linkages among their responsibilities, obligations, public perceptions and consumer confidence in assuring well-cared-for animals and quality products. The Ohio Department of Agriculture (ODA) requires all youth exhibiting food animal projects to participate in quality assurance programming. OSU Extension provides leadership for implementing quality assurance programming in partnership with ODA, FFA/agricultural education and agricultural societies. **What has been done:** Ohio State University Extension developed the Assuring Quality Care for Animals Youth QA Curriculum. Annual updates are created and county QA adult coordinators/instructors are trained once every three years. Youth livestock exhibitors ages 8 to 11 annually participate in a face-to-face education session that is taught by an authorized instructor. Those ages 12 to 19 annually complete an educational session or successfully complete a test-out option. **Results:** In 2019, 35,552 youth livestock exhibitors successfully completed QA training and 8,313 adult coordinators/instructors assisted with delivery of the QA programs.	
28.	Real Money. Real World.	**Issue:** One of the most important life skills young people will need to succeed as adults is resourceful money management. **What has been done:** OSU Extension developed the Real Money. Real World Curriculum designed to: 1) increase youth awareness of how education level and corresponding career choice influence personal income and financial security; 2) increase youth knowledge of money management tools used in daily spending for cost-of-living decisions; and 3) increase youth awareness of how income and lifestyle choices affect the amount of money available for discretionary spending. Middle and high school age youth learn basic money management practices in the classroom and then make simulated lifestyle and budget choices through a spending simulation. During the spending simulation, students assume the role of a 27-year-old adult. They receive an occupation, monthly salary, and the number of children they are raise. Community volunteers staff booths that represent actual businesses in the community. **Results:** In 2019, 43,619 youth participated in RMRW. More than 1,800 adult community volunteers assisted with the RMRW simulation.	Preparing Youth for Success/15

29.	4-H Camp Programming	**Issue:** Camping is a primary 4-H delivery modality and an important way that youth experience essential positive youth development elements necessary for positive youth development. The goal of 4-H camping is to provide opportunities to enhance life skills development. **What has been done:** Ohio State University Extension's 4-H Camping Design Team created a curriculum and series of learning engagements designed to maximize the benefits of the camp experience for the youth participants. Staff (paid and volunteer) training and program planning are key components in creating a quality camp environment where all youth are accepted and have the opportunity to thrive. **Results:** 12, 079 youth participated in 118 OSU Extension 4-H camping programs across the state in 2019. Data from 5,054 of those youth (who responded to a survey) shows that: • 98% want to return to 4-H camp 'next year' • 97% will recommend 4-H camp to their friends • 97% made a new friend • 96% had someone to look up to • 94% learned something new • 87% feel more confident making decisions	Preparing Youth for Success/15
30.	Ohio 4-H Youth Development and 4-H Volunteer Program	The Ohio 4-H Youth Development Program had nearly 172,000 youth involved in 2019. Included here is a link to Ohio's 2019 4-H statistical infographic: http://go.osu.edu/OH4-H2019Stats **Financial impact of Ohio's adult 4-H volunteer time contribution:** The North Central Region (NCR) Volunteer Specialists conducted a survey of volunteers across the region in the summer of 2019 with a 30% response rate. The 199 Ohio 4-H volunteers who gave usable responses to a question asking them the number of hours they donate to 4-H, indicated they give an average of 9 hours per month. The average in Ohio is exactly the same as across the NCR. The Independent Sector lists the value of Ohio volunteer time at $24.05/hour (2018 data, 2019 delayed due to COVID-19). Therefore, 9 hours x 12 months = 108 hour/year 108 x $24.05 = $2597.40 per year per volunteer $2597.40 x 16,114 adult 4-H volunteers = $41,854,503 of donated time	Preparing Youth for Success/15

31.	Successful Co-Parenting	**Issue:** When parents divorce, the children often pay the highest price. Of the approximately 40,000 marriages that break up in Ohio each year, more than 45% involve minor children. Co-parenting allows a child or children to have a secure upbringing without conflict of interest. Co-parenting enables the child or children to maintain a healthy close relationship with both parents. **What has been done:** Family and Consumer Sciences' Successful Co-Parenting is a face to face two to three-hour class designed to equip parents with the knowledge, skills, tools, awareness and strategies to help their children adjust to divorce now and in the future. A new addition in late 2019 was the introduction of an online format for the class. **Results:** In 2019, 1289 participants took part in the program. Ninety two percent of participants report being more prepared to co-parent as a result of the program. Ninety three percent report learning new information and 97% plan to use the information that they learned.	Strengthen Families and Communities/16
32.	Building Consensus and Assessing Feasibility of Food Growing and Processing in Lima, OH	**Issue:** The project was an effective reuse of vacant land planned in collaboration with a dozen stakeholders who reached consensus to develop and implement the South Jackson Community Gardens project. Stakeholders met twenty times between 2017-2019 to reach consensus on the scope, timeline and management of the project. Commitments ranged from funding to programming expertise to project management. The final project is design and build a model urban garden and community space for food and health-related entrepreneurial activities. The space will provide wellness programming and opportunities for residents. **What has been done:** From December 2018 through September 2019, the focus was to implement the project plan. Stakeholders held a final planning meeting in December 2018 to develop a timeline and identify who would be responsible to do what. Tasks included scheduling and publishing events, developing a timeline for excavation and construction, and developing a master list of programs that would be conducted at the site. The first step, to complete and execute a lease agreement between the City and Chamber, was completed by Spring, 2019. While this was being accomplished, OSU Extension Community Development and the Knowlton School design faculty developed site and construction plans. Plans were shared and revised during three group and several one-on-one stakeholder meetings that occurred between January and May. Following plan development, beginning May 31, five Final Friday and two separate planting events were held to engage the community and to build neighborhood support. Poster boards of the site plan was posted during these events.	Strengthening Families and Communities/16

		Results: More than 200 community members attended, with 7 neighbors volunteering to take leadership roles in supporting the project. In addition to learning about how the site would be developed, neighbors participated in a variety of programs and activities, food giveaways and fun. Excavation and planting was completed in August and September, in addition to building raised planting beds. A building is planned for construction in Spring 2020. A Town Hall meeting is also being planned with City of Lima Community Development to formally create a neighborhood association that would provide ongoing support for the project. Future plans include sharing the project process and lessons learned to date with other communities. A goal is to replicate the process in other jurisdictions and to assist them in implementing successful land reuse strategies.	