

2016 Ohio State University Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

The Ohio Agricultural Research and Development Center (OARDC) and Ohio State University Extension (OSUE) are symbiotic components of The Ohio State University's (OSU) College of Food, Agricultural, and Environmental Sciences (CFAES). OARDC serves as the research arm of CFAES, whereas OSUE is the public interface that delivers research-based education to improve the lives, businesses, and communities of Ohioans. The mission of the college is simply but profoundly stated, "We Bring Knowledge to Life."

During this past year, the college experienced multiple leadership changes. In May 2016, Dr. Lonnie J. King was appointed Interim Dean and Vice President for Agricultural Administration for CFAES, assuming the roles previously held by Dr. Ron Hendrick. In March 2017, The Ohio State University announced the appointment of Dr. Cathann Arceneaux Kress as Vice President for Agricultural Administration and Dean of the College of Food, Agricultural, and Environmental Sciences effective May 1, 2017.

Dr. Jerry Bigham's interim appointment as Associate Dean for Research and Graduate education ended on December 31, 2016. Dr. Charles Goebel now serves in this interim role. Dr. David Benfield continues to serve as Associate Vice President of Agricultural Administration and Director of the Wooster Campus.

Dr. Roger Rennekamp succeeded Dr. Keith Smith as the 12th leader of Ohio State University Extension on January 4, 2016. Dr. Smith retired in 2015, after 23 years serving as the Director of OSU Extension. Dr. Rennekamp comes to Ohio State from Oregon State University, where he had served as the Associate Dean for Outreach and Engagement.

Though the leadership of the college has changed, its mission and goals have not. OSUE and OARDC are to be engaged, to deliver impacts, and to make a difference in the lives of Ohioans. This charge is implicit in the land-grant mission and is reinforced by university leadership, elected officials, and by those we serve. Likewise, this charge is central to the USDA-NIFA mandate. Engagement and impact-oriented programs continue to be our hallmark. OARDC and OSUE are leaders in "Agbioscience": the integration of scientific disciplines to address critical needs of (1) food security, production and human health; (2) environmental quality and sustainability; and (3) advanced bioenergy and biobased products. CFAES' agbioscience program underpins Ohio's \$107+ billion agricultural industry. These three signature areas of agbioscience have been adopted as key research priorities for OARDC. At any given time, OARDC researchers are engaged in more than 400 research projects in these areas.

Similarly, CFAES' research and Extension programs continue to focus on OSU's three university-wide Discovery Themes: (1) Food Production and Security; (2) Energy and Environment; and (3) Health and Wellness. The Discovery Themes provide Ohio State with an unprecedented opportunity to find durable solutions to today's--and tomorrow's--most compelling issues. The Discovery Themes Initiative is a transformative program. In 2016, a total of 18 Discovery Theme tenure or tenure-track faculty positions were filled within CFAES, with 11 new, additional positions approved. These positions were in the following five focus areas: Data Analytics; Infectious Diseases; Foods for Health; Food & AgriCultural Transformation; and Sustainable and Resilient Economy. Of those new hires, 53 percent are from

underrepresented populations. These new positions provide a focused and significant opportunity to enhance the diversity of Ohio State's faculty.

OARDC and OSUE, collectively employ approximately 1,600 fulltime employees, and work jointly with all CFAES agbioscience programs. Fifty faculty members hold joint appointments at OARDC and OSUE, and most also have advising and teaching appointments in CFAES academic programs. Likewise, OSUE and OARDC work closely with CFAES's Agricultural Technical Institute (ATI), the nation's largest two-year degree program of its kind, offering 25 Associate programs and three certification programs of study. ATI is ranked number one in the nation among two-year schools awarding degrees in agriculture and related sciences and currently enrolls approximately 750 students. This close collaboration among the three entities in CFAES (OARDC, OSUE and academic programs including ATI) results in seamless programs, such as our agronomic field days--that are held annually at our research stations across the state. OARDC, while serving as the research arm of CFAES, is also intimately involved in student learning. OARDC research supports approximately 318 graduate level students and 77 postdoctoral researchers each year who spend their time in field experiments and performing laboratory investigations.

In 2016, Dean King announced ten strategic goals for CFAES, including a college-wide, program and partnership-driven re-envisioning and rebuilding of state-of-the-art infrastructure to support both learning and research. This re-envisioning further connects the three entities as "one college." For example, the Waterman Agricultural and Natural Resources Laboratory, a staple of The Ohio State University's Columbus campus, is a 261-acre green oasis that harkens back to the university's agricultural roots. However, as part Dean King's college-wide re-envisioning, Waterman Farm is looking toward the future. With support from public-private partnerships, the goal is to transform Waterman Farm into a modern, urban agricultural laboratory with an emphasis on production of local foods. Other plans include the development of a new multispecies facility for the Department of Animal Sciences that will include teaching, research and Extension work on cattle, poultry, swine and horses. Additionally, a greenhouse will allow produce to be grown for campus dining services. The Waterman Farm will also be the future home of the new Franklin County Extension office as well as an institute to study urban agriculture and food security.

OARDC and OSUE have continued to manage their programs within current fiscal constraints despite ever-increasing demands for services, even in the face of Ohio's need for advancing job growth and economic development. While economic turnaround is evident throughout Ohio, OARDC and OSUE have continued to leverage investments made in research and Extension to expand the economy while ensuring the wise use of our social, environmental, and human capital.

OARDC uses federal and state capacity funds to leverage additional support from a variety of competitive sources. During the 2016 fiscal year, CFAES received 338 new grant awards valued at over \$35 million. The total portfolio of all active awards was valued at over \$180 million. Some examples are listed below.

From the United States Department of Agriculture:

- \$8.3 million in competitive grants, research support, and cooperative agreements to support the research enterprise
- \$0.9 million to advance sprayer technologies for specialty crops - ranging from components to sophisticated systems
- \$0.5 million to explore the biodiversity and ecosystem services in urban soils
- \$0.6 million to develop a statewide network that creates multiple pathways to earn a baccalaureate degree in sustainable agriculture

From the National Science Foundation:

- \$0.5 million to support new and ongoing research

From the Ohio Soybean Council:

- \$0.9 million to address soybean priority areas

From the Ohio Department of Agriculture:

- \$0.9 million targeting wildlife biodiversity in Ohio

From the National Institute of Health:

- \$3.1 million to continue the cross-disciplinary study of the molecular effects and chemopreventive potential of natural foods, such as black raspberries, on human oral cancer development

OSUE is a major partner in many of these studies. Without the expertise of Extension faculty and staff, translating the science to the into usable products for stakeholders would not occur efficiently. In order to manage programmatic priorities, one of the first projects Dr. Rennekamp undertook after taking the helm of OSUE was to rethink its impact areas. In 2015, OSUE was operating under four impact areas: advancing employment and income opportunities, enhancing agriculture and the environment, preparing youth for success, and strengthening families and communities. OSUE has now formally retired the aforementioned impact areas and adopted these six: health and wellness; job skills and careers; thriving across the lifespan; sustainable food systems; engaged Ohioans, vibrant communities; and environmental quality. These six impact areas will provide a framework for our reporting and help us to document our work.

OARDC and OSUE have submitted an array of impacts for the 2016 reporting period that demonstrate how our research and outreach activities are helping to advance both science and society. The institution has moved beyond food production to the creation of energy and manufacturing materials such as natural rubber, biogas, and ethanol. Plant and animal genetics research, in combination with food technologies, engineering, and plant and animal health research are supporting a safer, healthier food supply that is more sustainable with a smaller environmental impact. These programs will substantially contribute to reducing global hunger. For the most part, these are all collaborative efforts involving OARDC and OSUE, multiple business and industry partners, and multiple federal, state, local agencies and non-governmental organizations. CFAES continues to support the integration of cutting-edge research, innovative outreach programs, and development across five other OSU colleges, creating interdisciplinary partnerships to address complex problems and issues that require broad thinking.

Our programs impact Ohioans every day. One such program, Ohio State's Initiative for Food and AgriCultural Transformation, is pursuing a mission to create sustainable, resilient food systems for Ohio and beyond. Known as InFACT, this initiative pursues holistic approaches to ensure good food for all. Its work is based on collaboration across not only research and outreach, but also across the sciences, engineering and humanities, as well as the engagement of external partners in government and private industry. The program supports 10 new collaborative projects focused on research, education and outreach over the past year across all dimensions of food security. In total, the projects involve at least 76 Ohio State faculty and students, and 23 community partners. The university's investment in this area will add dozens of new faculty to its hundreds of food and food-related scholars.

Currently, InFACT is leading a campus-wide effort to acquire 40 percent of all food purchases from local and sustainable sources within 10 years. CFAES will work to secure resilient and sustainable food systems to assure the health and well-being of a growing world population in the face of unprecedented environmental change and constraints.

OARDC and OSUE are committed to innovative research to provide safe food and water worldwide. When nearly half a million Toledo residents were left without drinking water for days in August 2014, Lake Erie water quality received international attention as it became an issue that affected not only recreation and commercial fishers and beach users, but the general public as well. To address the problem, Ohio State and its academic and agency partners launched the Field to Faucet initiative to help ensure clean drinking water for Ohio residents.

With funding from Field to Faucet, a newly developed smartphone app, "Ohio State PLOTS," is helping to improve water quality throughout the state. The app was designed as a tool that allows farmers to digitally fine-tune nutrient management by allowing comparisons of the effectiveness of different management techniques. The app sets up virtual trials that can compare hybrids, seeding populations, fertilizer rates, and nutrient management systems; providing results that can help farmers to make decisions before extending financial or labor resources. The app is free, and available on both Android and Apple devices.

In addition, Ohio State University Extension has a new signature program dedicated to creating a soil health education and outreach network. Strengthening Ohio's soil health will create a vital, living ecosystem that better sustains plants, animals, and humans.

At least 25 faculty members in six CFAES departments are engaged in research on the biological, physical, chemical and/or social aspects of water quality and utilization. Field to Faucet projects currently underway include:

- Developing a controlled-access, geospatial-data warehouse that allows producers and researchers to secure and share publicly available data;
- Finding ways to best remove phosphorus and nitrogen from manure and anaerobic digester discharge before the materials are applied to fields. This effort will especially benefit the watershed around Grand Lake St. Mary's in western Ohio;
- Using unmanned aerial vehicles to provide real-time data on concentrations of microcystin created by harmful algal blooms in Lake Erie; and developing a sensor to detect real-time concentrations of microcystin in the lake.
- Edge-of-field water testing is ongoing on 20 sites using real-time monitoring of water leaving farm fields through drainage tile and other structures. Data generated from the sites include recognition of new water table management structures that will create strategies for reducing water volume leaving the field, resulting in lowered amounts of nutrients entering surface water.

Two other goals of the program are to advance harmful algal bloom research and improve collaboration to accelerate the movement of knowledge from academia to the field. Collaborations between academic researchers, Extension personnel, governmental agencies and agricultural organizations allow research-tested management methods to be used more quickly by producers. A great example is the Fertilizer Certification training in which OSUE, the Ohio Department of Agriculture and the Ohio Farm Bureau Federation collaborate to highlight the latest methods for fertilizer application to more than 12,000 Ohio farmers.

Ohio State research and Extension efforts extend beyond water quality, with a focus on food production and pollinators. About one third of all food crops grown in the United States must be pollinated by honeybees or other pollinators. Those crops are estimated to have a value of more than \$14 billion a year; protecting honeybees will help protect our food supply. Research conducted by OARDC scientists revealed that foraging honeybees can pick up insecticide dust from corn seeds that have been coated in chemicals. When the honeybees return to their hives, this dust can be very harmful to young, developing bees. Researchers are already postulating ways which can help minimize bees' exposure to insecticides, including: controlling weeds in corn before they flower, so bees aren't attracted to sprayed fields; using seed planters that vent downward (instead of up) to minimize dust spread; and limiting the use of coated

corn seeds. The potential economic impact of pollinators is huge: Ohio 2015 soybean and corn production was valued at \$2.1 and \$1.9 billion, respectively. Imagine what even a 1% difference in soybean income could mean for the state: \$21 million dollars!

Researchers have also discovered the presence of soybean pollen in nearly half of Ohio honey. This is of particular interest, as soybeans are self-pollinated plants. This discovery has sparked investigation to see how honeybees and soybeans are benefitting one another.

OSU Extension is working to aid our pollinator friends: through partnerships with energy companies and nurseries, the project 'A Monarch Right-Of-Way: A Pollinator Demonstration Plot' was created. Four different plots of land, all under power lines, have been planted with native wildflowers. The land under electrical transmission lines must be kept clear of trees, and there are about 7,000 miles of high-voltage lines in Ohio alone.

By planting wildflowers under transmission lines, two goals will be accomplished: food and homes will be provided to pollinators like bees and Monarch butterflies, and transmission lines will be kept free of tall vegetation. The test plots will include milkweed, which is the only plant on which Monarchs will lay their eggs. Due to the reduction in milkweed in and at the edge of fields, the Monarch population has plummeted by 90%. OSU hopes to help rebound the monarch population through the Monarch Right of Way project, which aims to encourage landowners who have utility rights-of-way on their property to adopt some alternative wildlife habitats.

Even Ohio 4-H members are getting in on honeybee awareness. In Ross County, Ohio, one 4-H member, Jacob, discovered beekeeping through a 4-H club project he took at age 13. Jacob currently keeps 14 of his own hives, and created "Teens Educating Adults and Children about Honey Bees" (or "TEACH B's"). He gives presentations and demonstrations, which illustrate the importance of honeybees, as well as the importance of eating the fruits (and vegetables) of the bees' labor, thus delivering healthy living messages. Jacob speaks to adult audiences too. A Ross County educator said of Jacob, "That was my first time in 22 years of working in Extension that I invited a 4-H'er to talk with adult farmers. They were impressed. Jacob's knowledge of bees is extensive, and he talked about the importance of spraying (pesticides) at times when bees aren't out harvesting."

The TEACH B's message has reached over 500 individuals to date. Jacob's mother said of the Ohio 4-H program, "We feel eternally blessed that we found 4-H. I didn't come from that background, but I always knew 4-H was something that gives you life skills. We're doubly blessed to have Jacob in our life and that we found 4-H to get him motivated and inspired to learn."

Total Actual Amount of professional FTEs/SYs for this State

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	550.0	0.0	410.0	0.0
Actual	665.3	0.0	281.0	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Internal University Panel
- External University Panel
- External Non-University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review

2. Brief Explanation

For OARDC, OSUE, and CFAES, merit review processes are critical to our mission and are mandated at all levels. Over the years, the review process has been streamlined and, with the introduction of digital media, we have seen dramatic changes in quality, quantity, and timeliness of reviews. Throughout 2016, internal and external stakeholder advisory committees have been used for input on multiple topics including: annual reports; new facilities such as the construction of swine facilities on the Wooster campus and a new multispecies facility for teaching at the Waterman Farm in Columbus; and new dimensions for agbioscience initiatives.

In addition, documents such as annual reports and one-page information sheets, are typically produced in draft form and targeted for initial review and future consumption by advisory committees, individuals, partner business groups, public officials and commodity organizations who are both knowledgeable and vested in the subject matter. They are asked to provide feedback on content, relevance and presentation of the stories and impacts.

All OARDC and OSUE published materials, ranging from traditional print to social media releases, are compiled and reviewed by panels with both technical and communication expertise. Most of these products also have some type of administrative review. OSUE requires all publications (whether electronic or print) that are intended for statewide (or broader) distribution to be submitted for blind peer review by a minimum of three people. This internal oversight provides a high-quality final document for stakeholder use.

With the introduction of OSU's Discovery Themes in 2012, an extensive internal review process has been developed to identify and fill new Discovery Themes positions. The candidates are reviewed by academic department representatives, college-level administrators, and the University Office of Academic Affairs.

During 2016, the Dean of CFAES in collaboration with the Directors of OARDC and OSUE held meetings with stakeholders to discuss the CFAES facilities planning. Stakeholder inputs at these meetings were recorded and used to improve the plans where feasible. As a result, the Wooster campus will be getting an integrated farm operations facility that will bridge Ohio State ATI and OARDC farm operations. The facilities planning process is a work in progress and additional stakeholder input will be important to finalizing the master plan, including the development of a new equine facility to be constructed with the College of Veterinary Medicine, a new science building for the Department of Entomology on the Wooster campus, and a multi-species facility scheduled for Waterman Farm on the Columbus campus.

OARDC utilized its advisory committee this year, as well as various other committees, to focus on facilities, programs, operations, and long-term planning. We have an extensive amount of one-on-one researcher-to-stakeholder interaction to identify needs, establish priorities, and engage in research and development programs. For the most part, a partnership with a stakeholder group exists for each program.

OSUE implements several levels of advisory committees, each tasked with helping to ensure that local or statewide programs are relevant and address the highest priority needs of our clientele. Tasks within the charge of the advisory committees include: identifying and prioritizing needs, providing input into the identification of staffing needs, connecting Extension with potential partners or those who could fill gaps in service, helping develop budgets, educating stakeholders on Extension's impacts, and advocating for Extension.

In Ohio, there is one state Extension advisory committee, which advises the Director on statewide programmatic issues, county-level advisory committees which provide feedback on county-level program issues, and program area advisory committees, which advise educators within the scope of their specific program area (agriculture and natural resources, family and consumer sciences, 4-H youth development, and community development). Extension also has local, specialized / topical committees such as goat committee, sheep committee, and various others specific to commodities.

Each of these committees has guidelines, which dictate how they should be composed. Diversity of membership is key, with consideration for diversity in categories such as: geography, age, race / ethnicity, gender, socio-economic status, program area, and political affiliation. Additional guidelines exist for term / length of membership, size of committee, meeting frequency, and membership rotation.

Excellent examples of the review process at work in OSUE are the signature programs. Signature programs are a cornerstone of the OSUE strategic plan. A key requirement of a program receiving the signature program designation is that it addresses a critical need or issue that is relevant to a significant proportion of Ohioans. The designation is only given to a small number of programs that complement the impacts of OSUE's current portfolio of core programs. Potential programs must apply to become a "signature program" and must demonstrate that they meet pre-determined criteria. Applications are reviewed by a committee, and finally approved by OSUE Administrative Cabinet. Proposals for new signature programs are accepted annually, and a review of the relevance of current signature programs is also considered each year.

Signature programs are the broad strokes of OSUE's programming efforts. While Extension seeks to deliver programming that is readily applicable across the state, we also realize the need to develop programming specific to the needs of certain parts of the state. Extension Educators and program staff also work to develop programming that meet the needs of citizens within their county and region.

Given that all OARDC and OSUE efforts are planned to benefit some targeted group or groups, we engage those groups at the beginning of the process, thus providing formative reviews. This policy holds true even in highly theoretical research where interdisciplinary partners have been engaged to advance lines of inquiry. In such cases, the stakeholders may be internal to the organization, or they may be found in other colleges and universities. Specialists from academic disciplines provide insight from personal research and published literature, while county Extension personnel provide insight from local communities. Program area personnel work together to identify key issues that cut across disciplines, and special task forces collaborate to identify priority program efforts to address these issues. Funding is then allocated to support program priorities.

Our system provides flexibility for educators to maintain the ability to be responsive to unanticipated issues. In situations where grant monies were obtained, staff members with specific, short-term employment contracts have been hired to assist in meeting priority needs. Educators identify a subject matter specialization that relates to needs in their geographical area of the state. Educator specialization is a way for the system to provide subject matter expertise close to local communities. They receive additional training to remain on the cutting edge of their field, and they work with other educators to address local needs in a timely manner. In addition, educators remain linked to state specialists in the same discipline to enable the rapid dissemination of new information or the development of appropriate

programming to address critical needs. As OSUE specialists continue to work in the context of ever increasing societal needs and tight budgets at all levels, the need for assessment and input is more important now than ever to ensure limited resources are targeted to yield the greatest impacts.

As OSUE and OARDC continuously strive to be more relevant, make wiser use of limited resources, and maximize impact, program and publication review by stakeholders, internal and external peer review, and external specialists are more important than ever. To that end, the organization is committed to making use of both informal and formal reviews at all levels of the organization.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals
- Survey of selected individuals from the general public
- Other (focus groups, public information booths at local gatherings)

Brief explanation.

Stakeholder input is central to our organization's well-being and has long been part of our corporate culture. OARDC and OSUE, as well as CFAES as a whole, continually have wide support and active participation from our stakeholders. As groups and individuals are provided with meaningful opportunities to influence outcomes in their industry or area of expertise, they become increasingly engaged.

As an institution, emphasis is placed on business and industry participation and creating collaborative efforts that yield new commercialized products and jobs. This level of stakeholder engagement is critical as the organization seeks to help Ohio grow its economy and create jobs. Stakeholders understand that their collaborative participation is necessary to make this happen.

Throughout the year, we use both formal and informal methods to engage our stakeholders and encourage their participation. Due to the changing nature of economic and societal trends, agriculture, food, and the green industry depend on innovators and researchers to generate new processes and products. Ohio's agricultural industry increasingly links with other industries to take on common challenges and opportunities in key areas such as food production and security, energy and the environment, and health and wellness.

One example of this public-private collaboration is SEEDS: The OARDC Research Enhancement Competitive Grants Program. The SEEDS program encourages excellence in OARDC research by promoting exploration that is consistent with the mission and vision of the OARDC and by

encouraging connections across disciplines, with industry and with external partners or stakeholders.

Established in 1996 and supported by an appropriation from the Ohio General Assembly to OARDC, SEEDS is a unique program among U.S. state-assisted universities. In fostering high-quality research among scientists supported by OARDC and CFAES, SEEDS enables those scientists to collect preliminary data needed to give them a competitive edge in national programs, and it provides them with leverage to attract industry and stakeholder funding support. SEEDS has returned up to \$7 for every state dollar invested over the life of the program. Since its creation in 1996, SEEDS has supported research projects of over \$25 million in awards, and has received more than \$8.9 million in matching and extramural funding.

SEEDS grants have enabled scientists to establish collaborations with colleagues from 16 countries around the world. SEEDS research has produced applications for 11 U.S. patents using results from initial findings. Nine patent applications have been granted, and six licensing agreements have been obtained. SEEDS-supported scientists have a total of 979 peer-reviewed scientific manuscripts, abstracts, popular press articles, bulletins and book chapters and have made more than 1,500 presentations around the world. Since the student SEEDS grants were introduced in 1998, they have funded research projects for 74 doctoral dissertations and 115 master's theses.

OARDC centers and programs, and their stakeholders participate in three annual meetings to discuss research programs, infrastructure, annual reports, planning, and re-envisioning related to OARDC. OARDC asks for stakeholder input annually on our annual report format and content, as well as input on the direction of our research programs. For example, several researchers and educators from OARDC and OSUE were among a group of scientists from agencies, universities and environmental organizations who gathered during the fall to discuss their latest research on fighting harmful algal blooms and protecting water quality in Ohio. During the "Understanding Algal Blooms: State of the Science Conference" held in September in Toledo, Ohio, researchers presented information on how to prevent and predict harmful algal blooms and how to remove their toxins from drinking water.

Organizational and leadership changes are communicated at major College events (such as the annual Farm Science Review), to advisory groups, via the CFAES website, a weekly CFAES blog, and a weekly news release. Printed stories are released as appropriate. These items are prepared and released by the CFAES Communications and Marketing team, which also facilitates communications with stakeholder groups regarding major research issues and impacts.

In late 2016, the Program Development and Evaluation team for OSUE led an asset-based approach to needs assessment session with 23 members of the "Extension in the City" team. The purpose of the "dine and dialogue" session was to generate conversations and data that would provide insight into the needs and assets of the urban areas of Ohio. A nine-page report resulted from the discussion session, which will be coupled with extensive market analysis, surveys, focus groups, and a review of secondary data. All of these components will be used for a comprehensive examination of community trends, structure, gaps, and opportunities in Ohio's urban communities. The results of the full examination will help to determine programmatic priorities in the future.

Additionally, OARDC, OSUE, and most academic departments/schools within CFAES each effectively use their external advisory committees and stakeholder groups as forums to discuss current programs and gather input for future direction and strategic planning. Electronic messaging, social media, webinars, Tweeting, and blogging, as well as interactive group meeting/messaging systems have continued to expand rapidly. With lower time and travel costs, more stakeholders can now participate using communication technologies.

OSUE develops stakeholder-based strategic plans to inform the focus of statewide priority programs. The process is ongoing and involves collaboration with local advisory committees, reviews of demographic and other relevant data, and prioritization based on need and availability of resources. The process enables the creation of focused teams comprised of campus, center, and field specialists, as well as county educators who develop curriculum and evaluation strategies for statewide programs. In many cases, these teams have specific target audiences, whom they regularly involve in program planning and evaluation, including the development of educational materials. Some of the program teams include members from external organizations (e.g. state agencies, organizations, commodity groups) who can offer additional resources to enhance program outreach. County Extension Advisory Committees, as well as the State Extension Advisory Committee, are engaged in reviewing and prioritizing new interdisciplinary programs. Due to their long history of collaboration with OSUE and OARDC, stakeholders make significant input into our programs at a variety of levels.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys
- Other (one on one interactions with existing and new stakeholders)

Brief explanation.

OARDC and OSUE are continually making targeted efforts to find and link with representatives of all stakeholder groups. OARDC and OSUE identify individual stakeholders and stakeholder groups by utilizing faculty and staff, associates from support organizations, traditional stakeholders, and political leaders.

OARDC and OSUE use every opportunity, such as the CFAES Farm Science Review (FSR), to engage and garner stakeholder participation, feedback and support. FSR--Ohio's premiere agricultural event, and one of the largest in the nation--is dedicated to demonstrating the best agricultural research and best management practices with ready-access for our stakeholders. In September 2016, Farm Science Review hosted approximately 126,000 visitors over a three-day period. One-on-one sessions at FSR, the state fair, local fairs, special events, and active participation by faculty and staff in community group processes and business/professional meetings have provided an opportunity to better connect with constituents. This process also provides a means to expand our clientele list, knowledge of needs, and feedback on outputs and impacts. These contacts are logged and maintained.

The OARDC advisory committee is composed of a cross-section of members from the agricultural, natural resources and environmental sectors. Members serve a three-year term with no limits on reappointments to the committee. When a committee term expires, the committee recommends a new member from a similar area as the retiring member. Once the advisory committee approves the individual, the name is forwarded to the Director of OARDC for final approval and appointment.

County Extension advisory committee members are most useful in connecting to our traditional stakeholders and expanding the list of those within the county that should be contacted. Extension advisory committees have guidelines that dictate how they should be composed. Diversity of membership is key, with considerations for diversity in categories such as: geography, age, race/ethnicity, gender, socio-economic status, program area, and political affiliation. Additional guidelines for term length of membership, size of committee, meeting frequency, and membership rotation also exist. The membership of committees is reviewed during annual onsite and self-study diversity reviews to ensure that involvement is sought from the broadest array of constituents feasible. Extension educators are encouraged to reach out to new and underserved target audiences. Each team, or faculty and staff group, working on a project proposal or existing project will have a client partner list that is ever expanding. Likewise, all administrative units in CFAES have advisory committees that continually seek to be more representative and are constantly opening up new channels to new stakeholder individuals and groups.

Our future success in meeting needs and fulfilling our land-grant mission lies in our ability to maintain links with a representative cross-section of our stakeholders. These linkages aid in assessing research and Extension-related needs, extending information, growing human capital, opening opportunities for Ohio based products and services that we have helped to develop, and ensuring we have a feedback mechanism from our stakeholders.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Survey of the general public
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public
- Survey of selected individuals from the general public
- Other (focus group interviews, unobtrusive observation, qualitative data collection)

Brief explanation.

The methods noted above have all been utilized to a greater or lesser extent this reporting year at various levels of the organization to gather data from stakeholders. While there are some formal processes used to gather input, many of our efforts are informal. Our survey of various groups is often done in open forum interview/discussion settings that generate more qualitative data than quantitative. OSUE and OARDC, as well as many faculty and staff members, departments and schools, and various research and Extension groups within the institution have stakeholder lists that serve as their foundational contact points. In turn, there are business and industrial partners, fellow research and Extension institutions, and support organizations that are on our contact list. Federal, state, regional, and local governments; agencies; advisory committees; commodity groups; as well as special interest groups also add to the list of stakeholders from whom we seek input in the initial

planning and execution phases of our programs.

OARDC invites members of private and public industry from around the state of Ohio to participate as OARDC advisory committee members. This committee meets three times a year along with the OARDC Directors and other OARDC representatives to discuss current research, gather input for future direction and long-term initiatives, and address any other immediate priorities. In 2016, the OARDC advisory committee invited individuals from the Ohio Farm Bureau, OSUE and the Ohio Lake Erie Commission for a panel presentation on Ohio water quality. The panel addressed the use of phosphorous and its effects on our waters, Lake Erie restoration, available water quality grants, and answered questions regarding current efforts. Advisory committee members, CFAES faculty and staff and community stakeholders were invited to participate in the panel presentation.

Additionally, each year, OARDC's eight Outlying Research Station advisory committees review research projects, impacts of research projects, budgets, and equipment and facilities needs for their respective locations. The Station Manager and the Assistant to the Director for Research Operations provide input and data to the committees. The committee uses this information to revise the five-year strategic plan at each location on an annual basis. Examples include: new vegetable crops or new varieties of vegetable crops produced at a research station; changes in pesticide use due to new pests discovered by producers or research personnel; and new recommendations for nitrogen and phosphorus management on agronomic crops.

All of these stakeholders are continually being re-engaged as we move forward. The ultimate aim is to have 'meaningful engagement' so our stakeholders find reasons to stay involved. We work on the premise that 'meaningful engagement' will yield meaningful data, both quantitative and qualitative, and that interpretation and internalization of that data will help lead the organization to meaningful partnerships that will help foster real impacts.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities
- Other (Business management practices, culture of organization)

Brief explanation.

OSUE and OARDC, collectively and independently promote both basic and applied research, and build and test advanced models for Extension/outreach programming that meet client needs. Accomplishing this goal requires close client/stakeholder/customer interaction. Throughout this reporting year, both OARDC and OSUE have continued stakeholder engagement activities that reinforce our client-centered, client-focused organizational culture. At each juncture of our decision-making, our organization has sought to weigh stakeholder input against demand for our science and programs, and our capacity to deliver. While there are often competing and conflicting demands, input from our stakeholders is strongly reflected in what we do. Client needs and their feedback are critical in the state-level budget process. Meeting client requests is the key to fulfilling the land-grant mission and demonstrating that stakeholder support exists for programs that fulfill their needs and contribute to national well-being.

It is the field-level interactions among stakeholders, researchers, and Extension specialists where the majority of emerging issues are identified. While strong, theoretical insight is critical, food, agricultural, and environmental issues most often manifest themselves in field settings and in our clients' daily work and social lives. Stakeholders remain our true partners by joining with faculty and staff to identify emerging issues. Needs and issues originating from producers, processors, manufacturers, distributors, consumers and special interest groups have, and will continue to inform Extension and research programs. It is this input, when filtered through our academic knowledge base, that provides our scientists with relevant study questions. Once answered, the response is framed for the clients as well as other interested parties. The response includes interventions to affect change, deliver new goods, provide services, and ultimately generate real impacts. This approach has and will continue to influence faculty and staff hiring, shifts in priorities and resource allocation, and strategic planning.

Likewise, stakeholder input continues to influence how our college positions itself in the marketplace and conducts business. Stakeholder input has transformed the corporate culture in that, as a public institution, it is imperative for society to see our organization reflecting their aspirations.

Stakeholder input is considered at many levels of the organization. The Administrative Cabinet of OSUE reviews input from surveys and strategic planning processes to determine funding and staffing needs. The State Extension Advisory Committee and the OARDC Advisory Committee have met multiple times this year to provide input on programmatic needs and proposed priorities. Cooperative Extension administrators and others with statewide program leadership responsibility have initiated a departmental accountability process with all campus units receiving Extension funding. This process involves meetings to discuss shared priorities, surveys of internal and external stakeholders about their satisfaction with the content and expertise delivered from that unit, and review of documented impacts. This process is directly linked to annual funding for the campus departments. Locally, Extension Advisory Committees and other programmatic committees assist educators in prioritizing programs annually. They review information about local needs and the capacity of Extension to deliver programs, and guide the overall local programmatic vision.

Across all levels of administration and at all program levels, stakeholder input has and continues to prove most valuable. Both OSUE and OARDC are extensively engaged with federal, state, and local officials, as well as business, industry, and special interest groups. The stakeholders' voices and needs are central to setting our institution's agendas and fulfilling our collective land-grant mission.

Brief Explanation of what you learned from your Stakeholders

The individuals, groups, organizations, and businesses that are vested in CFAES' research and Extension activities provide a level of input that is central to our success. The primary information learned in these interactions is that:

- The stakeholder perspective is not always as we assume; thus, it is imperative that we listen intently, communicate broadly, and stay engaged. This has been a strong recommendation from a number of stakeholders who have noted that periodic mailings and webpages do not equate to staying engaged;
- Our science and services are highly valued. Our research and Extension work has positive social, economic, ecological, and ethical impacts, both quantitatively and qualitatively, for individuals, families, groups, communities, businesses and industry;
- OARDC and OSUE do not have the resources and personnel to meet all demands, or to take advantage of all opportunities that present themselves. The breath of demand is so wide and the quantities so great that the organization must be engaged in constant planning to garner and optimize resources, invest them in targeted programs, and generate impacts in a timely manner. We

also must clearly articulate to the full array of stakeholders what we have the capacity and resources to accomplish.

An issue that is likely to garner more attention from OSU in the future is the opioid crisis Ohio is currently experiencing. The Kaiser Family Foundation says that in 2014, Ohio had the highest number of deaths from opiate overdoses in the United States, topping the charts with 2,106 opiate-related deaths. The death toll increased to 3,050 in 2015. While the research is showing that opioids are a huge problem in Ohio, we're also hearing concerns from Ohio citizens. A recent survey conducted in an Ohio county on community health revealed that over 50% of respondents personally knew someone who used illegal drugs, and of those individuals, half of them knew a heroin user. In 2016 and 2017, numerous lectures and forums were held at the university on the topic, with attendees from multiple colleges. We expect to see research and Extension programming addressing this topic in the future.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
11315915	0	7622831	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	10058891	0	6928540	0
Actual Matching	10058891	0	21033476	0
Actual All Other	0	0	0	0
Total Actual Expended	20117782	0	27962016	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	4731261	0	0	0

V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Climate Change
2	Sustainable Energy
3	Childhood Obesity
4	Food Safety
5	Global Food Security and Hunger
6	Soil, Air and Water (OARDC Led)
7	Natural Resources and Environmental Systems (OARDC Led)
8	Plants Systems (OARDC Led)
9	Animals Systems (OARDC Led)
10	Food, Agricultural, and Biological Engineering Systems (OARDC Led)
11	Economics and Social Dimensions (OARDC Led)
12	Human Health (OARDC Led)
13	Advancing Employment and Income Opportunities (Extension)
14	Enhancing Agriculture and the Environment (Extension)
15	Preparing Youth for Success (Extension)
16	Strengthening Families & Communities (Extension)

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Climate Change

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation	100%		39%	
605	Natural Resource and Environmental Economics	0%		61%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	2.0	0.0	1.0	0.0
Actual Paid	4.0	0.0	0.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
196271	0	125099	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
196271	0	347720	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Ongoing research activities related to climate change will include both basic and applied research. This research will continue to take place in all academic departments/schools within the College of Food, Agricultural, and Environmental Sciences. Laboratories for experiments, pilot plants, a feedstock processing plant, greenhouses, and research plots and stations will support this program. All functional laboratories and sites will be improved over time as program needs warrant. In 2016, the National Oceanic and Atmospheric Administration (NOAA) installed a new weather station at the OARDC Snyder Farm as part of the U.S. Climate Reference Network (CRN). The CRN is a long-term project to monitor climate change, which involves a network of weather stations located across the U.S. OSU Extension will provide parallel programs within this planned program to advance knowledge, promote adoption and change, and develop human capital. OSUE will maintain websites on related topics, such as the "Nutrient Stewardship for Cleaner Water" site, and provide parallel programming on climate change topics. OARDC and OSU Extension faculty and staff will engage in appropriate levels of outreach and consultation with both internal and external stakeholders.

2. Brief description of the target audience

Targeted audiences in the Climate Change planned program include, but are not limited to:

- Businesses and industries that have expressed a need for climate change information that is derived through new and ongoing research, or is extracted from scientific literature;
- Fellow academic units that partner with program scientists to create systems and processes needed to support research and the adoption of the research findings by industrial partners;
- Agricultural producers and farmers;
- Federal, state or local agencies or support organizations who will not only use the information but will also be brokers of that information, including embedding it into groups to encourage change;
- Populations who have not requested the information, but will likely benefit from access;
- Other scientists and scientific groups;
- Political entities;
- Other education, outreach, and extension personnel;
- Students from pre-school to post doctorate studies;
- News organizations.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	21118	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016
 Actual: 1

Patents listed

Wet Scrubber Apparatus for Ammonia Capture

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	15	15

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of participants attending educational programs
Not reporting on this Output for this Annual Report

Output #2

Output Measure

- number of webinars / online educational and research sessions
Not reporting on this Output for this Annual Report

Output #3

Output Measure

- number of acres impacted as a result of educational events on the management of natural resources
Not reporting on this Output for this Annual Report

Output #4

Output Measure

- number of individuals receiving one-on-one consultation or assistance
Not reporting on this Output for this Annual Report

Output #5

Output Measure

- number of people completing non-formal educational events on water quality and quality of surface water and groundwater supplies (OSUE)

Year	Actual
2016	21118

Output #6

Output Measure

- number of Fertilizer Applicator Certification Training events offered

Year	Actual
2016	72

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Create strategies / technology within our program mission to reduce atmospheric pollution that can contribute to global climate change (OARDC)
2	Proportion of climate webinar participants who indicate they have learned new information and would share their new knowledge with others (OSUE)
3	Advance knowledge of how climate change affects crops (OARDC)
4	percentage of participants who improved their knowledge of nutrient management (OSUE)
5	Seeking innovative research to conserve and enhance natural resources that contribute to the economic and emotional well-being of stakeholders (OARDC).

Outcome #1

1. Outcome Measures

Create strategies / technology within our program mission to reduce atmospheric pollution that can contribute to global climate change (OARDC)

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Proportion of climate webinar participants who indicate they have learned new information and would share their new knowledge with others (OSUE)

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Advance knowledge of how climate change affects crops (OARDC)

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

percentage of participants who improved their knowledge of nutrient management (OSUE)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	93

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Nutrient stewardship impacts everyone. Fertilizer is essential to crop production; but if nutrient applications are not managed, farm field nitrogen and phosphorus can be lost into water resources and can promote hazardous algal blooms. Ohio has had problems with water quality -- Lake Erie and Grand Lake St. Marys are two examples of massive algal blooms which have greatly impacted Ohio water quality.

What has been done

OSU Extension developed the "Nutrient Stewardship for Cleaner Water" program, which was designed to improve water quality by helping growers lessen the use of nitrogen and phosphorus while maximizing the amount kept on the fields, which will ultimately result in increased farm yields and profits, as well as cleaner waterways. The program encompasses fertilizer application certification and pesticide application programming.

In 2016, fertilizer applicator certification training was offered 72 times through events such as 2-3 hour trainings, field days, seminars, displays, and the soil and nutrient management series. These events reached 21,118 producers and agricultural business persons. During the Conservation Tillage Conference, nearly 900 individuals heard lectures on soil and nutrient management topics. Farm Science Review featured several activities on nutrient stewardship, which had the potential to be viewed by the 125,000 in attendance. In addition, numerous newspaper articles and radio spots featuring nutrient stewardship education were published or aired in 2016.

Results

OSU Extension educators report that over 90% of clientele have adopted soil testing, and most clientele are following the fertilizer recommendations for agronomic and other crops and using organic and inorganic nutrient sources for optimal crop production. Participants in the Fertilizer Applicator Certification Training programs were surveyed following the educational event. Responses indicated that 75% either "agreed" or "strongly agreed" that farm field phosphorus is a significant problem to our water resources (streams, rivers, lakes). 93% of participants believed they had improved their knowledge of nutrient management. 84% of participants plan to review their soil test and phosphorus recommendations, and 61% plan to change their nutrient management practices. OSUE has identified fields with high nutrient loss risk, and those fields will be studied for the efficacy of appropriate and cost-effective best management practices to see if there is a reduction in nutrient loss.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

Outcome #5

1. Outcome Measures

Seeking innovative research to conserve and enhance natural resources that contribute to the economic and emotional well-being of stakeholders (OARDC).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Population growth, industrial development and globalization are driving increased natural resource consumption and waste generation despite steady gains in production efficiencies. Emerging economies, rapid urbanization and modern cultures of consumption have also increased global per capita resource demands. Without significant changes in production and consumption patterns, scientists predict irreversible losses to forests, soils, wetlands, freshwater supplies and other ecosystem services that provide the foundation for both industrial activities and community well-being. Managing economies, communities and organizations to become more sustainable and resilient is a multi-faceted challenge due to complex interactions among environmental, industrial and societal systems.

What has been done

OARDC scientists are lead directors for Ohio State's "Sustainable and Resilient Economy" (SRE) Discovery Themes program. The SRE program advances the science of sustainable production and consumption by working to develop a comprehensive, integrated approach to sustainability and resilience assessment. Their research focuses on areas such as: the design of products and manufacturing processes to foster an economy that treats waste materials as valuable resources; innovations in renewable materials and resource efficiencies that account for interdependences with food, energy, water, land and other resources; and the management of natural capital assets in which the external costs of resource use and environmental damages are made explicit and future needs and availability of resources are considered.

Results

OARDC researchers partnered with 16 departments across six colleges to develop a strategic faculty hiring plan and position descriptions for 30 new faculty positions. This effort has resulted in the hiring of 13 new Ohio State faculty who will be engaged in SRE and who represent a wide range of disciplines. Additionally, 75 current faculty members are also actively engaged across the university in SRE programs. The SRE program hosted a workshop on the Food-Energy-Water-Nexus that attracted 60 participants, including leading scholars at Ohio State and nationally, and resulted in the development of a multi-disciplinary research agenda on human adaptations to climate change and impacts on food, energy and water systems.

The SRE program also initiated an ongoing series of meetings with major corporations with R&D centers in the Columbus metropolitan area to develop strategic partnerships to support interdisciplinary research on sustainability, resilience and food and nutrition topics.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Other (Social acceptance of the issue)

Brief Explanation

Limited resources require choices. Should a more compelling issue surface, it is possible that resources currently devoted to this program and planned for the future could be re-directed. Likewise, natural disasters / climactic extremes may shift the focus of some programming efforts back towards issues regarding climate change.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Climate change is a global problem, but specific subsets of challenges are already affecting the Great Lakes region. Climate change can: affect the safety of drinking water, increase the number of droughts and floods, cause changes in precipitation and higher mean temperatures, and cause a decrease in crop yield dramatically over time, and impact species migration.

For 2016, OSU Extension reported results related to the signature program, "Nutrient Stewardship for Cleaner Water," which aims to educate farmers about the impacts of nutrient runoff on water quality.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Sustainable Energy

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
511	New and Improved Non-Food Products and Processes	10%		92%	
608	Community Resource Planning and Development	90%		8%	
Total		100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	2.0	0.0	2.0	0.0
Actual Paid	2.0	0.0	2.0	0.0
Actual Volunteer	11.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
98135	0	247064	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
98135	0	1010191	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Throughout the planning period, research and extension activities will inform sustainable energy and advanced materials programs through both basic and applied research, and with the full range of extension activities. This research takes place in all academic departments/schools within CFAES. Laboratories for experiments, pilot plants, a feedstock processing plant, greenhouses, and research plots and stations throughout the state support this program. All functional laboratories and sites are improved over time, as program needs warrant.

'Energize Ohio' is one of OSUE's former signature programs. The program is multi-disciplinary and addresses a wide range of energy education needs, including large-scale renewable energy development, shale energy development, youth energy education, and distributed renewable energy development. A total of 59 'Energize Ohio' programs were offered in 2016, reaching 2,352 participants.

OARDC and OSU Extension faculty and staff engage in appropriate levels of outreach and consultation with both internal and external stakeholders, to ensure the research has the greatest chance of affecting change within society.

2. Brief description of the target audience

Targeted audiences include, but are not limited to:

- Businesses, industries, and residents that have expressed a need for sustainable energy and advanced materials information that is derived through new and ongoing research or is extracted from scientific literature;
- Other stakeholders, with particular focus on consumers;
- Academic units that partner with program scientists to create systems and processes needed to support research and the adoption of the research findings by industrial partners;
- Federal, state or local agencies or support organizations who will not only use the information, but will also be brokers of that information, including embedding it into groups to encourage change;
- Populations who have not requested the information but will likely benefit from access, e.g. community leaders, general public;
- Other scientists and scientific groups;
- Political entities;
- Other education, outreach, and extension personnel;
- Students from pre-school to post-doctorate studies;
- News organizations.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2644	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016
 Actual: 5

Patents listed

1. Herbicide Resistant Taraxacum Kok-Saghyz and Taraxacum Brevicorniculatum
2. Fungal Treatment to Enhance Extractable Rubber Yield From Plants
3. Methods to Extract Natural Rubber from Guayule and Other Plants Using Different Flocculation
4. Novel Biofiller-Natural Rubber Composites for Industrial Applications
5. Bioprocessing of Harvested Plant Materials for Extraction of Biopolymers and Related Materials and Methods

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	12	12

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of educational workshops / seminars on "Sustainable Energy" topics (OSUE)

Year	Actual
2016	59

Output #2

Output Measure

- number of visitor sessions to the "Energize Ohio" website (OSUE)
 Not reporting on this Output for this Annual Report

Output #3

Output Measure

- number of attendees at on-farm photovoltaic solar energy development workshops (OSUE)

Year	Actual
2016	2352

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Annually the program will report, in conjunction with industrial partners, non-proprietary research gains made to the consuming public to garner interest in adoption of new products and processes when released.
2	By 2018, the program will contribute at least two alternatives to a petroleum-based product or process that meets client needs with an acceptable point of purchase price.
3	Support, through research, the building of biobased development that annually, beginning in 2013, utilizes Ohio and the region's plentiful supply of biomass, including waste steam materials in such manner as to improve the economy.
4	Number of on-farm alternative energy projects completed (OSUE)
5	Complete plan for community, business, or farm energy activity (OSUE)
6	Proportion of participants who indicated they know more about energy as a result of the "Energize Ohio" program (OSUE)
7	Proportion of participants who indicated that they plan to use the materials and / or information from the "Energize Ohio" program in making decisions related to energy at their home, farm, or business (OSUE)
8	Proportion of "Energize Ohio" participants who indicated that the program provided valuable information that they would recommend to others (OSUE)
9	The program will build scientist/stakeholder cores to guide/provide biological, chemical, physical, engineering, and social research necessary to create new and improved processes and products commensurate with demand. (OARDC)
10	Proportion of participants who indicated that they plan to use the materials and / or information in the OSUE-developed solar curriculum in their classrooms

Outcome #1

1. Outcome Measures

Annually the program will report, in conjunction with industrial partners, non-proprietary research gains made to the consuming public to garner interest in adoption of new products and processes when released.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Growing productive and economically viable crops on marginal sites in Ohio remains a significant issue for many Ohio farmers. Giant miscanthus is a new perennial crop for farmers in Ohio, a new raw material for biobased product manufacturers that are looking to diversify their product lines, and a focus of development by Ohio State.

What has been done

Farmers in Ashtabula County, about 70 miles east of Cleveland, started growing giant miscanthus in 2011. There are now about 4,000 acres of the crop in the county. The harvest from the crop goes to two new Ashtabula County manufacturing facilities run by Conneaut-based Aloterra Energy. One of these facilities uses giant miscanthus fiber to make compostable food containers, while the other uses giant miscanthus to produce biodegradable absorbents for soaking up fluid spills, such as oil.

Results

Since first starting to use giant miscanthus as a source for biobased materials, Aloterra Energy has expanded its efforts and increased employment by 50 individuals. Aloterra Energy's success has provided evidence for farmers and landowners about the long-term possibilities for giant miscanthus. OARDC scientists are now studying the best ways to grow giant miscanthus in test plantings at the Ashtabula Agricultural Research Station and have expanded these trials OSU South Centers in Piketon, Ohio.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

By 2018, the program will contribute at least two alternatives to a petroleum-based product or process that meets client needs with an acceptable point of purchase price.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Support, through research, the building of biobased development that annually, beginning in 2013, utilizes Ohio and the region's plentiful supply of biomass, including waste steam materials in such manner as to improve the economy.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of on-farm alternative energy projects completed (OSUE)

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Complete plan for community, business, or farm energy activity (OSUE)

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Proportion of participants who indicated they know more about energy as a result of the "Energize Ohio" program (OSUE)

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Proportion of participants who indicated that they plan to use the materials and / or information from the "Energize Ohio" program in making decisions related to energy at their home, farm, or business (OSUE)

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Proportion of "Energize Ohio" participants who indicated that the program provided valuable information that they would recommend to others (OSUE)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Current energy concerns in Ohio include increasing populations, the desire to minimize foreign dependency for oil, and environmental concerns. Ohio has an abundance of natural resources and open spaces, which gives them the opportunity to play a role in addressing energy concerns.

What has been done

OSU Extension developed a curriculum called "Energize Ohio," which provides Ohioans with non-biased, research-based information to address critical energy issues. Energize Ohio is designed to enhance knowledge of energy drivers and development in order to promote best practices, informed decision making, and the implementation of sustainable energy strategies in Ohio's communities. Educational events were offered on four primary areas of focus: large-scale renewable energy development, shale energy development, youth energy education, and distributed renewable energy development. The curriculum consists of worksheets, presentation materials, workshops, website blog discussions, bulletins, technical reports, fact sheets, and journal articles to help educators customize an energy program to meet local needs. 59 events reaching 2352 individuals occurred in 2016.

Results

Short term changes include increased knowledge and understanding of energy development options and their benefits and challenges; increased knowledge and confidence in decision-making by local leaders; and confidence in decision-making and planning abilities. 100% of the program evaluation participants indicated the program provided them with valuable information which they would recommend to others.

When participants were asked "As a result of this program, I am more likely to consider a solar energy project on my farm", results showed that the likelihood of participants acting on a solar energy project increased by 1.9 points on a 6-point scale. A follow-up assessment with program participants showed that nine farmers who attended Energize Ohio programming have since installed an on-farm solar system to offset a portion of the electric needs for their farms. Energize Ohio has also helped Ohioans to save money in other ways -- five participants were able to use information from the program to determine that a solar project was not a good investment for their business or farm, thus savings them from a costly investment that wouldn't provide good returns. Since 2015, it is estimated that Energize Ohio education has led to the offsetting of nearly 513,000 pounds of CO₂e greenhouse gasses per year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes
608	Community Resource Planning and Development

Outcome #9

1. Outcome Measures

The program will build scientist/stakeholder cores to guide/provide biological, chemical, physical, engineering, and social research necessary to create new and improved processes and products commensurate with demand. (OARDC)

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Proportion of participants who indicated that they plan to use the materials and / or information in the OSUE-developed solar curriculum in their classrooms

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Current energy concerns in Ohio include increasing populations, the desire to minimize foreign dependency for oil, and environmental concerns. OSU Extension has developed curriculum for students in grades 7-10, which is intended to promote literacy related to solar photovoltaic and solar thermal technologies, thus creating a new generation of energy-literate citizens and responsible decisions makers and environmental stewards.

What has been done

A hands-on curriculum with experiential learning activities has been developed. There are five lessons in the curriculum: 1) exploring solar technology; 2) understanding the mechanics of solar technology, 3) using an investigative process to explore solar thermal technology, 4) exploring series and parallel circuits using solar photovoltaic arrays, and 5) using real-time data to relate solar energy production to the sun's location. The lessons may be used together, or independently depending upon need. The lessons align with Ohio Science Standards, Next Generation Science Standards, and the U.S. Department of Energy, Energy Literacy Standards. Lessons include a teacher outline, materials list, student worksheets, experimental activities, extension challenges, vocabulary lists, and web-based resources.

73 formal educators and seven Ohio 4-H educators were trained on using the curriculum in their classrooms. In 2016, portions of the curriculum were used at several 4-H camps. 52 educational programs spanning summer 2015 through the end of 2016 were provided to 2,203 youth.

Results

All the educators who were trained indicated they planned to use the curriculum in their classrooms in the fall of 2016. Feedback from one participating educator: "Thank you for the amazing resources, lessons, and materials today at the Stone Lab Solar workshop. It was, by far, the best workshop I have ever attended in my 11 years of teaching."

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes

Brief Explanation

ECONOMY: Volatile oil prices greatly influence the exploration and development of shale formations in Ohio. Shale development creates jobs, increases the demand for retail and other services, which results in the stimulation of the local economy. The challenge is to ensure that many of the new jobs benefit the local labor force. Workforce development becomes an important strategy to build local economic sustainability.

PUBLIC POLICY CHANGES: The following policies all influence the development of distributed renewable energy systems:

- Ohio State Bill 221
- Ohio State Bill 310
- Consolidated Appropriations Act (40% ITC)
- Clean Power Plan

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Energize Ohio programming directly reached 2,352 individuals in 2016. 100% of program evaluation participants indicated the program provided them with valuable information which they would recommend to others.

Five participants to Energize Ohio programming were able to save money and time by determining that a solar project was not a good investment for their business or farm.

73 formal Ohio educators were trained on recently developed solar photovoltaic and solar thermal technology curriculum. Lessons designed by OSUE align with Ohio Science Standards, Next Generation Science Standards, and the U.S. Department of Energy standards. All educators trained on the new curriculum planned to use the materials in their classrooms in the fall of 2016.

It is estimated that since 2015, Energize Ohio education has led to the offsetting of nearly 513,000 pounds of CO₂e greenhouse gasses per year.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Childhood Obesity

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
702	Requirements and Function of Nutrients and Other Food Components	0%		97%	
703	Nutrition Education and Behavior	50%		3%	
724	Healthy Lifestyle	50%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	8.0	0.0	0.5	0.0
Actual Paid	1.0	0.0	0.5	0.0
Actual Volunteer	1.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
49068	0	73509	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
49068	0	500993	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Ohio State is committed to being a leader in the science of using food and nutrition to promote health and prevent disease. Many costly and preventable chronic conditions -- heart disease, stroke, cancer, diabetes, hypertension and obesity -- are affected by diet. And worldwide, inadequate nutrition is a major cause of developmental delays and death. Given the complex nature of obesity, the subject is broadly supported in scientific areas ranging from genetics for breeding plants and animals that can be processed into healthier food products, to education of school children about eating healthy. Thus, not all impacts relating to obesity, per se, are found in this planned program. OARDC and OSU Extension advance programs to ensure that nutritious foods are affordable and available, and provide guidance so that individuals and families are able to make informed, science-based decisions about their health and well-being. By building on the collaborations among faculty that span a breadth of expertise, and by joining with key partners in the public and private sectors, CFAES will create a healthier future for individuals and communities around the world.

2. Brief description of the target audience

Related research and extension information will be derived from new and ongoing research or extracted from the scientific literature. Within the Childhood Obesity planned program, such research will be shared with targeted audiences including, but not limited to:

- Specific individuals, families, and groups who have expressed a need, or where there are latent needs.
- Fellow academic units that partner with OARDC and OSU Extension who will support not only the research, but also the adoption of the research findings by stakeholders;
 - Agencies or support organizations who will not only use the information, but will also be brokers of that information, including embedding it into groups to encourage change;
 - Populations who have not requested the information but will likely benefit from access, e.g. obese children;
 - Other scientists and scientific groups;
 - Political entities;
 - School administrators;
 - Students from pre-school to post-doctorate studies;
 - News organizations;
 - Businesses and industry groups concerned about obesity in their workforce;
 - Businesses and industry groups who are producers of foods and food additives that can help reduce obesity and its side effects.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	400	0	1600	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of educational sessions held

Year	Actual
2016	36

Output #2

Output Measure

- number of participants attending educational events related to 'Childhood Obesity' that can be defined as under-served (i.e. individuals whose needs have not been addressed in past events)
 Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	To better understand human decision making; specifically with reference to how individuals make food consumption decisions.
2	Apply new knowledge to programs at the field level with a goal of significant long term weight loss and overall improvement of health in those who participate.
3	To identify research activities such as new data sources, improved techniques for data analysis, and improved hypotheses for obesity research questions.
4	Number of participants who learned new information from this program. (OSUE)
5	Number of participants who plan to increase their level of daily physical activity. (OSUE)
6	Number of participants who plan to increase their consumption of fruits and vegetables (OSUE)

Outcome #1

1. Outcome Measures

To better understand human decision making; specifically with reference to how individuals make food consumption decisions.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Apply new knowledge to programs at the field level with a goal of significant long term weight loss and overall improvement of health in those who participate.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Honduras, whose economy depends predominately on agriculture, supports a population of nearly 9 million people. Based on 2015 data, the country struggles with a poverty rate of roughly 71%, and continues to have issues with crime, notably its high murder rate. Rural dwellers require over two times the average salary just to meet their nourishment needs, and in rural areas, over 68% of the children are affected by malnutrition. Culturally, Latino people are typically more comfortable with the promotora (community health worker) approach to health care because of its personal and informal style. Consequently, promotoras provide culturally appropriate health education and assist people in receiving the care they need.

What has been done

OARDC researchers have launched a program focusing on the nutritional needs of the citizens of Honduras. Three communities were the target of this nutrition education program where there was no standardized training curriculum for promotoras. A nutrition education curriculum had to be developed for delivery of content to the local citizens. The curriculum, which was fully developed by February 2015, was tested for validity and reliability.

Results

Today, the curriculum is being used extensively by the promotoras to educate the community members, with 11 promotoras hired along with a promotora coordinator. These 12 individuals serve three communities by delivering weekly nutrition education content to the women of these communities. The 12 promotoras are serving approximately 400 families and over 3,000 individuals. The promotoras not only teach the citizens how to grow vegetables that will yield higher nutritional value, but also to use and prepare the vegetables for greater family nutritional outcomes.

Prior to the development of the program, surveys indicated that there were stretches of four or five days that families, and often the entire community, would go without food. With the implementation of the promotora program, the number of days without food has been diminished and almost eliminated.

In addition, "hoop houses" have been built in the three communities so that citizens can grow their own vegetables. The hoop houses were necessary because of the white fly that invades almost all vegetables grown in Honduras. As part of the program, community members were taught composting, planting, maintaining, and harvesting the vegetables.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #3

1. Outcome Measures

To identify research activities such as new data sources, improved techniques for data analysis, and improved hypotheses for obesity research questions.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of participants who learned new information from this program. (OSUE)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
------	--------

2016

2000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In the United States, it is estimated that over 20% of teens are obese, and nearly 60% aren't physically fit. Research shows that other common health issues for teens include sleep deprivation, drug and alcohol use, and compromised emotional well-being.

What has been done

In both 2015 and 2016, Ohio 4-H sent a small delegation to the National Youth Summit on Healthy Living. The team was introduced to the "Smoothie Bike" -- a stationary bicycle which can power an attached blender by pedaling the bike. Ohio 4-H saw the opportunity to use the Smoothie Bike as a fun and interactive tool to get the message about healthy lifestyle choices out to the public. A bike was purchased, and during 2016 the bike was featured at an average of three events per month statewide.

More than 2,000 Ohioans have used the bike to date. The bike gives people the opportunity to make a healthy smoothie while riding -- it only takes a few minutes to whip up a nutritious, delicious drink, some hummus, or a few seconds to make salsa. While someone is riding the bike, OSU Extension educators are busy conducting other activities that promote healthy living. Information about how to include a variety of fruits and vegetables into a diet, how to eat low-fat or non-fat dairy products, and limiting beverages with added sugars is discussed. While someone is riding the bike, OSUE educators also have the opportunity to use the bike to make a point about calories: people learn how many minutes of biking it would take to burn off the calories in fruits and veggies, sugary treats, and high-fat foods. The comparison is often surprising.

Results

Those who visited the bike learned that it would take more than an hour of moderate biking to burn off the calories in a milkshake, compared with just 15 minutes of cycling to burn off a healthy smoothie. Handouts are provided at Blender Bike exhibits, which feature tips on nutrition, as well as recipes for smoothies, hummus, and salsa. Recipes made on the blender bike can be replicated at home with a regular blender.

The Ohio 4-H Healthy Living program was created in 2014, and has since grown to include approximately 25 teen ambassadors, known as "Health Heroes." The Healthy Living group is spreading the word that young people can have a strong voice in advocating for healthy changes, not only individually but also community-wide. A summit held in November 2016 brought 38 Ohio teens together from across the state (10 of those were Health Heroes). At the summit, those teens developed action plans to take back to their 9 Ohio communities to help make their hometowns healthier places. Most teens came with another teen and an adult from their community, to facilitate implementing plans in their communities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #5

1. Outcome Measures

Number of participants who plan to increase their level of daily physical activity. (OSUE)

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number of participants who plan to increase their consumption of fruits and vegetables (OSUE)

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (Support in schools for programs)

Brief Explanation

Obesity is a complex topic to address, in that it encompasses a range of variables, including food quality, access to healthy foods, economics, and the decisions of individuals in food choice. Shifts in these variables impact all aspects of people's lives--psychologically, socially, and physically. Recent research shows that obesity outcomes for individuals are somewhat determined by the time children reach kindergarten. Reaching individuals with effective education and prevention measures at such a young age presents challenges to researchers and extension personnel as they consider new curriculum and delivery methods.

Within this program area, public monies and the fluctuations in appropriations have had a dramatic effect (both positive and negative) on human well-being, as have levels of government support for obesity education. The varying level of importance placed on social science research impacts our ability to compete for limited dollars, and thus impacts the extent to which research can be carried out. Factors such as the availability of base funding to ensure a core faculty and staff, availability of extramural funds, and excessive programmatic demands can affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For 2016, OSUE shared one example of an effort to raise awareness regarding healthy eating: the blender bike / smoothie bike. 2016 was the first year the bike was exhibited around the state. The bike was purchased to attract attention at events (like county fairs) -- once people have gathered, OSUE educators are able to provide more information about healthy recipes, exercise, and good eating habits.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Food Safety

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
502	New and Improved Food Products	0%		38%	
703	Nutrition Education and Behavior	80%		1%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	20%		61%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	7.0	0.0	1.5	0.0
Actual Paid	5.0	0.0	1.8	0.0
Actual Volunteer	0.4	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
245339	0	272722	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
245339	0	782067	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

OARDC's food safety research for advancing broad food safety goals includes both basic and applied research. Research ranges from microbial assays to studies of food packaging. Laboratories, pilot plants, farms, and multiple business sites are available throughout the state to permit data gathering and to continue long-term experiments. All functional laboratories and sites will be improved over time as program needs warrant.

Parallel OSU Extension food safety programs will be developed based on client demand and food safety standards set by both the industry and regulators. Food safety programs to reduce the incidence of foodborne illness and provide a safer food supply by addressing and eliminating causes will continue to be a primary program goal of OSU Extension and OARDC.

Specific activities of food safety education for consumers will include:

- Conducting ServSafe classes with food establishment managers and employees;
- Providing research-based information to consumers through various forms of media, phone calls, etc.;
- Providing Home Canning / Food Preservation workshops for individuals.

2. Brief description of the target audience

Targeted audiences within our food safety programs include, but are not limited to:

- Individuals or groups who have expressed a need for food safety research and Extension information that resulted from new and ongoing research or is extracted from the scientific literature;
- Academic units that partner with food scientists to create systems and processes needed to support research and adoption of the research findings by stakeholders;
- Federal, state or local agencies or support organizations who will not only use the information but will also be brokers of that information, including embedding it into groups to encourage change;
- Populations who have not requested the information but will likely benefit from access, e.g. persons who engage in home canning of food;
- Other scientists and scientific groups;
- Political entities to influence policies related to food safety;
- Students from pre-school to post-doctorate studies;
- News organizations;
- Businesses and industrial groups;
- Food establishment managers (ServSafe manager training; food service employees ServeSafe training);
- General consumers (via both formal and informal education).

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	8658	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)
Patent Applications Submitted

Year: 2016
 Actual: 4

Patents listed

1. Black Goji (*Lycium ruthenicum* Murr.) as a Potential Source of Natural Color in a Wide pH Range
2. Colorant Compositions and Methods of Use Thereof
3. Coating Shell Eggs with Synthetic Plastic Emulsions (Mexico)
4. Coating Shell Eggs with Synthetic Plastic Emulsions (Canada)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	88	88

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of educational sessions held

Year	Actual
2016	196

Output #2

Output Measure

- Individual instruction on food safety through phone calls

Year	Actual
2016	845

Output #3

Output Measure

- number of home canners (pressure of boiling water) tested

Not reporting on this Output for this Annual Report

Output #4

Output Measure

- number of participants attending local food preservation educational sessions

Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Contribute to the advancement of knowledge about food packaging technologies, e.g. ultrasonic sealing, controlled environment packaging, to the extent that, annually, the risk of contamination due to packaging is reduced measurably.
2	Expand the knowledge base for contamination detection within packaged foods by developing or refining technologies such as magnetic resonance or infrared spectroscopy that will, within ten years, eliminate the problem.
3	Reduce food borne pathogens in the food supply chain.
4	Number of participants who learned new information from this program. (OSUE)
5	Number of participants who plan to adopt one or more recommended practices. (OSUE)
6	Reduce health risk by releasing at least one major study every five years demonstrating nutritional health benefits, e.g. carotenoids and cataracts, anthocyanins and colon cancer or as a substitute for artificial dyes (OARDC).
7	Number of ServSafe® Level 2 attendees that answered "Agree" or "Strongly Agree" when presented with the statement, "I am comfortable talking with coworkers about increasing the safety of food in my establishment."
8	Increased knowledge around the topic of safe food handling, as demonstrated by the mean score on post-tests (out of a possible 10) compared to pre-tests for attendees of the 'Occasional Quantity Cooks' program
9	percentage of food preservation participants who plan to make behavior changes as a result of educational intervention (OSUE)
10	Ensure a safe and plentiful food supply through research that reduces or eliminates food contaminants (OARDC).

Outcome #1

1. Outcome Measures

Contribute to the advancement of knowledge about food packaging technologies, e.g. ultrasonic sealing, controlled environment packaging, to the extent that, annually, the risk of contamination due to packaging is reduced measurably.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Expand the knowledge base for contamination detection within packaged foods by developing or refining technologies such as magnetic resonance or infrared spectroscopy that will, within ten years, eliminate the problem.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Reduce food borne pathogens in the food supply chain.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of participants who learned new information from this program. (OSUE)

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Number of participants who plan to adopt one or more recommended practices. (OSUE)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	78

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Microbial contamination can taint produce anywhere from farm to fork. There are many pathogens that can grow quickly at room temperature. Some pathogens produce toxins that are not destroyed by heating during the cooking process. Contaminated produce, if further mishandled, can make an outbreak more likely. The best way to respond to food safety issues to prevent them, rather than respond to or treat them after they occur.

What has been done

The OSU Fruit and Vegetable Safety Team educates growers of fresh produce about Good Agricultural Practices (GAPs). The team strives to inform growers how to safely handle all of the steps to enact an HACCP (Hazard Analysis Critical Control Point) plan to develop the understanding and specific skill set needed to produce, pick, package, and safely sell locally produced vegetables and fruits to the public. A secondary goal of the team is to teach individuals how to avoid or address potential food contamination problems that may influence or afflict local vegetable production. OSUE has provided Giant Eagle grocery stores with lessons on produce safety. In 2016, OSUE educators taught Good Agricultural Practices to 168 growers of produce.

Results

Growers, farmers, farm businesses, market managers, auction owners, and other stakeholders became aware of new laws and regulations. Nearly all participants increased awareness of the details of the Food Safety Modernization Act. Awareness of the impacts of certain food handling behaviors was also noted in sessions across the state. Fulton Farms in West Central Ohio reported changing their practices by writing and implementing a GAP plan of action. Evaluations from one educator revealed that 78% of her GAP participants indicated they were either "likely" or "very likely" to make changes as a result of GAP education.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #6

1. Outcome Measures

Reduce health risk by releasing at least one major study every five years demonstrating nutritional health benefits, e.g. carotenoids and cataracts, anthocyanins and colon cancer or as a substitute for artificial dyes (OARDC).

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Number of ServSafe® Level 2 attendees that answered "Agree" or "Strongly Agree" when presented with the statement, "I am comfortable talking with coworkers about increasing the safety of food in my establishment."

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	219

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The manner in which people handle and prepare food is a major reason why foodborne illness occurs. The CDC estimates that approximately 1 in 6 Americans (or about 48 million people) get sick each year due to foodborne pathogens. Of those that become ill from food, about 128,000 are hospitalized, and 3,000 die each year.

What has been done

OSU Extension offers the ServSafe® program to help food service industry professionals learn more about how to protect food from contamination with pathogens, and teaches them best practice skills for food preparation and handling. The program is a nationally recognized food safety training and certification program, which was established by the National Restaurant Association. Nearly 300 food service industry workers completed the ServSafe® program in 2016 through OSU Extension educators.

Results

A post-program evaluation was distributed to the ServSafe® participants to assess the program effectiveness. Participants indicated their level of agreement with the following statements (percentages represent the amount of individuals who indicated "agree" or "strongly agree" on a 4-point scale): 'I learned new information from this program' (99%); 'I plan to use the information I learned in this program' (100%); 'I am confident I can make changes recommended in this program' (98%); 'I plan to make a change within 1 month.' (96%). The most common types of changes participants indicated were: better / proper cleaning and sanitizing of equipment and work areas), keeping food the correct temperatures for the correct amount of time, better personal hygiene and educating / sharing knowledge with co-workers. Approximately 75% of participants indicated they were willing to "be vocal" about what they learned from ServSafe® programming (sharing information with co-workers). The most common concepts to be shared with co-workers that were indicated included: "everything", sanitizing, cleaning, food storage, personal hygiene, time / temperature, and cross-contamination or food allergens.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #8

1. Outcome Measures

Increased knowledge around the topic of safe food handling, as demonstrated by the mean score on post-tests (out of a possible 10) compared to pre-tests for attendees of the 'Occasional Quantity Cooks' program

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

percentage of food preservation participants who plan to make behavior changes as a result of educational intervention (OSUE)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	70

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A renewed interest in home gardening and purchasing of local foods across Ohio has revived consumer interest in preserving food at home through canning, freezing, and drying. However, there are areas of potential concern related to food safety in preservation and storage processes. There are an estimated 76 million cases of foodborne illnesses causing more than 5,000 deaths annually in the United States (based on 2015 CDC statistics). The USDA and US Extension services have been the recognized authority on home canning recommendations and educational materials for many years.

What has been done

OSU Extension offers Food Preservation curriculum to Ohio citizens, with the aim of teaching participants how to preserve food safely through a variety of methods, following USDA recommended safe food handling procedures. Learning objectives include: rules for good personal hygiene; use sanitary practices for food preparation areas; select and use safe food preparation practices and equipment; recognize the factors that lead to foodborne illness; recognize the impact foodborne illness could have on a quantity food event; how to keep food safe during purchasing and transport; how to safely store leftover food; use a thermometer to check for proper cooking and holding temperatures; use safe thawing methods; and select and use safe food preparation practices / equipment.

Over 250 completed program evaluations were collected for Food Preservation programming in 2016. Results showed that the majority participants were home growers (67%), with farmer's markets (55%) also being a popular source for produce. Community gardens represented 16.3% and "pick your own" farms represented 26% of the locations that were indicated as a place where individuals got their food. The top three reasons participants provided for taking Food Preservation courses were: saving money (57%), controlling ingredients for health (48%) and preserving excess garden harvest (58%).

Results

The evaluation revealed the following food preservation methods being used by participants: freezing (fruits and vegetables) (76%), water bath canning (57%), pressure canning (36%), pickling or drying (both 26%). Learning gains were indicated by individuals on the following points (percentage of individuals experiencing learning gain in parentheses): acidify tomatoes with lemon juice or citric acid (62.9%); use a boiling water bath canner to process high acid foods (48.7%); use a pressure canner to process low acid food (49.1%); use the correct headspace while filling the jars (55.8%); and use current OSUE and USDA canning and freezing recommendations (68.3%). Not only did students learn a lot during 2016 Food Preservation courses, but many also were able to have their home pressure canners inspected by OSUE staff. Following a food preservation course, one student commented: "I am going to can jam / jelly now! Inspired to move beyond freezing, which is all I've ever done before." Another student commented, "Great course, I want to can, but have never done so before for fear of not doing something right and which could make someone sick. I really liked how food safety was addressed." Many other evaluation comments thanked their instructors for a great class, or indicated the students had fun and "learned a lot."

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

712 Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #10

1. Outcome Measures

Ensure a safe and plentiful food supply through research that reduces or eliminates food contaminants (OARDC).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Research shows that ware-washing protocols outlined in the FDA Food Code and NSF Standards may be effective for bacteria, but fall short against harmful Norovirus on tableware utensils. Noroviruses are responsible for 70 percent of all foodborne illnesses today. Currently-used ammonia and chlorine-based sanitizers, however, are not as effective against Norovirus when compared to bacteria. Ohio food regulations also fail to address viral food safety and their removal from tableware, plates or glasses common to every restaurant.

What has been done

A team of CFAES experts partnered with Hobart Corporation, a commercial kitchen equipment manufacturer in Troy, Ohio to investigate electrolyzed water and ozone for the removal of Murine Norovirus, Tulane virus, Salmonella and Listeria bacteria from typical tableware found in restaurants.

Results

Researchers found that electrolyzed water and ozone significantly removed foodborne pathogenic bacteria and surrogate viruses from tableware during manual and mechanical warewashing procedures. These results were passed on to the FDA and Hobart Corporation so that new mechanical washers could be designed to accommodate these new sanitizers. These studies place OARDC at the forefront in developing effective sanitizers for the cleaning of tableware used at restaurants and food service institutions. Research coming out of OSU may lead to a significant revision of the nation's Food Code and has the potential to minimize the risk of patrons getting sick after dining out.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Food Safety is impacted by all sectors of agbioscience: physical, chemical, biological, social, economic, and environmental. Climactic extremes impact food safety by fostering the growth and dispersion of pests and pathogens. Climactic extremes that are now occurring throughout the world impact the quantity and quality of food supplied as well as the timely distribution of food before contamination is an issue.

Economic shifts, such as the cost of processing equipment or production costs, public policy shifts, new regulations, and changes in demand will impact outcomes. Food trends, food advertising agendas, new biological and chemical threats, and public health-related issues are also external factors that affect outcomes. All of these place greater demands on the land-grant system. Factors such as the availability of base funding to ensure a core faculty and staff, availability of extramural funds, and programmatic demands that exceed resources may affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

OSU Extension addressed food safety-related educational needs in a variety of ways in 2016. Education was delivered to farmers, growers, producers, and food industry workers through Good Agricultural Practices (GAP) programming and ServSafe. The general public received education through home preservation educational programming, which teaches safe canning and preserving methods for fruits and vegetables. All programs documented educational gains through pre-post or retrospective assessments.

Key Items of Evaluation

V(A). Planned Program (Summary)**Program # 5****1. Name of the Planned Program**

Global Food Security and Hunger

 Reporting on this Program**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies	0%		38%	
503	Quality Maintenance in Storing and Marketing Food Products	35%		3%	
504	Home and Commercial Food Service	0%		1%	
607	Consumer Economics	15%		0%	
701	Nutrient Composition of Food	0%		14%	
702	Requirements and Function of Nutrients and Other Food Components	0%		11%	
703	Nutrition Education and Behavior	10%		0%	
704	Nutrition and Hunger in the Population	40%		1%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	0%		6%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		26%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	12.0	0.0	4.0	0.0
Actual Paid	9.0	0.0	4.2	0.0
Actual Volunteer	3.6	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
441610	0	641793	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
441610	0	2167032	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

This Planned Program advances broad global food security goals and includes both basic and applied research along with associated outreach and Extension programs. As a result of OSU's Discovery Themes investments, Dr. Casey Hoy, Kellogg Endowed Chair in Agricultural Ecosystems Management in CFAES has continued to contribute to the Resilient, Sustainable and Global Food Security for Health initiative. This initiative aims to improve agroecosystem health, and the associated property of food security, with balance between the cultural/humanities and scientific/technical contributions of OSU faculty, staff and students.

Additional research foci include both traditional and non-traditional plant and animal production systems, microbial studies, food processing and preservation, packaging, food taste tests, and consumer preferences and behavior. Laboratories, pilot plants, farms, and multiple business sites are available throughout the state to permit data gathering and to continue long-term experiments. All functional laboratories and sites are improved over time, as program needs warrant.

OARDC and OSU Extension faculty and staff engage in outreach and consultation with both internal and external stakeholders, across Ohio and nationally.

2. Brief description of the target audience

Targeted audiences for global food security research and extension include, but are not limited to:

- Individuals or groups who have expressed a need for food-related information that resulted from new and ongoing research or is extracted from scientific literature;
- Academic units that collaborate with food scientists to create systems and processes needed to support research and the adoption of the research findings by stakeholders;
- Federal, state or local agencies or support organizations that will not only use the information, but will also be brokers of that information, including embedding it into groups to encourage change;
- Populations who have not requested the information but will likely benefit from access, e.g. persons who engage in home canning of food;
- Youth who plan to exhibit and sell livestock into the food system;
- Operators of animal product farm operations
- Other scientists and scientific groups;
- Political entities;
- Other Extension personnel;
- Students from pre-school to post-doctorate studies;
- News organizations;

- Business and industrial groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	31465	0	15150	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	35	35

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- total number of participants attending educational programs of one teaching hour or more (OSUE)
 Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Total number of workshops offered to producers and agribusiness leaders on topics related to global food security and hunger (OSUE)

Year Actual

2016 685

Output #3

Output Measure

- Total number of volunteers (committee members, teachers/trainers, unpaid staff, etc.) in the planning and implementation of events related to global food security and hunger (OSUE)

Year	Actual
2016	1957

Output #4

Output Measure

- number of community gardens associated with local and community food systems programming and demonstrations (OSUE)
Not reporting on this Output for this Annual Report

Output #5

Output Measure

- number of participants in community gardening efforts associated with local and community food systems programming and demonstrations (OSUE)
Not reporting on this Output for this Annual Report

Output #6

Output Measure

- number of volunteer hours associated with community gardens and local community food systems programming (OSUE)
Not reporting on this Output for this Annual Report

Output #7

Output Measure

- percentage of total program participants that are considered to be under-represented (OSUE)

Year	Actual
2016	8386

Output #8

Output Measure

- percentage of total program participants that are considered to be under-served (OSUE)

Year	Actual
2016	7654

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Advance processing techniques, e.g. electrostatic coating, to achieve the desired traits requested by industrial partners, that are manifested in consumer demand studies, or that are novel technologies that may meet latent needs.
2	Processing technology research will improve and optimize equipment and processing of food in such manner as meet consumer demand as or before that demand emerges.
3	Advance and document improvements in quality and quantity of food stocks to meet global food security and hunger goals.
4	Number of new local / regional food systems (community gardens, farmers markets, food banks) established following an OSUE educational program or guidance by an OSUE professional or volunteer (OSUE)
5	Number of schools purchasing Ohio produced food as part of the Ohio Farm to School program (OSUE)
6	Participate in the creation of a standardized model and protocols for studying functional foods for the purpose of providing consumers with more informed functional choices that are currently available (OARDC).
7	Number of producers becoming certified following 'Fertilizer Applicator Certification' training (OSUE)
8	percentage of participants who intend to start a new food-based business or enterprise as a result of educational events (OSUE)
9	percentage of individuals who indicated they would spend at least \$10 on local foods during an awareness week (OSUE)

Outcome #1

1. Outcome Measures

Advance processing techniques, e.g. electrostatic coating, to achieve the desired traits requested by industrial partners, that are manifested in consumer demand studies, or that are novel technologies that may meet latent needs.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The food and beverage industry faces unprecedented regulation as consumers and governments worldwide demand high levels of food quality and safety with "farm to fork" and "boat to plate" traceability. Quality managers need better real-time monitoring tools to proactively reduce risks, improve product consistency and reduce costs. The average total cost of a recall to a food company is approximately \$10 million, in addition to brand damage and lost sales. Thus, there is a critical need for sensor technology that would allow industry personnel to rapidly assess food quality to avoid economic losses and adverse human health impacts.

What has been done

For the last 16 years, OARDC food scientists have been examining the use of infrared technology to determine the quality of food products. Within the last four years, portable scanners have emerged on the market, giving researchers an opportunity to adapt this new tool for the needs of the food industry. The portable scanners are able to make real-time assessments of the quality of the product, and make tweaks to the processing immediately, instead of waiting several hours or days for laboratory results. OARDC is one of the first to obtain these instruments for applications in the food industry. Researchers developed the algorithms for the scanners to use in detecting different aspects of the food items such as consistency, texture and flavor.

Results

Researchers worked with the California League of Food Processors to test tomato juice and tomato paste, evaluating 12 different attributes in less than a minute with the new technology. Food quality tests that traditionally take hours--or days--to perform in the laboratory now can be completed in just minutes, without the need to even step away from the production line. Such testing is required to ensure the safety and quality of the tomato juice, much of which goes on for further processing into tomato paste and other products. Several companies have already

adopted this technology in their factories, including Mars and Heinz, as a result of this research.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies

Outcome #2

1. Outcome Measures

Processing technology research will improve and optimize equipment and processing of food in such manner as meet consumer demand as or before that demand emerges.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Advance and document improvements in quality and quantity of food stocks to meet global food security and hunger goals.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of new local / regional food systems (community gardens, farmers markets, food banks) established following an OSUE educational program or guidance by an OSUE professional or volunteer (OSUE)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Hocking County, Ohio is deficient in food producers, and has widespread food insecurity, with 1 in 6 residents being food insecure; this increases to 1 in 4 when discussing children only. The county educator recognized the need for programming to help residents grow healthy and inexpensive food for themselves and their families. OSU Extension hopes to have successes with Hocking County, and expand and replicate this program to other Ohio counties in the Appalachian region, which also experience food insecurity.

What has been done

The Urban Farm at Southeast Ohio Regional Kitchen was created to be a food production garden, and was certified by the State of Ohio as a farm, and entered into food sales in late October 2016. The farm was started on unused land, with the goal of growing food for Hocking County residents, beginning with seniors. The Urban Farm is located at the Southeast Ohio Regional Kitchen, which is part of the Southeast Ohio Regional Food Bank. This food bank is the distribution hub for the surrounding counties of Athens, Meigs, Morgan, Perry, and Washington. Food grown at the Urban Farm will be sold to seniors, who will be able to redeem their federal Senior Farmer's Market vouchers for fresh, healthy produce.

The Urban Farm is being developed in phases. So far, a perennial herb garden, and six raised beds have been started for vegetable gardens. In 2018, the Urban Farm hopes to add more raised beds, and a hoop house / high tunnel for seed propagation and season extension.

Additionally, two garden walks were held at community gardens and Extension helped Hocking citizens create three new gardens in Hocking County.

Results

Fall 2016 yielded fresh herbs: rosemary, thyme, sage, and oregano. The Urban Farm was able to obtain some fresh fruit from the Chesterhill produce auction, so boxes of fruit and herbs were sold to Hocking County residents for \$5 / box, which included recipes which would make use of the items received. Twenty six produce lots were sold, with 12 going to seniors using vouchers, and 14 going to private cash sales.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
607	Consumer Economics
704	Nutrition and Hunger in the Population
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #5

1. Outcome Measures

Number of schools purchasing Ohio produced food as part of the Ohio Farm to School program (OSUE)

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Participate in the creation of a standardized model and protocols for studying functional foods for the purpose of providing consumers with more informed functional choices that are currently available (OARDC).

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Number of producers becoming certified following 'Fertilizer Applicator Certification' training (OSUE)

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

percentage of participants who intend to start a new food-based business or enterprise as a result of educational events (OSUE)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	45

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

OSU Extension recognized a need in several urban centers for urban dwellers to get into the food and crop production industry. The overall goal is to provide these individuals with a basic understanding of how to create or expand agriculture-related business opportunities. The program also focuses on economic development, food insecurity, and environmental and community redevelopment in urban areas.

What has been done

OSUE is working to train new urban farmers. To date, the new Ohio Master Urban Farmer program has trained over 180 people in the Toledo and Columbus areas to become food and crop producers within city limits. The program teaches participants how to produce and market food in urban areas. Participants learn how to choose a farm enterprise, how to select a site, and how to soil-test for urban food production.

Results

Program graduates receive free assistance to help secure the land, tools, seeds, and other resources needed to start or expand a successful growing venture. The program is working: 45% of participants say they plan to start a new food-based business or enterprise; 21% plan to increase their family's income based on what they've learned. Further, 84% say they plan to produce safe, high-quality foods. And in two years, the number of urban farms within Columbus has grown from five to 15. The program will be expanding in the future to include Dayton and Youngstown, and a similar program is already being offered in Cleveland.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
607	Consumer Economics
702	Requirements and Function of Nutrients and Other Food Components
704	Nutrition and Hunger in the Population

Outcome #9

1. Outcome Measures

percentage of individuals who indicated they would spend at least \$10 on local foods during an awareness week (OSUE)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	88

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Food and agriculture is Ohio's top industry, contributing \$79 billion to the state's annual economy. A 2010 study found that consumers who value high-quality foods produced with low environmental impact are willing to pay more. Locally produced food fits this bill -- fresh, healthy,

locally grown produce that hasn't had to travel far (lower carbon emissions) accounts for about \$43 billion in sales each year in Ohio. OSU Extension's Local Foods program helps raise awareness of Ohio's local foods in an effort to maintain and grow the local food economy in Ohio.

What has been done

The following types of events and activities were conducted across the state in 2016 to raise awareness for Ohio local foods: webinars, lectures, demonstrations, face-to-face instruction, field days, farm tours, the maintenance of an Ohio Local Foods Week Facebook page, and Ohio Local Foods week events and challenges. In total, nearly 350 Local Foods-related events were held in 2016, reaching approximately 13,650 individuals. Nearly 11,000 handouts were distributed. Of the 88 Ohio counties, approximately 45% participated in Ohio Local Foods week events and challenges.

Results

Not all participants in Local Food events were surveyed / asked to evaluate the programming. However, of those surveyed (1,031), 65% indicated they learned new information and 78% indicated positive intentions for making behavior changes. During Local Foods week in Ohio, an online challenge was hosted through the Local Foods Facebook page. Of those that joined the challenge, 88% agreed to spend at least \$10 during the awareness week on local foods.

4. Associated Knowledge Areas

KA Code	Knowledge Area
607	Consumer Economics
703	Nutrition Education and Behavior

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Research and extension programs are dramatically improving strategies for feeding the world. However, there are major limitations that affect outcomes including the cost of supply, distribution, and storage of food--both raw and processed. Climatic extremes may also impact growth and supply. Additionally, economic shifts such as the cost of processing equipment or production costs, public policy shifts, regulations, and shifts in demand are also affecting outcomes.

In developing countries, technologies, availability of basics such as seeds or livestock, soil and water for farming, labor, and a secure farming environment are limiting factors. While each of the limiting factors also presents an opportunity for research and extension

programming, the availability of base funding to ensure a core faculty and staff, availability of extramural funds, and programmatic demands that exceed resources may affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Local Foods programming reached approximately 13,650 individuals in 2016. Nearly half the counties in Ohio participated in Local Foods-related events. Of those surveyed, 65% indicated they learned new information; 78% indicated positive intentions for making behavior changes.

45% of Urban Master Gardener participants say they plan to start a new food-based business or enterprise, and 84% say they plan to produce safe, high-quality foods for personal use. In just two years, the number of urban farms within Columbus, Ohio has grown from five to 15.

In Hocking County, Ohio, a new urban farm has been created, which will serve area residents, who suffer from food insecurity. The senior demographic in the area is being specifically targeted as recipients of the garden's bounty; they are able to use Senior Farmer's Market Vouchers at the new Hocking urban garden.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Soil, Air and Water (OARDC Led)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	0%		23%	
102	Soil, Plant, Water, Nutrient Relationships	0%		62%	
111	Conservation and Efficient Use of Water	0%		6%	
112	Watershed Protection and Management	0%		1%	
133	Pollution Prevention and Mitigation	0%		8%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.0	0.0
Actual Paid	0.0	0.0	4.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	587129	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1742480	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Ongoing OARDC research activities in this program area encompass a full range of basic and applied agbioscience. Both laboratory and multiple field sites/research stations are available throughout the state to permit data gathering and to continue long-term experiments, such as the Triplett-Van Doren no-till plots established in 1962. On-farm research takes place, including current studies to evaluate the effect of field-scale management practices on phosphorus loss to surface runoff and tile drainage in the Western Lake Erie Basin. National and international studies are also conducted through programs such as OARDC's Carbon Management and Sequestration Center. All functional laboratories and sites controlled by OARDC will continue to be improved over time as program needs and resources warrant. OARDC faculty and staff engage in appropriate levels of outreach and consultation with both internal and external stakeholders.

2. Brief description of the target audience

OARDC's targeted audiences for this Planned Program include, but are not limited to:

- Individuals or groups who have expressed a need for certain information that resulted from new or ongoing research, or is extracted from the scientific literature. Often these requests are communicated to OARDC by an intermediary such as a staffer at the Ohio Department of Agriculture or a county Extension agent;
- Federal, state or local agencies or support organizations that will not only use the information but will also be brokers of that information, including embedding it into groups to encourage change;
- Populations who have not requested the information but will likely benefit from access, e.g. home gardeners;
- Other scientists and scientific groups;
- Political entities;
- Extension personnel;
- Students from pre-school to post-doctorate studies;
- News organizations;
- Business groups such as chambers of commerce and community coalitions.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	22	22

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of graduate students completed
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Expand watershed and ecosystem level modeling to the extent that scientific data and watershed management protocols can bring all streams effected by agriculture and natural resource runoff into compliance with Ohio EPA standards.
2	Through the provisioning of watershed specific data, support the creation of and conservation action of community-based watershed networks in each major watershed in Ohio.
3	Advance the basic knowledge contribution so that Ohio continues to be viewed as a center of excellence in terms of soils and water sciences, and associated extension programming.
4	Provide the necessary soil, air, weather/climate, and water research, in conjunction with actions in other planned programs KA (e.g. IPM), to permit continued adoption of conservation tillage practices in the face of problems such as climatic changes, pest, etc.
5	Provide the necessary research finding (scientific knowledge and techniques) to support stakeholder compliance with Ohio and federal EPA regulations, and future regulations, regarding odors and other air quality issues in ag production and processing.
6	Through the provisioning of watershed specific data, support the creation of and conservation action of community-based watershed networks that collaborate to improve water quality in Ohio.

Outcome #1

1. Outcome Measures

Expand watershed and ecosystem level modeling to the extent that scientific data and watershed management protocols can bring all streams effected by agriculture and natural resource runoff into compliance with Ohio EPA standards.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Through the provisioning of watershed specific data, support the creation of and conservation action of community-based watershed networks in each major watershed in Ohio.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Advance the basic knowledge contribution so that Ohio continues to be viewed as a center of excellence in terms of soils and water sciences, and associated extension programming.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Provide the necessary soil, air, weather/climate, and water research, in conjunction with actions in other planned programs KA (e.g. IPM), to permit continued adoption of conservation tillage practices in the face of problems such as climatic changes, pest, etc.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Provide the necessary research finding (scientific knowledge and techniques) to support stakeholder compliance with Ohio and federal EPA regulations, and future regulations, regarding odors and other air quality issues in ag production and processing.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Through the provisioning of watershed specific data, support the creation of and conservation action of community-based watershed networks that collaborate to improve water quality in Ohio.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Harmful algal blooms are a growing health and environmental concern, not just in Ohio, but also around the world, partly because some of the blooms produce toxic microcystin. Unsafe microcystin levels in western Lake Erie, for instance, were responsible for the two-day shutdown of Toledo's drinking water supply in 2014. Consequently, there is a great need to develop a cost-effective, rapid, and sensitive method to detect microcystin.

What has been done

A new test developed by OARDC-funded scientists detects microcystin in water samples quickly and at a low cost.

Results

Based on technology called enzyme-linked immunosorbent assay, or ELISA, the new test is simple to use, fast--less than three hours from preparing the test kit to detection--and more than 10 times cheaper than the current ELISA test--less than \$1 per sample instead of \$10. The diagnostic test is also effective on a wide variety of samples, from drinking water sources to municipal water treatment plants and more. An end result will be better protection of people's health, including the 3 million Ohioans (and 11 million people total) who rely on Lake Erie for their drinking water.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (extramural funding)

Brief Explanation

Climatic extremes, coupled with the introduction of pests and diseases that are often climate related, can impact outcomes. As the soil-dependent food, fiber, and environmental economies adjust to the global marketplace, outcomes are impacted in conjunction with public policy shifts, new regulations, and shifts in demand. The availability of productive soils is a limiting factor worldwide. In addition, the availability of base funding to ensure a core faculty and staff, availability of extramural funds, and programmatic demands that exceed available personnel and resources can affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For 2016, CFAES-OARDC has conducted no formal studies regarding evaluation of our research program. Surrogate evaluation metrics that are considered indicators of research success are:

- Research contracts and awards received/ongoing/completed (\$180 million plus in active projects during 2016);
- Number of referred publications reported elsewhere in this report;
- Number of businesses, industries and groups engaged in CFAES' research programs;
- Number of patents received;
- Economic impact of the college's research program as reported elsewhere in this report;
- The level of base funding from USDA-NIFA and the State of Ohio in 2016;
- Impacts submitted in this report, and the continued robustness of CFAES' research program throughout 2016, both in terms of breadth of programs and depth of new knowledge generated and applied.

The research reported herein is also supported by an informal yet effective formative evaluation. Very little research is conducted at OARDC without early engagement of businesses, industries, commodity groups, special interest groups, or other interested parties. These are the individuals who have the need for and will be the adopters of our research output/impacts. Even in the case of very theoretical research, fellow researchers in industry, government, and academic institutions are consulted (formative evaluation/needs

assessment) in the formulation of studies.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Natural Resources and Environmental Systems (OARDC Led)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
134	Outdoor Recreation	0%		22%	
136	Conservation of Biological Diversity	0%		78%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.5	0.0
Actual Paid	0.0	0.0	0.7	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	64177	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	256060	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The natural resources and environmental systems program includes both basic and applied research. Both laboratories and multiple field sites are available throughout the state to permit data gathering and to

continue long-term experiments, such as human-wildlife interaction studies. Extensive, in-state research takes place, as do national and international studies, such as those conducted through OARDC's Terrestrial Wildlife Ecology Program. Close working relationships with organizations such as the Ohio Department of Natural Resources and the USDA will continue to greatly enhance program capacity and impacts. For example, cooperative studies have identified small numbers of native ash trees that are resistant to the invasive emerald ash borer, and these trees are now being evaluated as a source of native germplasm for use in breeding programs. All functional laboratories and sites are improved over time as program needs and available resources warrant. OARDC faculty and staff engage in appropriate levels of outreach and consultation with both internal and external stakeholders.

2. Brief description of the target audience

OARDC's targeted audiences for this program include, but are not limited to:

- Individuals or groups who have expressed a need for natural resources and environmental research knowledge that resulted from new or ongoing research, or is extracted from the scientific literature. Often these requests are communicated to OARDC by an intermediary such as a staffer at USDA, the Ohio Department of Natural Resources, or a county Extension agent;
- Related agencies or support organizations who will not only use the information but will also be brokers of that information, including embedding it into groups to encourage change, e.g. fish and wildlife clubs;
- Populations who have not requested the information but will likely benefit from access; e.g. people who fish for recreation;
- Other scientists and scientific groups;
- Political entities;
- Extension personnel;
- Students from pre-school to post-doctorate studies;
- News organizations;
- Business groups such as Ohio Farm Bureau;
- Community groups such as watershed collations.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	29	29

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of graduate students completed
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increase the scientific understanding necessary to maintain flow of environmental goods and services through conservation actions commensurate with regional demand, i.e. Buffer zones in forest riparian zones, reforestation, CREP, carbon sequestration in forests and grassland biomass, outdoor recreation opportunities, urban forest zones.
2	Advance research knowledge, both basic and applied, in the areas of silviculture and horticulture to existing and emerging industry and consumer demand regarding forest genetics, forest biology, seed production, nutrition, and related topics.
3	Meet ODNR, USDA, USDI, local, commodity groups, community, and other stakeholder demands for scientific knowledge to inform existing and emerging issues/practices in aquatic and terrestrial wildlife including human wildlife use/conflicts, and human to human conflicts related to wildlife and use.
4	To contribute to the theoretical knowledge base within this planned program to ensure that where possible all applied research can be grounded in the best science and evaluation available in all knowledge areas selected.
5	Improve the biodiversity and utilization of land use in rural and urban environments.
6	Strive to protect the biological diversity in native ecosystems through the elimination or control of invasive species.

Outcome #1

1. Outcome Measures

Increase the scientific understanding necessary to maintain flow of environmental goods and services through conservation actions commensurate with regional demand, i.e. Buffer zones in forest riparian zones, reforestation, CREP, carbon sequestration in forests and grassland biomass, outdoor recreation opportunities, urban forest zones.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Advance research knowledge, both basic and applied, in the areas of silviculture and horticulture to existing and emerging industry and consumer demand regarding forest genetics, forest biology, seed production, nutrition, and related topics.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Meet ODNR, USDA, USDI, local, commodity groups, community, and other stakeholder demands for scientific knowledge to inform existing and emerging issues/practices in aquatic and terrestrial wildlife including human wildlife use/conflicts, and human to human conflicts related to wildlife and use.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

To contribute to the theoretical knowledge base within this planned program to ensure that where possible all applied research can be grounded in the best science and evaluation available in all knowledge areas selected.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Improve the biodiversity and utilization of land use in rural and urban environments.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Strive to protect the biological diversity in native ecosystems through the elimination or control of invasive species.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Invasive species--species that quickly invade and outcompete native species--have a dramatic effect on natural resource availability, human health and economy. The National Wildlife Federation estimates that invasive species cause billions of dollars in economic losses to ecosystems and the U.S. economy each year. In Ohio, common invaders include the Asian carp, emerald ash borer, round goby fish, Palmer amaranth, and zebra and quagga mussels. Invasive species reduce ecosystem diversity, which can impact recreational activity in the state. A study by the U.S. Fish and Wildlife Service says wildlife-related recreation has an economic impact on Ohio's economy of \$3.6 billion. Additionally, in northwestern Ohio alone, bird-watching generates more than \$26 million a year in economic activity.

What has been done

OARDC scientists recently studied a previously unreported aspect of such invasions: How do non-native species, such as the round goby, affect the native fish and the wildlife that eat them, such as Lake Erie watersnakes or smallmouth bass? After reviewing more than 100 studies on predator-prey interactions, the scientists found that predator populations rose by as much as 57 percent after an invasion of new prey--but only when the predators' traditional native prey remained abundant, too.

Results

According to OARDC scientists, eating non-native prey is less beneficial for predators than eating native prey. This might be because the new prey is not as nutritious or the predator might not have evolved the ability to eat or digest it well. In all of the studies, whenever a predator's diet was restricted to non-native prey, the predator did not perform as well as it did on a diet of native prey.

These findings will help environmental agencies identify where invasive species will have the

greatest impact. One result will be better targeted, more cost-effective efforts to control the invaders, support native species, and protect habitat.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Changes in public policies, new regulations and laws, and shifts in demand continue to impact outcomes. Climatic variations, coupled with pests and diseases that are often climate related, are also impacting outcomes. Exotic invasive species, such as the Emerald Ash Borer, represent significant external factors, especially in terms of forest ecosystem management. Factors such as the availability of state and federal base funding to ensure a core faculty and staff, availability of extramural funds, and programmatic demands that are exceeding resources can affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For 2016, CFAES-OARDC has conducted no formal studies regarding evaluation of our research program. Surrogate evaluation metrics that are considered indicators of research success are:

- Research contracts and awards received/ongoing/completed (\$180 million plus in active projects during 2016);
- Number of referred publications reported elsewhere in this report;
- Number of businesses, industries and groups engaged in CFAES' research programs;
- Number of patents received;
- Economic impact of the college's research program as reported elsewhere in this report;
- The level of base funding from USDA-NIFA and the State of Ohio in 2016;
- Impacts submitted in this report, and the continued robustness of CFAES' research program throughout 2016, both in terms of breadth of programs and depth of new knowledge generated and applied.

The research reported herein is also supported by an informal yet effective formative evaluation. Very little research is conducted at OARDC without early engagement of businesses, industries, commodity groups, special interest groups, or other interested parties. These are the individuals who have the need for and will be the adopters of our research output/impacts. Even in the case of very theoretical research, fellow researchers in industry, government, and academic institutions are consulted (formative evaluation/needs assessment) in the formulation of studies.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Plants Systems (OARDC Led)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		21%	
202	Plant Genetic Resources	0%		10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		8%	
204	Plant Product Quality and Utility (Preharvest)	0%		2%	
205	Plant Management Systems	0%		14%	
206	Basic Plant Biology	0%		2%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		4%	
212	Pathogens and Nematodes Affecting Plants	0%		18%	
213	Weeds Affecting Plants	0%		4%	
216	Integrated Pest Management Systems	0%		15%	
512	Quality Maintenance in Storing and Marketing Non-Food Products	0%		2%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	22.5	0.0
Actual Paid	0.0	0.0	20.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	2662489	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	8649611	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The goals of OARDC's ongoing research activities to advance plant systems goals include both basic and applied research. Both laboratory and multiple field sites/research stations are available throughout Ohio to permit data gathering and to continue long-term experiments, such as commodity yield trials and public breeding programs. Computational science and information technology are being used in a complementary fashion to improve our ability to analyze and utilize giant sets of molecular and genomic data. Bioemergent materials research is focused on the discovery, manipulation, and utilization of unique crops as alternatives to synthetic materials.

OARDC's efforts to develop and commercialize domestic, alternative rubber sources from dandelions will continue. With significant private investment from Bridgestone Corporation, Goodyear Tires and Ford Motor Company, research currently focuses on producing a crop that reaches production standards.

On-farm research takes place, as do national and international studies. All functional laboratories and field sites are improved over time as program needs and available resources warrant. OARDC faculty and staff engage in appropriate levels of outreach and consultation with both internal colleagues, such as fellow Extension personnel, and with external stakeholders.

2. Brief description of the target audience

Audiences targeted by OARDC include, but are not limited to:

- Individuals or groups who have expressed a need for plant systems information that resulted from new or ongoing research, or is extracted from the scientific literature. Often, these requests are communicated to OARDC by an intermediary such as a staffer at a USDA office, the Ohio Department of Agriculture, or a county Extension agent;
 - Federal, state or local agencies or support organizations who will not only use the information but will also be brokers of that information, including embedding it into groups to encourage change;
 - Populations who have not requested the information but will likely benefit from access, e.g. home gardeners;
 - Other scientists and scientific groups;
 - Political entities;
 - Extension personnel;
 - Students from pre-school to post-doctorate studies;
 - News organizations.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 9

Patents listed

1. Low Inoculum, Long Co-Culture Agrobacterium-Mediated Transformation of Plants
2. Novel Antimicrobials to Control Campylobacter
3. Use of Sesquiterpens and their Analogs as Green Insecticides for Controlling Disease Vectors and Plant Pests
4. Modulators of Clavibacter Michiganensis and Methods of Making and Using Thereof
5. System for Delivery of Microbial Inoculants and Related Materials and Methods
6. Methods for Using Cryptococcus Flavescens Strains for Biological Control of Fusarium Head Blight (New Zealand)
7. Methods for Using Cryptococcus Flavescens Strains for Biological Control of Fusarium Head Blight (Mexico)
8. Methods for Using Cryptococcus Flavescens Strains for Biological Control of Fusarium Head Blight (Europe)
9. Methods for Using Cryptococcus Flavescens Strains for Biological Control of Fusarium Head Blight (Canada)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	100	100

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of graduate students completed
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Meet or exceed the demand of fellow scientists and stakeholders within the next ten years for materials relating to plant genetics and plant breeding technologies, including identification of molecular markers for elite germplasms.
2	Enrich the gene pool and knowledge thereof in disease/pest resistance, and gene recombination and interaction studies
3	Enrich the gene pool and knowledge thereof in the areas of molecular studies to better understand how immune systems in plants inhibit diseases and how bacteria perturb the immune system.

Outcome #1

1. Outcome Measures

Meet or exceed the demand of fellow scientists and stakeholders within the next ten years for materials relating to plant genetics and plant breeding technologies, including identification of molecular markers for elite germplasms.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There have been no winter barley varieties adapted to the Midwestern U.S. that meet the quality standards of the American Malting Barley Association (AMBA). The AMBA-approved varieties suffered complete winter-kill in the cold of 2013-2014. Plant breeders have been screening barley to identify winter-hardy malting types. Such an endeavor is a 10-year undertaking, and once a variety is identified, even increasing quantities of pure seed to levels required for commercial production is an endeavor requiring five years. Yet within four years, 100,000 acres of Ohio-grown malting barley will be required to meet demand. Presently, Ohio barley acreage is 6,000, all of which is used as feed for animals.

What has been done

A barley breeding program at OARDC is developing high-yielding, high malting quality varieties adapted to Ohio. The first selections were made in 2010, 28 of which are being grown and tested across Ohio. The best lines will be released in 2018 for commercial production. Promising lines from other breeding programs were first identified in 2012-2013. One of these is currently in commercial production across Ohio. A second and more promising line will be in commercial production this year.

Results

Developing malting barley adapted to Ohio will transform local economies at multiple levels. The Ohio beer sector contributes \$4.5 billion annually to the Ohio economy and all agricultural raw materials are imported from out of state, much of which is even imported from outside the country. Ohio-grown winter malting barley varieties will reroute the economic factors associated with cultivation and processing of raw materials, and strengthen the local economy. This builds on an established infrastructure that ensures a quality product from seed source to end user. Following harvest, barley seed is transformed into malt through germination and kilning by the maltster, who

then sells their product to food and beverage industries. Large-scale malting facilities allow for the employment of hundreds of support personnel. Similarly, breweries can range in size from mega-breweries that create employment for hundreds of support personnel, to small microbreweries that operate as family-run businesses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)

Outcome #2

1. Outcome Measures

Enrich the gene pool and knowledge thereof in disease/pest resistance, and gene recombination and interaction studies

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Enrich the gene pool and knowledge thereof in the areas of molecular studies to better understand how immune systems in plants inhibit diseases and how bacteria perturb the immune system.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Pests, pathogens, weeds, and climate change, among other factors, can impact outcomes within plant systems. As the food, fiber, and environmental related economies adjust to the global marketplace in conjunction with public policy changes, new regulations, and shifts in demand, outcomes will be impacted. Production agriculture is highly sensitive to these shifts. Research that is conducted well before its outcomes are needed may be critical to reduce future crop failures. Formative evaluations to identify opportunities and problems can yield returns throughout the life of a program. Factors such as the availability of base funding to ensure a core faculty and staff, the availability of extramural funds, and

programmatic demands exceeding resources can affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For 2016, CFAES-OARDC has conducted no formal studies regarding evaluation of our research program. Surrogate evaluation metrics that are considered indicators of research success are:

- Research contracts and awards received/ongoing/completed (\$180 million plus in active projects during 2016);
- Number of referred publications reported elsewhere in this report;
- Number of businesses, industries and groups engaged in CFAES' research programs;
- Number of patents received;
- Economic impact of the college's research program as reported elsewhere in this report;
- The level of base funding from USDA-NIFA and the State of Ohio in 2016;
- Impacts submitted in this report, and the continued robustness of CFAES' research program throughout 2016, both in terms of breadth of programs and depth of new knowledge generated and applied.

The research reported herein is also supported by an informal yet effective formative evaluation. Very little research is conducted at OARDC without early engagement of businesses, industries, commodity groups, special interest groups, or other interested parties. These are the individuals who have the need for and will be the adopters of our research output/impacts. Even in the case of very theoretical research, fellow researchers in industry, government, and academic institutions are consulted (formative evaluation/needs assessment) in the formulation of studies.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Animals Systems (OARDC Led)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
302	Nutrient Utilization in Animals	0%		17%	
303	Genetic Improvement of Animals	0%		1%	
304	Animal Genome	0%		1%	
305	Animal Physiological Processes	0%		25%	
307	Animal Management Systems	0%		5%	
308	Improved Animal Products (Before Harvest)	0%		3%	
311	Animal Diseases	0%		44%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	0%		4%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	9.5	0.0
Actual Paid	0.0	0.0	9.3	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	1319116	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	3156101	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

OARDC researchers seek to advance global food security by integrating animal agriculture into food production systems. Both basic and applied agbioscience research is conducted throughout Ohio to permit data gathering and to continue long-term experiments, such as fish genetic improvement research in the aquaculture facilities at South Centers in Piketon, OH. Ohio on-farm research is conducted as part of this program as are national and international studies. Effective research requires a mixture of laboratory and on-farm research to maximize knowledge. Emerging disease threats now require more advanced facilities, such as OARDC's bio-security lab, which is particularly useful for studies of infectious animal diseases, such as the recent outbreak of avian flu that has seriously impacted the nation's poultry industry. OARDC's biosecurity lab has been fully functional throughout this planning period. All functional laboratories and sites are improved over time, as program needs and available resources warrant. OARDC faculty and staff engage in appropriate levels of outreach and consultation with both internal and external stakeholders.

2. Brief description of the target audience

OARDC's targeted audiences include, but are not limited to:

- Individuals or groups who have expressed a need for food animal systems information that resulted from new and ongoing research, or extracted from the scientific literature. Often, these requests are communicated to OARDC by an intermediary such as a staffer at a USDA office, the Ohio Department of Agriculture, or a county Extension agent;
- Federal, state or local agencies or support organizations who will not only use the information but will also be brokers of that information, including embedding it into groups to encourage change;
- Populations who have not requested the information but will likely benefit from access, e.g. small or recreational farmers;
- Other scientists and scientific groups;
- Political entities;
- Extension personnel;
- Students from pre-school to post-doctorate studies;
- News organizations;
- Business groups such as the Ohio Farm Bureau or commodity groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 2

Patents listed

1. Nanoparticle Based Vaccine Strategy Against Swine Influenza Virus
2. Metapneumovirus Immunogens and Related Materials and Methods

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	47	47

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of graduate students completed
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Improve reproduction efficiency and enhanced application of new technologies over the next five years to fully meet the competitive demands faced by OARDC's stakeholders in areas such as early maturation, estrus, fertility, and ovulation
2	Increase dietary research and nutrition utilization for the purpose of increased growth and quality of products commensurate with consumer demand.
3	Meet the demand of fellow scientists and stakeholders within ten years for materials relating to genetics and breeding, including id of molecular markers for improved animal health and reproductively, and increased quality and quantity of products
4	Improve management for multiple animal farm types, including organics, that will produce higher yields for and lower costs to the producer and consumer
5	Animal disease researchers will provide the necessary research to inform producers in a timely manner how to protect against known and present diseases, e.g. bovine mastitis
6	Animal disease researchers will advance the research frontiers in emerging disease investigations to the extent that OARDC continues to serve as a center for excellence.
7	Meet the demand of fellow scientists and stakeholders within ten years for materials relating to genetics and breeding, including identification of molecular markers for improved animal health and reproductive efficiency, and increased quality and quantity of animal products.

Outcome #1

1. Outcome Measures

Improve reproduction efficiency and enhanced application of new technologies over the next five years to fully meet the competitive demands faced by OARDC's stakeholders in areas such as early maturation, estrus, fertility, and ovulation

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Increase dietary research and nutrition utilization for the purpose of increased growth and quality of products commensurate with consumer demand.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Meet the demand of fellow scientists and stakeholders within ten years for materials relating to genetics and breeding, including id of molecular markers for improved animal health and reproductively, and increased quality and quantity of products

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Improve management for multiple animal farm types, including organics, that will produce higher yields for and lower costs to the producer and consumer

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Animal disease researchers will provide the necessary research to inform producers in a timely manner how to protect against known and present diseases, e.g. bovine mastitis

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Animal disease researchers will advance the research frontiers in emerging disease investigations to the extent that OARDC continues to serve as a center for excellence.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Meet the demand of fellow scientists and stakeholders within ten years for materials relating to genetics and breeding, including identification of molecular markers for improved animal health and reproductive efficiency, and increased quality and quantity of animal products.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Today, commercial pigs grow faster on less feed and produce leaner carcasses than before. Yet, these improvements in growth oftentimes result in a decrease to meat quality. Currently, the meat processing industry utilizes a number of pork enhancement strategies. However, these enhancements may change the quality (i.e. taste, texture) of the final product and do not allow for all-natural labeling claims. With the increasing demand of global and domestic consumers for naturally tender, juicy, all-natural pork, new strategies to improve pork quality are necessary. In order to overcome this quality versus quantity conundrum, investigating breeds of pigs known to produce naturally juicy and tender meat is necessary.

What has been done

Of all breeds of pigs, Berkshire pigs are widely considered as the superior breed for producing high quality meat. Unfortunately, raising Berkshire pigs to supply the export market is not a feasible solution due to their small litter sizes. OARDC researchers, however, are focusing on understanding the underlying genetic and biochemical mechanisms controlling the formation of their superior meat quality. The researchers hypothesize that the improved meat quality is caused by a naturally occurring genetic mutation that results in a single amino acid change in one

regulatory protein. If the hypothesized genetic mutation is responsible, researchers will be able to quickly provide genetic selection criteria to incorporate the mutation into commercial herds.

Results

Global pork consumption is around 88 pounds per person per year, and that number is expected to increase by 25% in the next decade. Compared to all states in the U.S., Ohio regularly ranks in the top 10 for pork production. The Ohio pork industry generates \$542.7 million in revenue and provides more than 8,700 jobs. Furthermore, Ohio exports \$71 million in pork, which results in approximately 1,700 export jobs. OARDC research intends to improve pork quality in order to meet the changing domestic and global market demands. By doing so, the research will strengthen the position of the Ohio pork market and provide stability of this important commodity in the food industry.

4. Associated Knowledge Areas

KA Code	Knowledge Area
308	Improved Animal Products (Before Harvest)

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Animal diseases coupled with abnormal weather patterns often impact outcomes. Public policy shifts, new regulations, and shifts in demand for animal products continue to impact outcomes. Human values and environmental sensitivities of the population to animal production and processing are also external factors that influence results. Formative evaluations relating to animal care norms and protocols can be effective in informing the process; however, uncertainty is a constant factor in the animal industry. Factors such as the availability of base funding to ensure a core research faculty and staff, availability of extramural research funds, and programmatic demands that exceed resources can affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For 2016, CFAES-OARDC has conducted no formal studies regarding evaluation of our research program. Surrogate evaluation metrics that are considered indicators of research success are:

- Research contracts and awards received/ongoing/completed (\$180 million plus in

active projects during 2016);

- Number of referred publications reported elsewhere in this report;
- Number of businesses, industries and groups engaged in CFAES' research programs;
- Number of patents received;
- Economic impact of the college's research program as reported elsewhere in this report;
- The level of base funding from USDA-NIFA and the State of Ohio in 2016;
- Impacts submitted in this report, and the continued robustness of CFAES' research program throughout 2016, both in terms of breadth of programs and depth of new knowledge generated and applied.

The research reported herein is also supported by an informal yet effective formative evaluation. Very little research is conducted at OARDC without early engagement of businesses, industries, commodity groups, special interest groups, or other interested parties. These are the individuals who have the need for and will be the adopters of our research output/impacts. Even in the case of very theoretical research, fellow researchers in industry, government, and academic institutions are consulted (formative evaluation/needs assessment) in the formulation of studies.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Food, Agricultural, and Biological Engineering Systems (OARDC Led)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
402	Engineering Systems and Equipment	0%		50%	
403	Waste Disposal, Recycling, and Reuse	0%		23%	
404	Instrumentation and Control Systems	0%		15%	
405	Drainage and Irrigation Systems and Facilities	0%		9%	
723	Hazards to Human Health and Safety	0%		3%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.5	0.0
Actual Paid	0.0	0.0	1.6	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	200938	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	589390	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Engineering research activities to advance OARDC goals include both basic and applied research. For example, OARDC scientists are working with farmers, industry groups, and government agencies to improve access to field data gathered from new-generation farm machinery and remote-sensing tools to better support real-time management decisions by producers. Laboratories, construction sites, farms, and multiple field sites/research stations are also available throughout Ohio to permit data gathering and to continue long-term activities. All functional laboratories and field sites are improved over time, as program needs warrant. OARDC faculty and staff engage in appropriate levels of outreach and consultation with both internal and external stakeholders.

2. Brief description of the target audience

OARDC's targeted audiences include, but are not limited to:

- Individuals or groups who have expressed a need for engineering information that resulted from new and ongoing research, or is extracted from the scientific literature. Often these requests are communicated to OARDC by an intermediary such as a staffer at a USDA office, the Ohio Department of Agriculture, Soil and Water Conservation Districts, or a county Extension agent;
- Fellow academic units that rely on engineers to create systems and processes needed to support their research and the adoption of research findings by stakeholders;
- Federal, state and local agencies or support groups who not only use information but broker that information by embedding it into clientele groups supportive of change;
- Populations who have not requested the information but will likely benefit from access, e.g. recreational animal owners;
- Other scientists and scientific groups;
- Political entities;
- Extension personnel;
- Students from pre-school to post-doctorate studies;
- News organizations;
- Business groups such as small town administrators, county commissioners, or commodity groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	18	18

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of graduate students completed
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Provide appropriate facilities design and engineering processes commensurate with stakeholders demand, including fellow research units demands, to the extent that they have all the information necessary for making adoption decisions
2	Develop enhanced systems to support integrated plant growth systems that will annually result in increased productivity at reduced costs for the industry
3	Improve mechanical devices and instrumentation needed by stakeholders
4	Advance development of state of the art integrated waste management systems to the extent that OARDC and Ohio are viewed as one of the top ten programs/states in this area nationally
5	Advance the knowledge of ecological based engineered systems for waste management to the extent that, where cost effective and appropriate, they will be adopted over mechanical systems
6	Provide appropriate facilities design and engineering processes commensurate with stakeholders demand, including fellow research units demands, to the extent that they have all the information necessary for making value-added decisions.

Outcome #1

1. Outcome Measures

Provide appropriate facilities design and engineering processes commensurate with stakeholders demand, including fellow research units demands, to the extent that they have all the information necessary for making adoption decisions

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Develop enhanced systems to support integrated plant growth systems that will annually result in increased productivity at reduced costs for the industry

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Improve mechanical devices and instrumentation needed by stakeholders

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Advance development of state of the art integrated waste management systems to the extent that OARDC and Ohio are viewed as one of the top ten programs/states in this area nationally

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Advance the knowledge of ecological based engineered systems for waste management to the extent that, where cost effective and appropriate, they will be adopted over mechanical systems

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Provide appropriate facilities design and engineering processes commensurate with stakeholders demand, including fellow research units demands, to the extent that they have all the information necessary for making value-added decisions.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Planting is the most critical operation of crop farming. Improperly placing seed or working a poor seedbed could potentially cut a crop's yield in half.

What has been done

In farm fields, particularly those in central and southern Ohio, soil type can vary significantly within a matter of 50 feet. Multihybrid planters allow farmers to simultaneously plant different seeds at different rates to produce the highest yields or generate the highest returns for their operations. In 2016, Ohio State researchers tested prescription planting protocols on approximately 600 acres across central Ohio.

Results

On some fields, especially in northwest Ohio where soil tends to be more uniform, high-speed planters may be more beneficial. By speeding up planting 40 to 60 percent, crops can be planted when weather narrows the planting window, as it did in spring 2016. Researchers work to help farmers determine the right equipment for their operation, whether it's high-speed, variable-rate, multihybrid or some combination of each method.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Economic shifts such as changes in interest rates to borrow money for facilities, public policy shifts, new regulations, shifts in demand, and issues such as climate change are impacting outcomes. Human values and conflicts, e.g. urban-rural interface issues and environmental sensitivities to agricultural processes and facilities, are also external factors that affect outcomes. Climate change may dictate new and different types of structures, equipment, and processes. Factors such as the availability of base funding to ensure a core research and extension faculty and staff, availability of extramural funds, and programmatic demands that often exceed resources can affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For 2016, CFAES-OARDC has conducted no formal studies regarding evaluation of our research program. Surrogate evaluation metrics that are considered indicators of research success are:

- Research contracts and awards received/ongoing/completed (\$180 million plus in active projects during 2016);
- Number of referred publications reported elsewhere in this report;
- Number of businesses, industries and groups engaged in CFAES' research programs;
- Number of patents received;
- Economic impact of the college's research program as reported elsewhere in this report;
- The level of base funding from USDA-NIFA and the State of Ohio in 2016;
- Impacts submitted in this report, and the continued robustness of CFAES' research program throughout 2016, both in terms of breadth of programs and depth of new knowledge generated and applied.

The research reported herein is also supported by an informal yet effective formative evaluation. Very little research is conducted at OARDC without early engagement of businesses, industries, commodity groups, special interest groups, or other interested parties. These are the individuals who have the need for and will be the adopters of our research output/impacts. Even in the case of very theoretical research, fellow researchers in industry, government, and academic institutions are consulted (formative evaluation/needs assessment) in the formulation of studies.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 11

1. Name of the Planned Program

Economics and Social Dimensions (OARDC Led)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management	0%		10%	
602	Business Management, Finance, and Taxation	0%		3%	
603	Market Economics	0%		14%	
604	Marketing and Distribution Practices	0%		3%	
605	Natural Resource and Environmental Economics	0%		14%	
606	International Trade and Development	0%		22%	
607	Consumer Economics	0%		5%	
608	Community Resource Planning and Development	0%		3%	
609	Economic Theory and Methods	0%		17%	
610	Domestic Policy Analysis	0%		8%	
611	Foreign Policy and Programs	0%		1%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.0	0.0
Actual Paid	0.0	0.0	3.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	565321	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1307368	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

To fulfill the goals of the Economics and Social Dimensions Program, OARDC supports both basic and applied research initiatives. Extensive in-state research occurs, as well as national and international cooperative studies. For example, the OARDC's Agro-ecosystems Management Program is working with partners in many states to harness the power of social media to help agricultural entrepreneurs map assets, find potential supply chain connections, and launch cooperative networks of businesses supplying food, energy, and bio-based products. Close working relationships with multiple industries and organizations will continue to provide real-world settings and data, greatly enhancing the program's capacity and its impacts. OARDC faculty and staff supporting this program engage in appropriate levels of outreach and consultation with both internal and external stakeholders.

2. Brief description of the target audience

OARDC's targeted audiences for this planned program include, but are not limited to:

- Individuals or groups who have expressed a need for social, educational, and economic findings related to some aspect of human capital that resulted from new or ongoing research, or is extracted from the scientific literature;
- Fellow academic units that depend on scientists in this program for support information and for the approaches/measures they generate;
- Federal, state and local agencies or support organizations who will not only use the economic information but will also extend that information;
- Populations who have not requested the information but will likely benefit from access;
- Other scientists and scientific groups;
- Political entities;
- Extension personnel;
- Students from junior high school to post-doctorate studies;
- News organizations;
- Business and industry groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	56	56

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of graduate students completed
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Business management knowledge, including policy analysis, in targeted areas, e.g. risk management, weather insurance, impacts of land use shifts, grant management that are necessary for and result in increased profitability for stakeholders.
2	Market economies and efficiencies studies relating to factors such as pricing, finance, supply and demand, exchange rates, trade policies, etc. ensuring that stakeholders are informed and their identified needs.
3	Advance basic and theoretical knowledge in sociological, educational, and human capital dimensions related to food, agriculture and environment topics
4	Advance human capital and sociological studies that will inform strategies for expanding and strengthening individual and family well-being, community stability, and agricultural workforce leading to improved quality and quantity of life.
5	Study rural education systems relative to educational resources, curriculum, instructional delivery, and student learning to the extent necessary to inform decision-makers how to improve rural education systems as requested.

Outcome #1

1. Outcome Measures

Business management knowledge, including policy analysis, in targeted areas, e.g. risk management, weather insurance, impacts of land use shifts, grant management that are necessary for and result in increased profitability for stakeholders.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The unique nature of horizontal drilling used in shale exploration allows for a reduction in the footprint of shale-related activity in the landscape. However, existing policies regulating shale activity across the Northeast, particularly in Pennsylvania, largely miss an opportunity to encourage such consolidation, which would result in substantial ecosystem conservation.

What has been done

OARDC researchers are examining the impact of shale exploration activity on forest cover and forest fragmentation in Pennsylvania, and the implications for conservation policy. The researchers used data on unconventional shale gas activity in Pennsylvania between 2006 and 2011 to empirically identify the differential impacts of well pads and wells on forest cover. They also explored the policy implications of regulating well pads and wells by combining the existing permit fee with a quantitative restriction on the number of well pads permitted.

Results

Using satellite land cover data for the years 2006 and 2011, combined with data on shale drilling activity in Pennsylvania, researchers found that a consolidation of wells to underutilized well pads would have resulted in a forest conservation gain of over 112,838 acres between 2006 and 2015. Adopting tax and permit policies to encourage higher well pad utilization provides substantial carbon sequestration benefits. Using a social cost of carbon value of \$15/ton, along with an estimated sequestration quantity of 80 tons per acre per year results in carbon sequestration gains from conserving 112,838 acres in Pennsylvania alone at \$135 million per year.

The results suggest a feasible, targeted role for policy to enhance forest conservation in areas likely to experience unconventional shale gas exploration by combining a cap on the total number of new well pads with a graduated permit fee that provides an incentive to fully utilize well pads.

The findings have broad implications for policymakers seeking to encourage conservation as shale activity continues to expand in Pennsylvania as well as in other areas experiencing shale gas development.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Market economies and efficiencies studies relating to factors such as pricing, finance, supply and demand, exchange rates, trade policies, etc. ensuring that stakeholders are informed and their identified needs.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Advance basic and theoretical knowledge in sociological, educational, and human capital dimensions related to food, agriculture and environment topics

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Advance human capital and sociological studies that will inform strategies for expanding and strengthening individual and family well-being, community stability, and agricultural workforce leading to improved quality and quantity of life.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Study rural education systems relative to educational resources, curriculum, instructional delivery, and student learning to the extent necessary to inform decision-makers how to improve rural education systems as requested.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Shifts in economic dimensions impact all aspects of people's lives. Within this program area, public monies, and fluctuations in the appropriations of such, can have either positive or negative effects on human well-being, as do levels of government regulation. Likewise, public policies, societal priorities and perceptions, popular culture, education, and family norms are major external factors impacting this program in its research and extension efforts. Factors such as the availability of base funding to ensure a core faculty and staff, availability of extramural funds, and programmatic demands that exceed available resources can affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For 2016, CFAES-OARDC has conducted no formal studies regarding evaluation of our research program. Surrogate evaluation metrics that are considered indicators of research success are:

- Research contracts and awards received/ongoing/completed (\$180 million plus in active projects during 2016);
- Number of referred publications reported elsewhere in this report;
- Number of businesses, industries and groups engaged in CFAES' research programs;
- Number of patents received;
- Economic impact of the college's research program as reported elsewhere in this report;
- The level of base funding from USDA-NIFA and the State of Ohio in 2016;
- Impacts submitted in this report, and the continued robustness of CFAES' research program throughout 2016, both in terms of breadth of programs and depth of new knowledge generated and applied.

The research reported herein is also supported by an informal yet effective formative evaluation. Very little research is conducted at OARDC without early engagement of businesses, industries, commodity groups, special interest groups, or other interested parties. These are the individuals who have the need for and will be the adopters of our research output/impacts. Even in the case of very theoretical research, fellow researchers in industry, government, and academic institutions are consulted (formative evaluation/needs assessment) in the formulation of studies.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 12

1. Name of the Planned Program

Human Health (OARDC Led)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
502	New and Improved Food Products	0%		62%	
703	Nutrition Education and Behavior	0%		1%	
721	Insects and Other Pests Affecting Humans	0%		20%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%		13%	
723	Hazards to Human Health and Safety	0%		4%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.5	0.0
Actual Paid	0.0	0.0	1.4	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	169183	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	524463	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Ongoing research activities to advance human health and societal well-being include both basic and applied research, such as that conducted through OARDC's Center for Advanced Functional Foods Research and Entrepreneurship (CAFFRE). Examples include the identification, extraction and commercialization of natural, cancer-fighting food dyes from berries. Effective food science research requires a mixture of laboratory and gathering places for human subjects to undergo sensory evaluations of experimental food products. Emerging health threats now require more advanced facilities--such as bio-security labs--particularly needed in the study of infectious animal, plant and insect-vectored diseases that may directly impact humans. All functional laboratories and sites are improved over time, as program needs warrant. OARDC faculty and staff engage in appropriate levels of outreach and consultation with both internal and external stakeholders.

2. Brief description of the target audience

Targeted audiences include, but are not limited to:

- Individuals or groups who have expressed a need for health, obesity, and safety information that resulted from new or ongoing research, or is derived from the scientific literature;
- Fellow academic units that depend on scientists in this program for support information and for new health and safety technologies and approaches;
- Federal, state and local agencies or support organizations who will not only use the information, but will also extend that information;
- Populations who have not requested the information but will likely benefit from access;
- Other scientists and scientific groups;
- Health workers/organizations;
- Political entities;
- Extension personnel;
- Students from pre-school to post-doctorate studies;
- News organizations;
- Business and industrial groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	49	49

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of graduate students completed
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Release studies on insects, ticks, and mites to protect human health that will provide a set of alternatives leading to health gains with lowered risks, and within economic realities, for the affected populations.
2	Advance the understanding of means and methods related to transmission of zoonotic diseases to humans, including prevention, that meets consumer demand/health threat, as or before such emerges.
3	Reduce through research, development, and outreach the exposure to biohazards, pathogens, and similar to the extent that annually such are reduced per capita with an overall time and economic savings to those who may be affected.
4	Create a growing base of knowledge that supports improving human health as it relates to food, environment, and lifestyle
5	Expand utilization of products with known functionality or nutraceutical value and give consumers greater informed choices, including the bioavailability of the desired substance in food, than they presently have.

Outcome #1

1. Outcome Measures

Release studies on insects, ticks, and mites to protect human health that will provide a set of alternatives leading to health gains with lowered risks, and within economic realities, for the affected populations.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Asian tiger mosquito (*Aedes albopictus*) is responsible for the transmission of Zika virus, which can cause birth defects and poor pregnancy outcomes. They also help spread a host of other dangerous diseases worldwide, including dengue fever, which infects hundreds of millions of people annually and can be fatal. A highly invasive insect, the Asian tiger mosquito is present in parts of Ohio and could potentially transmit Zika if the virus were to become established in the state.

What has been done

Female mosquitoes rely on their Malpighian tubules, which are the equivalent of human kidneys, when consuming a human blood meal. They may ingest the equivalent of their own body mass in blood, so they need to immediately get rid of the excess fluid they consume. They achieve this by urinating on their host while they are still feeding. As a result, mosquitoes with impaired kidney function would be less likely to escape the human host they are feeding on and survive the ingestion of blood.

OARDC entomologists used state-of-the-art genomics to sequence the genes that are expressed in the Malpighian tubules of adult female Asian tiger mosquitoes, and documented the changes in gene expression that occur after mosquitoes feed on blood. They found significant changes in the expression of around 4,000 genes after blood feeding.

Results

This study represents the first characterization of global gene expression in the Malpighian tubules of mosquitoes, and offers molecular insights into the physiological roles of the mosquito kidneys during the processing of blood meals. They also reveal potentially important molecular targets for the development of chemical or gene-silencing insecticides that would disrupt renal

function in mosquitoes. Existing control measures for mosquitoes are being challenged by the emergence of resistance to conventional insecticides that target the mosquito nervous system. Consequently, it is becoming increasingly necessary to identify novel physiological targets to guide the development of new insecticides.

If the researchers can develop insecticides targeting the mechanisms activated after a blood meal, then we may be able to establish next-generation mosquito-control products that would not be harmful to non-blood feeding beneficial insects, such as honeybees and that are highly selective for adult female mosquitoes which are primarily responsible for disease transmission, due to this being the only blood-feeding life stage.

4. Associated Knowledge Areas

KA Code	Knowledge Area
721	Insects and Other Pests Affecting Humans

Outcome #2

1. Outcome Measures

Advance the understanding of means and methods related to transmission of zoonotic diseases to humans, including prevention, that meets consumer demand/health threat, as or before such emerges.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Reduce through research, development, and outreach the exposure to biohazards, pathogens, and similar to the extent that annually such are reduced per capita with an overall time and economic savings to those who may be affected.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Create a growing base of knowledge that supports improving human health as it relates to food, environment, and lifestyle

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Expand utilization of products with known functionality or nutraceutical value and give consumers greater informed choices, including the bioavailability of the desired substance in food, than they presently have.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Multiple factors, including climate change and weather conditions, play a major role in encouraging the growth and spread of pests and diseases that can be transmitted to humans. Shifts in the economy can impact the government's ability to address human health concerns. Access to healthcare and education regarding healthy lifestyles also affects outcomes. Within this program area public monies, and fluctuations in the appropriations of such, can have dramatic effects on human health, as do the levels of regulation. Likewise, public policy and the public's priorities and perceptions, especially regarding risks, are major external factors impacting this program.

Research priorities, limited research dollars, and the resulting competition impact the extent of research that can be carried out. Items such as potential levels of public exposure to certain zoonotic diseases are major external influence. Likewise, public willingness to learn safety procedures to contain pests and mitigate zoonotic disease threats may impact research outcomes. Willingness of consumers to pay for additional food safety is also an external factor. Factors such as the availability of base funding to ensure a core faculty and staff, availability of extramural funds, and programmatic demands that exceed available resources can affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For 2016, CFAES-OARDC has conducted no formal studies regarding evaluation of our research program. Surrogate evaluation metrics that are considered indicators of research success are:

- Research contracts and awards received/ongoing/completed (\$180 million plus in active projects during 2016);
- Number of referred publications reported elsewhere in this report;
- Number of businesses, industries and groups engaged in CFAES' research programs;
- Number of patents received;
- Economic impact of the college's research program as reported elsewhere in this report;
- The level of base funding from USDA-NIFA and the State of Ohio in 2016;
- Impacts submitted in this report, and the continued robustness of CFAES' research program throughout 2016, both in terms of breadth of programs and depth of new knowledge generated and applied.

The research reported herein is also supported by an informal yet effective formative evaluation. Very little research is conducted at OARDC without early engagement of businesses, industries, commodity groups, special interest groups, or other interested parties. These are the individuals who have the need for and will be the adopters of our research output/impacts. Even in the case of very theoretical research, fellow researchers in industry, government, and academic institutions are consulted (formative evaluation/needs assessment) in the formulation of studies.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 13

1. Name of the Planned Program

Advancing Employment and Income Opportunities (Extension)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
602	Business Management, Finance, and Taxation	50%		0%	
608	Community Resource Planning and Development	50%		0%	
Total		100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	0.0	0.0	0.0
Actual Paid	4.0	0.0	0.0	0.0
Actual Volunteer	4.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
196271	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
196271	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- On-site workshops
- Meetings
- Curriculum development and maintenance
- Leadership development training
- Development and maintenance of online resources
- Establishment of collaborative partnerships
- One-on-one client consultations
- Volunteer organizational efforts

2. Brief description of the target audience

- Community leaders
- Economic development professionals
- Community residents (families and individuals)
- Business owners/operators
- Professional economic developers
- Certified Public Attorneys
- Certified Financial Planners
- Enrolled agents with the Internal Revenue Service
- Tax return preparers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	24266	103303	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
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Actual	0	0	0
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V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of formal 'Business Retention and Expansion' training workshops
Not reporting on this Output for this Annual Report

Output #2

Output Measure

- number of one-on-one 'Business Retention and Expansion' consultations
Not reporting on this Output for this Annual Report

Output #3

Output Measure

- number of volunteers who have participated in 'Advancing Employment and Income Opportunities' programming

Year	Actual
2016	1584

Output #4

Output Measure

- number of volunteer hours contributed to planning and implementing 'Advancing Employment and Income Opportunities' programming

Year	Actual
2016	8453

Output #5

Output Measure

- number of volunteers who have participated in 'Business Retention and Expansion' programming

Year	Actual
2016	18

Output #6

Output Measure

- number of volunteer hours contributed to planning and implementing 'Business Retention and Expansion' programming

Not reporting on this Output for this Annual Report

Output #7

Output Measure

- number of mail (including email) contacts for 'Advancing Employment and Income Opportunities' programming

Year	Actual
2016	7058

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	number of community plans developed and adopted (BR&E)
2	number of jobs created
3	number of jobs retained
4	number of local leaders and community residents that have indicated they are using knowledge gained from 'Business Retention and Expansion' programming to make better informed community decisions

Outcome #1

1. Outcome Measures

number of community plans developed and adopted (BR&E)

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

number of jobs created

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	52000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

As shale energy development took off in Ohio, it was unclear what the impacts would be on Ohio citizens. OSU Extension wanted to dig deeper to uncover these answers, so with funding from the Economic Development Administration (EDA) we were able to partner with four Regional Economic Development Organizations: Eastgate Regional Council of Governments, Northeast Ohio Four County Regional Planning Development Organization, Ohio Mid-Eastern Governments Association, and the Buckeye Hills-Hocking Valley Regional Development District to investigate. The four EDA districts represent 25 counties in Eastern Ohio, where shale development is prominent. Specifically, OSU wanted to use the study results to determine regional needs, such as workforce training and education. The EDA districts plan to use the findings to develop strategies to diversify their economies and sustain economic growth.

What has been done

In partnership with the leadership and members of the four development groups (representing 25 of Ohio's 88 counties), we conducted an advanced industry cluster analysis, industry capacity assessment, asset mapping, and implemented a sustainable strategic shale energy planning process, including the identification of implementation strategies. A summary report, written in 2016, analyzed trends in the shale region of Ohio from 2010 to 2014. The report highlights Ohio oil and gas production trends, demographic trends, and illustrates the impact of oil and gas

production in these 25 counties with respect to employment by sector.

Results

Results indicated that shale development benefitted five industrial sectors the most: energy; chemicals and chemical-based products; forest and wood products; metals and manufacturing; and machinery manufacturing. The metals and machinery manufacturing sector alone accounted for a net increase of 52,000 jobs. The analysis further shows that 90% of job creation in the five sectors occurred as a result of regional influences rather than national economic trends. Armed with study findings, development officials in these communities can more efficiently target their business attraction, retention, and expansion efforts to maximize strength of regional economic clusters involving these key sectors.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #3

1. Outcome Measures

number of jobs retained

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	229

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

According to the Appalachian Regional Commission, residents in Appalachian Ohio experienced 8.9% unemployment from 2011 through 2013, with a per-capita income in 2013 of \$24,855, and a three-year poverty rate of 17.6%. OSU Extension is working to increase economic productivity and job and business development in the region by helping to develop all types of cooperative businesses and "cooperative like" groups. A cooperative is a member-owned and controlled business. Cooperatives are formed to benefit their members and distribute those benefits equitably among their membership. Cooperatives exist in many industries, including agriculture, food, finance, energy, and hardware and lumber.

What has been done

During the past five years, The Ohio Cooperative Development Center, housed at The Ohio State University South Centers in Piketon, has provided more than 2,900 hours of technical assistance and has provided expertise to help in the formation of 35 cooperatives and other business entities in a variety of industries.

Results

Creation of these cooperatives and businesses has resulted in an estimated 194 new and 229 retained jobs. Examples of the formed cooperatives include the Our Harvest Cooperative, a group of urban vegetable farmers in Cincinnati; the Ohio Hop Growers Guild (comprised of more than 70 hop growers across Ohio), Great River Organics (a non-profit co-op committed to expanding the availability of local, organic products in the central Ohio marketplace), and a group of pumpkin growers in southern Ohio who are in the process of developing their own cooperative.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

Outcome #4

1. Outcome Measures

number of local leaders and community residents that have indicated they are using knowledge gained from 'Business Retention and Expansion' programming to make better informed community decisions

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	89

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Business Retention and Expansion program has been positively impacting communities for over 30 years as a structured approach to assessing and addressing business needs. The program helps to inform community leadership about their economy and assist in decision-making. Local community leaders in Ohio frequently lack an understanding of issues related to their economy.

Local officials lack knowledge of existing business needs and resulting expansion and growth

strategies. Relations among community stakeholders (businesses, residents, local leaders / officials) are often fragmented, challenging communities even more. The goals of BR&E programming are: 1) to assist businesses in solving local problems and working with local government; 2) to assist businesses in using state and federal development programs; 3) to develop a database for local economic strategic planning to improve the community's climate for growth; and 4) to establish an early warning system for plant closures, allowing the community to prevent or ease such situations when possible.

What has been done

239 individuals were provided with BR&E programming in 2016. Through a community engagement process, local community socio-economic data and resident input have been collected and compiled by OSU Extension professionals in community plan / report formats that can be referenced to better inform local decision making. BR&E sessions are hosted as either one-on one individual instruction or as a small group workshop.

Results

Program participants are demonstrating improved working relationships: county and city officials are now meeting once a month to discuss community and economic development issues. While not all participants were evaluated on the effectiveness of the BR&E program, of those evaluated, 89 individuals indicated that they now better appreciate the need to understand existing businesses, and 85 are now aware of the roles they can play in the development of their community's economy.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Business Retention and Expansion programming competes with other economic initiatives on the local level as leadership decides how to best allocate limited dollars.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For the 'Advancing Employment and Income Opportunities' planned program, OSUE faculty and staff work in communities around the state, helping local leaders and officials to:

- investigate, evaluate, and plan for stronger local economies;
- manage and leverage resources;
- implement action plan strategies;

- learn how to operate a sustainable community economy;
- make better decisions based on sound information;
- and evaluate progress

The following outcomes were achieved in 2016:

- The Business Retention and Expansion program worked with 239 individuals, which helped local community leaders across Ohio make better informed local decisions
- The Ohio Cooperative Development Center has helped create 194 jobs, and retain another 229.
- A recent OSUE study has found that Ohio has experienced a net increase of 52,000 jobs in the metals and machinery manufacturing sector alone between 2010 and 2014.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 14

1. Name of the Planned Program

Enhancing Agriculture and the Environment (Extension)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	10%		0%	
112	Watershed Protection and Management	15%		0%	
123	Management and Sustainability of Forest Resources	5%		0%	
133	Pollution Prevention and Mitigation	10%		0%	
205	Plant Management Systems	10%		0%	
216	Integrated Pest Management Systems	15%		0%	
307	Animal Management Systems	10%		0%	
601	Economics of Agricultural Production and Farm Management	5%		0%	
602	Business Management, Finance, and Taxation	10%		0%	
723	Hazards to Human Health and Safety	10%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	45.0	0.0	0.0	0.0
Actual Paid	59.0	0.0	0.0	0.0
Actual Volunteer	12.7	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
2894998	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2894998	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

"Enhancing Agriculture and the Environment" programming is very diverse. For the 2016 report, we chose to highlight four "new" topics, which have been part of our curriculum for several years, but we have not touched on in past reports. Other programs reported in the past (Grain C.A.R.T., Conservation Tillage Conference, OSU Tax Income Schools, Transitioning Your Farm to the Next Generation, Integrated Pest Management, Ohio Women in Agriculture, Pesticide Applicator Training, Fertilizer Application, Agricultural Emergency Management, etc) are all still offered programs by OSU Extension; we have simply chosen to highlight a few new programmatic efforts for this year's report.

- Maintain educational websites on related topics (e.g., Crop Observation and Recommendation Network; PestEd, etc websites);
- Create and distribute educational materials / information (via fact sheets, field guides, manuals, webinars, tv spots, radio broadcasts, conference participation, etc)
 - Enhance the adaption of production techniques through utilization of on-farm research to work directly with producers to evaluate practices to enhance productivity and profitability;
 - Organize and conduct Women in Agriculture / "Annie's Project" seminars;
 - Extend the reach of OSU Extension educational programming through the utilization of volunteers, such as Ohio Master Gardeners;
 - Provide education on fertilizer and commercial and private pesticide application best practices (including potential certification);
 - Organize / host / present at conferences, such as Farm Science Review, the Conservation Tillage Conference, Small Farm Conference, Women in Agriculture Conference, etc;
 - Educate Ohioans on forest stewardship best management practices;
 - Provide agriculture emergency management training for first responders and farm operators;
 - Promote independence for Ohio farm families who have family members with disabilities that impact their ability to function in farm operations;
 - Organize and conduct Transitioning Your Farm Business to the Next Generation workshops;
 - Organize and conduct meetings, seminars, conferences, programs, and activities for "Local Foods" program (addressing the critical need for outreach education around the broad topic of local food systems)

2. Brief description of the target audience

The target audience for efforts under the 'Enhancing Agriculture and the Environment' programs include:

- Ohio citizens;
- commercial green-industry companies;

- consumer horticulture advocates;
- commodity / farm advocacy groups;
- federal / state and agricultural / environmental agencies;
- state-wide consumer groups;
- volunteer groups;
- community leaders;
- business leaders;
- elected and appointed officials;
- non-government organizations;
- tax practitioners and preparers and certified public accountants;
- female agricultural or agricultural-related business owners / partners;
- pesticide application license holders;
- Ohio farmers;
- livestock haulers;
- livestock producers;
- manure haulers and applicators;
- fertilizer applicators;
- forest landowners;
- professional foresters and loggers;
- banks / financial & lending institutions, especially those in rural communities.

Included in the reporting of the NIFA planned program, 'Enhancing Agriculture and the Environment', OSU Extension has a number of programs that have more specific audiences, which are detailed separately below.

The OSU Extension 'Ohio Volunteer Master Gardener Program' targets the following audiences:

- Ohio citizens
- Community leaders and officials
- Master gardeners

eXtension "Ask a Master Gardener" - Ohio targets the following audiences:

- New and beginning gardeners
- Gardeners with distressed gardens, plants, new / unusual problems with plants and / or diseases

The 'Ohio Certified Volunteer Naturalist' program targets the following individuals:

- Ohio citizens
- Community leaders and officials
- Certified naturalists

OSU Extension programming on the topic of bed bugs targets the following audiences:

- Local and State Departments of Health
- Business owners
- Community leaders
- Government Officials
- Citizens of Ohio

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	215127	161450	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of volunteers involved in delivery and implementation of 'Enhancing Agriculture and the Environment' programming

Year	Actual
2016	3831

Output #2

Output Measure

- number of multi-state partnerships

Year	Actual
2016	128

Output #3

Output Measure

- number of 'Crop Observation and Recommendation Network' (CORN) newsletters distributed
Not reporting on this Output for this Annual Report

Output #4

Output Measure

- number of participants attending regional / local agronomy meetings
Not reporting on this Output for this Annual Report

Output #5

Output Measure

- number of local / on-farm research project sites
Not reporting on this Output for this Annual Report

Output #6

Output Measure

- number of participants in local field days
Not reporting on this Output for this Annual Report

Output #7

Output Measure

- number of 'Weed Control Guide for Ohio and Indiana' distributed
Not reporting on this Output for this Annual Report

Output #8

Output Measure

- number of 'Corn, Soybean, Wheat, and Alfalfa Field Guide' distributed
Not reporting on this Output for this Annual Report

Output #9

Output Measure

- number of people participating in an OSUE 'Local Foods' program, activity, conference, or workshop

Year	Actual
2016	13650

Output #10

Output Measure

- number of individuals taught about disease identification, control, and scouting or other key weed control concepts

Not reporting on this Output for this Annual Report

Output #11

Output Measure

- number of people attending 'New and Small Farm College' events
Not reporting on this Output for this Annual Report

Output #12

Output Measure

- number of people attending the 'Small Farm Conference and Trade Show'
Not reporting on this Output for this Annual Report

Output #13

Output Measure

- number of 'Ohio Agronomy Guide' media distributed
Not reporting on this Output for this Annual Report

Output #14

Output Measure

- number of food animal producers that complete 'Livestock Mortality Composting' training
Not reporting on this Output for this Annual Report

Output #15

Output Measure

- number of program participants that are considered to be under-represented

Year	Actual
2016	11593

Output #16

Output Measure

- number of program participants that are considered to be under-served

Year	Actual
2016	7925

Output #17

Output Measure

- number of volunteer hours worked

Year	Actual
2016	26400

Output #18

Output Measure

- number of new Master Gardener Volunteers

Year	Actual
2016	307

Output #19

Output Measure

- number of direct contacts through the 'Nutrient Stewardship for Cleaner Water' signature program

Year	Actual
2016	21118

Output #20

Output Measure

- number of people attending the 'Farm Science Review' event

Year	Actual
2016	125700

Output #21

Output Measure

- number of Certified Crop Advisers (CCAs) in Ohio
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	number of people (agronomic crops, fruit, and vegetable producers) that demonstrated an increase in plant-based food biosecurity / biosafety knowledge
2	total number of people indicating an increased knowledge of current practices and emerging technology in conservation tillage as a result of attending the Conservation Tillage Conference
3	Number of Schedule "F" tax forms filed by tax practitioners that participated in OSU Income Tax Schools.
4	Total number of farms and agribusinesses that began using transitioning planning this year as a result of OSUE transition planning workshops
5	Total number of participants in an agronomic meeting, workshop, or field day that indicated they will implement at least 1 new management practice based on information received
6	number of crop production acres that will implement best management practices for nutrient management
7	number of crop production acres that implement weed resistance management strategies
8	Total number of Ohio crop acres (agronomic, vegetable and fruit crops) where appropriate utilization of integrated pest management (IPM) practices occur
9	number of individuals who plan to implement on their farm one of the learning outcomes from OSUE programming related to: disease identification and control, scouting, or key weed control concepts
10	number of farmers reporting positive changes in management and / or profitability of their farm as a result of information from farm financial analysis
11	reported economic impact of cost savings, increased yield, or other increased profitability from use of CORN newsletter, reported as total dollars
12	number of acres of forest land impacted by OSU Extension programming
13	number of Ohio breweries now able to produce beers using exclusively Ohio hops
14	number of acres of Ohio land dedicated to growing grasses which can be used for biofuel or bio-based products
15	number of individuals attending viticulture educational events
16	number of OSUE educators trained to teach farmers how to use UAV-collected data to make best production practice decisions

Outcome #1

1. Outcome Measures

number of people (agronomic crops, fruit, and vegetable producers) that demonstrated an increase in plant-based food biosecurity / biosafety knowledge

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

total number of people indicating an increased knowledge of current practices and emerging technology in conservation tillage as a result of attending the Conservation Tillage Conference

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of Schedule "F" tax forms filed by tax practitioners that participated in OSU Income Tax Schools.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Total number of farms and agribusinesses that began using transitioning planning this year as a result of OSUE transition planning workshops

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Total number of participants in an agronomic meeting, workshop, or field day that indicated they will implement at least 1 new management practice based on information received

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

number of crop production acres that will implement best management practices for nutrient management

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

number of crop production acres that implement weed resistance management strategies

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Total number of Ohio crop acres (agronomic, vegetable and fruit crops) where appropriate utilization of integrated pest management (IPM) practices occur

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

number of individuals who plan to implement on their farm one of the learning outcomes from OSUE programming related to: disease identification and control, scouting, or key weed control concepts

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

number of farmers reporting positive changes in management and / or profitability of their farm as a result of information from farm financial analysis

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

reported economic impact of cost savings, increased yield, or other increased profitability from use of CORN newsletter, reported as total dollars

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

number of acres of forest land impacted by OSU Extension programming

Not Reporting on this Outcome Measure

Outcome #13

1. Outcome Measures

number of Ohio breweries now able to produce beers using exclusively Ohio hops

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	73

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Ohio's brewing industry is booming. 2013 legislation permitted Ohio craft brewers to invest more money in their breweries, which has increased the demand for Ohio grown hops. 150 Ohio breweries produce an estimated 1,097,955 barrels of craft beer annually. This amount of beer requires approximately 4,000,000 pounds of dried hops for production. The amount of hops needed for Ohio breweries to produce it's annual output of beer is valued at an estimated \$30 million. Unfortunately, most hops are currently purchased from out-of-state farms. OSU Extension saw the high value of this specialty crop, and the opportunity to educate Ohio farmers about the producing locally grown hops to supply Ohio breweries, thus keeping jobs and money in Ohio.

What has been done

Educational programming has been offered in a variety of settings: workshops, hop yard tours, and summer field days. OSUE maintains a webpage related to hops, listserv, and a Facebook page dedicated to Ohio hops. The goal of OSUE hops education is to reduce risks and barriers associated with growing hops, and to provide potential growers with the knowledge needed to be successful in their farming enterprises. The current hops curriculum taught includes lesson plans, worksheets, teaching outlines, fact sheets, drying calculators and production budgets. Over 1,000 Ohioans were reached through 25 different hops education events in 2016.

Results

The number of Ohio hops-producing farms has increased from 12 in 2013 to 88 in 2016. The number of acres of hops planted in 2013 were less than 20, and in 2016 there were over 220 acres planted. In 2016, there were 73 Ohio breweries who are producing beers using exclusively Ohio-grown hops and malting barley, whereas only 6 breweries were doing this in 2014. Additionally, because of the increase in local hops availability, Ohio breweries can now produce "wet hop beer" -- a high value specialty green brew, which requires a supply of immediately harvested hops. Before 2014, it wasn't possible to make this type beer in Ohio. The estimated sales value of Ohio wet hop beer in 2015 was \$40 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management

Outcome #14

1. Outcome Measures

number of acres of Ohio land dedicated to growing grasses which can be used for biofuel or bio-based products

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	4000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Giant miscanthus is a perennial warm-season grass that grows relatively fast on less-than-ideal soils, and can be used as either a biofuel or to make bio-based products. This grass, as with many grasses, grows well in Ashtabula County, Ohio. Farmers in Ashtabula County started growing miscanthus in 2011, and there are now over 4,000 acres of the grass growing.

What has been done

In the winter of 2016, OSUE educators led a tour of miscanthus farmers' plantings and the Aloterra facilities to raise awareness and interest in the miscanthus crop.

Results

The harvest from the crop is now going to two new Ashtabula County manufacturing facilities, run by Conneaut-based Aloterra Energy. One of the facilities uses the fibers from the grass to make compostable food containers, the other facility makes biodegradable absorbents to soak up fluid spills, like oil, hydrocarbons, and automotive fluids. The absorbent product is safe, clean, and will dissolve back into the soil within days of application, or may be landfilled or incinerated in accordance with federal, state, and local requirements. The Aloterra company now employs 50 people. That's 50 jobs made possible by growing giant miscanthus.

Miscanthus provides farmers with a way to make use of marginal land, requiring little or no maintenance; an excellent way for farmers to increase profits: breakeven prices range from \$40 - \$80 per ton at the farm gate.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation

Outcome #15

1. Outcome Measures

number of individuals attending viticulture educational events

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	159

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There are more than 1,500 acres of Ohio vineyards and 145 wineries currently licensed in the state of Ohio. In 2008, Ohio winemakers produced over 1.1 million gallons of wine, contributing more than \$580 million dollars and 4,100 full time jobs to Ohio's economy. Viticulture education helps keep this industry thriving.

What has been done

OSU Extension hopes to improve production practices and profits for Ohio winemakers, through educational outreach, as well as new sprayer technologies. Ashtabula County is home to 60% of Ohio's wine grape acreage. The OSUE educator in Ashtabula hosted the Northeast Ohio Grape Twilight Tour Day and a Winter Grape School for Northeast Ohio grape growers in 2016. 106 individuals attended these events, where education on topics including production, bottling, marketing, managing winter damaged vines, controlling nuisance wildlife, and even preparing for unexpected events and vineyard succession planning were offered.

In Wayne County, Ohio, OSU Extension hosted a sprayer technology field day, where "intelligent sprayer" technology was showcased for 53 individuals. This technology was designed by USDA-ARS / OSU, and uses laser guidance to automatically adjust spray volume and nozzle pattern based upon tree size, leaf density, and plant spacing. OSUE hopes to have their sprayer mass-produced, so it will be commercially available. Adoption of the intelligent sprayer has impressive implications for farmers and the environment.

Results

Event evaluations revealed that 96.4% of Winter Grape School attendees believed the workshop provided them with ideas on how to increase profits from their grape and wine enterprises. 100% of the Northeast Ohio Grape School increased or gained awareness of sustainable vineyard practices.

Trials from intelligent sprayer technology show a reduction in pesticide use ranging from 47 to 70%, compared to the traditional air blast sprayers. Not only are there environmental benefits to using the intelligent sprayer, but also fiscal ones: use of the sprayer is estimated to save \$140 - \$280 per acre in chemical costs. Five sprayer prototypes were built at a cost of \$21,000 each, though commercial production of the technology is expected to lower the cost significantly. Four of the five prototypes are being tested for efficacy at commercial locations in Ohio, Oregon, and Tennessee. OSUE is currently looking for a company to produce the sprayer, so farmers and the environment may begin to benefit from this technology.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
205	Plant Management Systems
216	Integrated Pest Management Systems
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
723	Hazards to Human Health and Safety

Outcome #16

1. Outcome Measures

number of OSUE educators trained to teach farmers how to use UAV-collected data to make best production practice decisions

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	15

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

GPS technology has been changing many production practices on Ohio farms. Use of unmanned aerial vehicles ("UAVs" or "drones") is the newest in precision agriculture. Drones can help farmers increase their profitability and improve environmental stewardship. A farmer, with a pilot's license, is able to fly an UAV over his field, and record data which he can use to make management decisions. He can observe insect, disease, or weed issues, which helps to target interventions. Drones are able to be equipped with devices which will capture photos, HD videos, and even infrared imagery, which helps to measure the plant health (color spectrum that appears on UAV control screen helps indicate the level of crop health).

What has been done

Topics covered in educational events related to precision agriculture include: farm guidance systems and evaluation; GIS software; data collection and management; data storage; yield monitor calibration; developing management zones; developing variable rate fertilizer recommendations; and utilizing drone technology. Over 1,200 people attended educational events related to UAV technology and precision agriculture in 2016. Drones in precision agriculture were featured at Farm Science Review, at various agronomy meetings, 3 field days, an agronomy school (6-week workshop format reaching 11 counties, with 2 of the 6 weeks featuring precision agriculture topics), 14 different county-based meetings on precision agriculture, and a state event held in downtown Columbus.

OSU Extension's precision agriculture programming even had international reach in 2016: through live webinar technology, Ukrainian agricultural officials were able to experience drone software during a two-day training session. OSUE educators taught 6 Ukrainians about SMS software, demonstrating how to collect, manage, and use drone-collected data.

OSUE currently has site licenses for 30 accounts with SMS Software, as well as a mobile computer lab, which is taken to various locations around the state. In 2016, 15 OSUE educators

were able to be trained on the software, so they may in turn educate Ohio farmers on how to work with the big data that is collected by drones.

Results

Producers at OSUE educational events learned how site-specific data gathered by UAVs can become a tool in the decision making process of their farming operation. Participants at these workshops estimated a savings of \$12 - \$64 per acre based upon knowledge gained at these educational meetings.

Evaluations from the 6 week agronomy school revealed that participants rated the program as 9.1 out of 10 (where 10 is "excellent"). 100% of participants would recommend the school to others, as well as plan to make changes to their operation as a result of attending the agronomy school.

Unfortunately, OSU implemented new drone-related policies at the very end of 2015, which have made intervention and education with farmers very difficult, due to policy restrictions. OSUE educators hope to be able to continue working with farmers in 2017 and beyond, though their ability to do so effectively is currently in question.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
216	Integrated Pest Management Systems
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

- Ohio's agricultural nutrient certification law (Senate Bill 150) requires growers to meet certain criteria to attend certification training.
- Ohio regulations affecting the western basin of Lake Erie have been important to communicate to this audience in counties that are affected (House Bill 1)
- OSUE educators continue to offer fertilizer applicator training at the same time as other programming (greater time commitment, due to the increased demand for programming)
- Understaffed to meet the needs for programming in the areas of forest management / wildlife management / invasive species

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Education by OSU Extension has helped the beer / hops and wine / grape industry in Ohio continue to thrive. The number of hops-producing farms in Ohio has grown over the past 3 years, from 12 to 88.

Viticulture education was primarily focused on Ashtabula County, where 60% of the state's wine grape acreage can be found. Participants in Ashtabula viticulture programming found great value in the workshops offered in 2016, and learned about a diversity of related topics, including bottling, marketing, managing winter damaged vines, controlling nuisance wildlife, preparing for unexpected events and vineyard succession planning. Wine producers also had the opportunity to preview new sprayer technology, not yet commercially available. The sprayer was developed here at Ohio State with other partners, and has the potential to save growers \$140 - \$280 per acre.

OSU Extension trained more educators on how to use software which helps analyze and visualize data gathered by UAVs. Farmers were also provided with training on precision agriculture topics, including a group of Ukrainian agricultural officials.

OSUE has also been working to increase the awareness of northeastern Ohio farmers to the potential benefits of growing giant miscanthus, which is possible on edge-of-field / marginal land and requires little to no maintenance once established. Giant miscanthus is currently being harvested and sold to Aloterra Energy, an Ohio-based company which is using the grass to create compostable food containers and biodegradable absorbent products, which can be used to clean up spills (like oil, hydrocarbons, or automotive fluids). Growing giant miscanthus has not only benefitted farmers by providing additional income, but it has created 50 new jobs at the Aloterra company.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 15

1. Name of the Planned Program

Preparing Youth for Success (Extension)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
806	Youth Development	100%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	88.0	0.0	0.0	0.0
Actual Paid	87.0	0.0	0.0	0.0
Actual Volunteer	92.7	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
4268895	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
4268895	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Conduct workshops
- Face to face and virtual meetings

- Develop curriculum
- Provide training to professionals, volunteers and youth
- Media and web site creations
- Partnering with businesses and other organizations
- Fair (county and state)
- Camping
- Conduct educational programs with youth
- Conduct in-school and after-school enrichment

2. Brief description of the target audience

- Youth: infants through 18 years of age (with a special focus on new and underserved audiences)
- Parents of youth
- Volunteers working with youth audiences
- Teachers / educators working with youth audiences
- Families
- Youth development professional staff
- Community leaders involved in subject specific areas
- Youth (8-18 years), parents of youth, and volunteers working with youth; all with association with animal projects
 - General public who have interest in animals

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	243125	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
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Actual	0	0	0
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V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- number of youth enrolled/engaged in organized community 4-H clubs

Year	Actual
2016	72127

Output #2

Output Measure

- number of youth enrolled/engaged in after school 4-H programs

Year	Actual
2016	446

Output #3

Output Measure

- number of youth participating in special interest and short-term programs

Year	Actual
2016	44112

Output #4

Output Measure

- number of youth participating in school enrichment programs

Year	Actual
2016	59710

Output #5

Output Measure

- number of youth participating in 4-H overnight camping programs

Year	Actual
2016	12250

Output #6

Output Measure

- number of youth participating in 4-H day camping programs

Year	Actual
2016	4106

Output #7

Output Measure

- number of adult volunteers contributing to 4-H programming and events

Year	Actual
2016	22479

Output #8

Output Measure

- number of teen volunteers contributing to 4-H programming and events

Year	Actual
2016	7846

Output #9

Output Measure

- number of youth participating in "Assuring Quality Care for Animals" sessions
Not reporting on this Output for this Annual Report

Output #10

Output Measure

- number of adult volunteers contributing to the planning and implementation of the 'Real Money. Real World.' financial literacy program
Not reporting on this Output for this Annual Report

Output #11

Output Measure

- Number of youth participating in the "STEM Pathways" signature program

Year	Actual
2016	50000

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	number of youth indicating an increase in understanding of decision making processes
2	number of youth who have indicated the intention to practice improved basic life skills
3	number of youth who have participated in 4-H programs and indicated that they now possess transferrable workforce skills
4	number of participants who increased awareness about what it costs to maintain a household (RMRW)
5	number of participants who increased awareness about how spending impacts other choices and opportunities (RMRW)
6	number of participants who increased awareness about how the type of job they have affects how much money they will make (RMRW)
7	number of 'Real Money. Real World.' participants who indicated an intent to get more education or training after high school (RMRW)
8	number of participants who increased feeling of importance about waiting to have children until financially ready (RMRW)
9	number of 'Real Money. Real World.' participants who indicated they would develop a plan for their money that includes both needs and wants (RMRW)
10	number of 'Real Money. Real World.' participants who indicated they learned how to make wise financial decisions (RMRW)
11	number of youth participants who increased their knowledge of producing quality and safe animal products for consumers through responsible animal handling, care, and welfare (Assuring Quality Care for Animals)
12	percentage of youth indicating the intention to change driving habits as a result of 4-H CARTEENS programming
13	number of OSU Extension professionals who completed training so they could provide yoga instruction to youth
14	number of military family members who benefitted from Ohio Military Kids camping programs
15	percentage of youth who understand the importance of teamwork and communication
16	number of maker spaces created to foster technology learning and creativity
17	number of youth indicating an increased interest in STEM

Outcome #1

1. Outcome Measures

number of youth indicating an increase in understanding of decision making processes

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

number of youth who have indicated the intention to practice improved basic life skills

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

number of youth who have participated in 4-H programs and indicated that they now possess transferrable workforce skills

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

number of participants who increased awareness about what it costs to maintain a household (RMRW)

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

number of participants who increased awareness about how spending impacts other choices and opportunities (RMRW)

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

number of participants who increased awareness about how the type of job they have affects how much money they will make (RMRW)

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

number of 'Real Money. Real World.' participants who indicated an intent to get more education or training after high school (RMRW)

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

number of participants who increased feeling of importance about waiting to have children until financially ready (RMRW)

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

number of 'Real Money. Real World.' participants who indicated they would develop a plan for their money that includes both needs and wants (RMRW)

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

number of 'Real Money. Real World.' participants who indicated they learned how to make wise financial decisions (RMRW)

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

number of youth participants who increased their knowledge of producing quality and safe animal products for consumers through responsible animal handling, care, and welfare (Assuring Quality Care for Animals)

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

percentage of youth indicating the intention to change driving habits as a result of 4-H CARTEENS programming

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	91

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The United States is a highly vehicle-dependent society, with a long tradition of allowing driver licensing at age 16 or younger in most states. With that dependence, inexperienced adolescent drivers often demonstrate risky driving behaviors that put themselves, their passengers, and other motorists and personal property at risk. 4-H CARTEENS is a traffic safety program for juvenile traffic offenders, conducted by 4-H teen leaders and their program partners. The "CAR" in CARTEENS stands for "Caution and Responsibility", and the "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.

What has been done

Depending on the county, either monthly or bi-monthly 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. CARTEENS is currently offered in 52 of the 88 Ohio counties. The goals of the program are to reduce the number of repeat juvenile offenders,

decrease the number of teen traffic offenders, and increase teen awareness of traffic / vehicular safety.

In 2016, 666 teens completed retrospective pre-post program evaluations, with parental consent. Of the teens completing evaluations, a summary of their traffic violations follows: speeding (398), failure to control (78), assured clear distance (46), failure to yield (37), stop sign/ red light (27), reckless operation (13), seat belts (12), improper lane movement (6), traffic signs (6), no driver's license (4), and "other" (36). The majority of teens participating in driving education were either 16 or 17 years old.

Results

Evaluation results revealed the following: 40% of teens indicated they now think about their responsibility as safe drivers; 38% think about the consequences of engaging in risky driving behavior, 47% now adjust all things that might distract them (eating, cell phones, music) before driving their car, 37% now understand the relationship between vehicle speed and stopping distance.

As an overall indicators of the CARTEENS program, participants were asked to rate the instructors. 95.3% rated the instructors as either "Good" or "Excellent". When asked how likely the CARTEENS program was to change driving habits, 91% indicated "somewhat likely" or "very likely". Overall, participants rated the program as "excellent" (56.9%) or "good" (38.6%). Finally, 89% "agreed" or "strongly agreed" that they were less likely to be a repeat traffic offender as a result of attending the CARTEENS program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #13

1. Outcome Measures

number of OSU Extension professionals who completed training so they could provide yoga instruction to youth

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	36

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

It is estimated that less than half of children in the United States get the recommended 60 minutes per day of physical activity. Insufficient physical activity is judged to be one of the 10 leading risk factors for global mortality. There has been an increase in the reports of major depressive issues for teens, coupled with higher reported stress levels than are present in many adults. OSU Extension adopted the "Yoga for Kids" curriculum, which was initially developed by the University of Arkansas. Yoga has physical benefits, including improved flexibility, muscle strength, and better balance; there are psychological benefits as well: decreased stress, improved mental focus, and self-regulation.

What has been done

36 4-H and FCS educators and program assistants were trained on how to lead a yoga session with kids, including how to adapt the routine for different ages, and how to explain the health benefits of yoga. A three month follow-up evaluation was conducted, which received responses from 24 individuals.

Results

80% of the respondents had already taught yoga to kids back in their home counties, with 67% offering yoga at a 4-H county meeting, 25% incorporating yoga at another healthy living event, 20% conducted yoga at an after-school event, and 8% worked with teens to train them how to lead yoga sessions. One of the OSUE educators that participated in the Yoga for Kids training was asked to lead yoga sessions with a local high school football team in her county, to help improve the team's flexibility and agility! Sixty seven percent of Extension professionals observed positive changes among youth who participated. Three quarters of the respondents indicated they would like additional / further yoga instruction training, and 60% reported becoming more physically active as a result of learning yoga instruction.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #14

1. Outcome Measures

number of military family members who benefitted from Ohio Military Kids camping programs

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
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2016

1430

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Military deployment rates have occurred at unprecedented rates during the last 15 years. Deployment impacts the health and well-being of family roles and responsibilities, family routines and processes. Youth with deployed parents often feel isolated, and miss out on doing every day activities and celebrating special occasions. Older youth often have the added burden of taking on additional family responsibilities. Studies show that reintegration of military personnel into family life can also present challenges.

What has been done

Participation in camp programs provides positive benefits to young people and their parents. OSU Extension offers residential camps for military families, which brings together families with similar situations and experiences, allowing them to share their stories and gain support from each other. Camps help develop family cohesion.

In 2016, there were three one day "Hero Camps", one 5-day residential leadership camp for teens, two 5-day camps (one for 9-11 year olds, one for 12-15 year olds); seven weekend family camps, and 1 VIP day for donors and community partners. 1,012 youth and 418 adults participated in camps and club programs. Camp participants were family members of servicemen and women from the following branches of the military: Army National Guard, Air National Guard; and both reserve and active service for: Army, Air Force, Navy, Marine Corps, and Coast Guard. 520 programming hours were spent with campers, and camping was supported by 10,750 volunteer hours from 205 volunteers.

Camping activities included: horseback riding, swimming, singing camp songs, tie-dyeing shirts, and running relays. At the Ohio Military Kids residential camp, OSUE educators also incorporated deliberate healthy living activities, including using the smoothie bike, yoga, and thinking about drinking water first for thirst (rather than sugary drinks).

Photographs were taken at one five-day camp and posted to a Facebook page, so deployed military parents could see what their families were up to at camp.

Results

Youth and families have increased awareness of a support network through connecting with other families in similar situations. Youth develop skills, including independence, responsibility, social skills, and communication. Families spent quality time together and strengthened relationships. Youth participants reported greater confidence in their communication, coping, and social skills. Based on reports from parents, youth are better adjusted due to their camp experiences (they demonstrate pride in being part of a military family, they maintain connections with other military youth, and they practice new skills).

The 265 residential camp attendees were surveyed on their camping experience. On a 4-point scale, campers gave the following mean scores: "had fun" (3.7), "felt pride in being part of a military family" (3.7), "made new friends" (3.7), and "pushed myself to try new things" (3.4). Those campers were also asked about healthy living measures (which were hosted at their camp). As a result of the 234 campers responding to the survey, 88% indicated they learned how to make healthy food choices, and 89% learned why it is important to eat a healthy diet every day. Feedback from respondents indicated that campers were drinking more water and drinking less

soda (92%), eating more fruits and vegetables (82%), eating more whole grains (71%), and less junk food (70%) because of what they learned.

One Air National Guard member commented on the Facebook page: "This is my son's first military kids camp experience, first long-term deployment experience, and first time away from home for several days. Keep up the good work and I look forward to many more pictures from 6,000+ miles away!"

The Ohio Military Kids camps are working: not only do the numbers show it, but campers return to be counselors, in order to give back. One Army National Guard spouse commented, "Once he was a camper himself, now he is a counselor. If your camper is with my son, know that he is in good hands and he has been where they are. His dad was deployed three times in seven years, so he can definitely relate. He loves being a counselor and it's the highlight of his summer."

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #15

1. Outcome Measures

percentage of youth who understand the importance of teamwork and communication

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	94

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Pollinators, like honeybees, are responsible for one in every three bites of food we eat. OSU Extension knows how vital these animals are to our food chain; so making sure the next generation understands their value is paramount to maintaining a stable food supply.

What has been done

To increase students' understanding of honeybees as pollinators, Ohio 4-H offered an engineering challenge. Students were provided with a toothbrush head, a small vibrating motor, a watch battery, a bee sticker, and a piece of tape. Mentored by adult volunteers, the students engineered a bee bot, and which navigated forage routes to collect pollen on a simulated

landscape map. The map was provided, and students had to use straws, paper cups, and other tools to help guide the bees to areas that had the most "pollen" (sand or glitter were commonly used). The "pollen" was picked up by the bee bots via the tape, which was meant to mimic how bees pick up pollen with their fuzzy legs. Students were challenged to figure out how their bee bots could pick up the most pollen on each of three crop areas on their map mat in the least amount of time.

The buzzing bee bots don't just SOUND like bees -- they kind of move like bees, too. Students also learned about the honeybee "waggle dance," which is performed by worker bees when they find a good source of pollen and need to share with other workers in the hive. The orientation of the bee's movement indicates the direction of the pollen, and the length of the dance indicates the distance.

Local youth beekeepers and 250 teen leaders helped to conduct 306 bee bot events to both domestic and global audiences, reaching 13,210 youth in 2016. 2,135 of those youth were Ohio residents.

Results

Post-event evaluations, revealed that 94% of participants agreed that teamwork and communication, two essential elements of the honeybee challenge, were important to the challenge. 78% of participants indicated they were more interested in science and agriculture, and 98% indicated that honey bees are a good way to increase food production. 62% agreed that they are more interested in learning about food production. 85% are more interested in advocating for agriculture issues that impact the world and more than 90% like science and believe it is useful for solving real-world problems, like the honeybee challenge.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #16

1. Outcome Measures

number of maker spaces created to foster technology learning and creativity

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

It is not uncommon for urban centers to have many access points to technology, but in rural areas this is not always the case. In Hardin County, Ohio, one of the county educators recognized that residents needed better access to technology; he wanted the residents to see the local Extension office as a destination for technology needs and a place to engage in the maker movement. The vision was to create a space at the local Extension office that would spark creativity, innovation, and hands-on learning in young people and local entrepreneurs.

What has been done

This vision became a reality in 2016, and the Hardin County Spark Lab Innovation Center was born. The lab is home to a 3D printer (the county's first), a handful of drones (UAVs), GPS units, LEGO robotics kits, a smart board, a laser cutter, a video conferencing seminar room, iPads, Google Cardboard, and a video production lab with an HD video camera, a green screen, and a computer with Final Cut software for video production work. County program staff regularly host sessions, such as "Tech Tuesdays" and "Workshop Wednesdays," as well as special programming via projects ranging from sewing and art to robotics and rocketry. The Spark Lab also hosts food and nutrition cooking demonstrations and hosts webinars where students can interact face-to-face virtually with instructors. The space has hosted nearly 1,000 young people and adults in its first year of operation.

Results

The feedback from Hardin County residents has been overwhelmingly positive. One Spark Lab user and parent commented, "I've been very impressed with the technology that's in Spark Lab, even things like the robots my children have had access to all the way up to the iPads and the technology that I've learned to use with your video editing, and some of the programs you've shared on the Tech Tuesdays. I'm thoroughly impressed with the access that community members have to technology right here in Hardin County."

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #17

1. Outcome Measures

number of youth indicating an increased interest in STEM

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	47500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Recent statistics show STEM education in the United States is not improving. In 2011, only 30% of high school graduates were prepared for college-level science work, and only 45% were math-ready. Poor preparedness in STEM subjects, coupled with the fact that record numbers of current scientists and engineers are approaching retirement means there is a great need for the encouragement and development of STEM skills in today's youth.

What has been done

In 2016, the OSU Extension "STEM Pathways" program reached more than 50,000 youth. The program was supported by 58 OSUE Extension professionals, and more than 2,500 adult and teen volunteers. STEM Pathways was delivered to Ohio youth through many different channels: camps, 4-H clubs, school classrooms, after-school sites, public events (including fairs, festivals, and sporting events), and Farm Science Review. STEM Pathways even reached youth in Honduras, using Ohio students to teach challenges there.

Results

Evaluation data was collected on both quantitative and qualitative measures. 95% of youth participants indicated an increased interest in STEM; 85% reported that completing STEM challenges and other STEM activities helped them develop or strengthen their abilities to work with other. Other quantitative results of note: 78% of participant are more interested in science as a result of their STEM programming participation; 94% agreed that teamwork and communication, two essential elements of STEM projects and real-life problem solving, were important to accomplish STEM challenges; and 90% of teen volunteers indicated they like science more after their volunteering role. Teachers of students who participated in 4-H STEM activities reported that their students had improved science test scores.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

In some counties, there do not exist a full complement of the other three program-area

related Extension educators, so 4-H educators often have to fulfill multiple programmatic roles, which puts a strain on their time and programming.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The Ohio 4-H program always has strong outcomes, thanks to solid programs and a dedicated, talented staff of professionals. The following outcome evaluation information is just a small sampling of the ways in which 4-H made a difference in the lives of Ohio youth last year:

In 2016, more than 660 teens participated in 4-H CARTEENS programming. 40% of teen participants indicated they now think about their responsibility as safe drivers; 38% think about the consequences of engaging in risky driving behavior; 47% now adjust all things that might distract them before driving their car; and 37% now understand the relationship between vehicle speed and stopping distance.

More than 50,000 youth participated in STEM Pathways programming in 2016. Evaluation data was collected on both quantitative and qualitative measures. 95% of youth participants indicated an increased interest in STEM; 90% of teen volunteers indicated they like science more after their volunteering role.

36 Extension program staff members were trained on how to conduct a yoga session with kids. 80% of follow-up survey respondents indicated they had already taught yoga to kids back in their home counties. One of the educators was asked to come teach yoga to local high school football players, to help improve flexibility and agility.

The Ohio Military Kids program reached 1,012 youth of families with a military parent, as well as 418 spouses of military personnel. A variety of camping activities were offered in 2016, which incorporated healthy living messages.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 16

1. Name of the Planned Program

Strengthening Families & Communities (Extension)

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
703	Nutrition Education and Behavior	25%		0%	
724	Healthy Lifestyle	25%		0%	
801	Individual and Family Resource Management	25%		0%	
802	Human Development and Family Well-Being	25%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	24.0	0.0	0.0	0.0
Actual Paid	34.0	0.0	0.0	0.0
Actual Volunteer	10.5	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1668304	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1668304	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Conduct formal and informal needs assessments
- Develop programming materials and curricula
- Conduct meetings, workshops and educational sessions
- Conduct program evaluation and applied research
- Form and sustain community partnerships
- Train volunteers, paraprofessionals, and other community agency/organization professionals

2. Brief description of the target audience

'Strengthening Families and Communities' programming is tailored to meet the needs of each audience we engage. School programming is age appropriate, whereas programs at senior centers are targeted to inform on safe food preparation for individuals living alone or with one other person. The end result is a planned program that has the potential to encompass all residents of the state. Below is a listing of the specific groups we intend to reach with targeted awareness, educational and skills-development programming:

- Parents of children ages birth to 18, including, but not limited to: teen, step, adoptive, foster, single, divorcing, incarcerated, fathers who have not yet established paternity, and grandparents;
- Adults in, or thinking about entering, intimate relationships;
- Young adults;
- Older adults and those who care for them;
- Baby boomers, especially women;
- Limited resource families, including mothers with young children and food stamp recipients;
- New employees;
- Bankruptcy filers;
- Debt burdened individuals and couples;
- First time home buyers;
- Individuals with diabetes and their caregivers/family support members;
- Food establishment managers and food service employees;
- Volunteer food preparers;
- Child care providers;
- Teachers;
- Social service professionals;
- General consumers (other formal or informal education).

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	58027	120048	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2016
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Educational sessions held with two or more participants
 Not reporting on this Output for this Annual Report

Output #2

Output Measure

- number of volunteer hours given

Year	Actual
2016	21833

Output #3

Output Measure

- number of Dining with Diabetes classes taught
 Not reporting on this Output for this Annual Report

Output #4

Output Measure

- total number of volunteers participating in the planning and / or implementation of 'Strengthening Families and Communities' programming

Year	Actual
2016	5109

Output #5

Output Measure

- number of individuals participating in 'Dining with Diabetes' programming
Not reporting on this Output for this Annual Report

Output #6

Output Measure

- number of individuals participating in the 'Live Healthy Live Well' program
Not reporting on this Output for this Annual Report

Output #7

Output Measure

- number of individuals participating in the 'Successful Co-Parenting' program
Not reporting on this Output for this Annual Report

Output #8

Output Measure

- number of individuals participating in 'Healthy Finances' programming
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	number of 'Dining with Diabetes' (DWD) participants that report engaging in cooking activities to help take control of their diabetes -- using healthy oils in cooking, substituting herbs and spices for salt, and using nutrition labels
2	number of 'Dining with Diabetes' participants that report engaging in physical activities to help take control of their diabetes -- fitting exercise into their daily routine, exercising continuously for at least 30 minutes at least three times per week, and being physically active on a daily basis
3	number of participants in the 'Live Healthy Live Well' program that report adopting one or more of the recommended practices that might help reduce their risk of developing chronic disease
4	number of individuals participating in the 'Successful Co-Parenting' program that feel more prepared to co-parent as a result of the program
5	number of individuals participating in 'Healthy Finances' programming that indicated the intent to change one or more behaviors as a result of attending an educational session
6	percentage of youth who now feel more compassionate toward seniors
7	number of community health assessments conducted, which will inform community and health industry leaders about the needs and assets of the community

Outcome #1

1. Outcome Measures

number of 'Dining with Diabetes' (DWD) participants that report engaging in cooking activities to help take control of their diabetes -- using healthy oils in cooking, substituting herbs and spices for salt, and using nutrition labels

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

number of 'Dining with Diabetes' participants that report engaging in physical activities to help take control of their diabetes -- fitting exercise into their daily routine, exercising continuously for at least 30 minutes at least three times per week, and being physically active on a daily basis

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	88

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Diabetes costs Ohio \$4.6 billion annually. According to 2015 state of Ohio data, more than 11.7% of Ohio adults have been diagnosed with diabetes. Since 2000, the number of Ohioans with diabetes has increased nearly 37%. Those with diabetes can develop serious health complications, including cardiovascular disease, blindness, kidney failure, and non-traumatic lower extremity amputations; diabetics lose an average of 10 - 15 years of potential life as a result of their disease.

What has been done

OSU Extension offers nutrition education for pre-diabetic and diabetic individuals, which helps them learn how to better manage their food intake and meals. Educational programs include live cooking demonstrations, menu planning, diabetes management, carbohydrate counting, insights on portion control, label reading, and healthy recipe taste-testing. The "Dining with Diabetes" course is a three part series, with three distinct modules: fats and sodium; carbohydrates and sweeteners; and vitamins, minerals, and fiber. Dining with Diabetes uses a pre-post evaluation tool, which matches responses from before the program to post-program. In 2016, 124 matched

evaluation tools were returned (though the number of participants in the program was higher).

Results

In comparison of the pre-test and the post-test measuring knowledge, evaluations showed that 48% of participants scored better on the post-test. Following educational events, more participants were reporting engaging in the following positive behaviors: using heart-healthy oils in cooking, using herbs and spices instead of salt, and using nutrition labels to help make food choices. Participants were given a list of several items, and asked which activities they have adopted since taking the Dining with Diabetes course. 71% indicated they were now fitting exercise into their daily routine (like taking the stairs instead of the elevator), 67% indicated they were deliberately engaging in physical activity (like taking a walk for exercise) on a daily basis, and 42% indicated they were exercising regularly for at least 30 minutes on each of three or more separate days per week. Impressively, over 97% of participants indicated that they were eating smaller portions after participating in the program, and 84% reported that they were cooking more at home.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #3

1. Outcome Measures

number of participants in the 'Live Healthy Live Well' program that report adopting one or more of the recommended practices that might help reduce their risk of developing chronic disease

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	3172

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

OSUE Family and Consumer Science educators believe the statistic that more than 70% of all health care costs are related to unhealthy lifestyle choices. Other statistics indicate that more than 72% of Ohioans do not get proper nutrition, and 1 in 4 are physically inactive. Education that encourages healthful habits has the potential to reduce the need for health care services, lower

absenteeism rates at work, and help control costs for employers.

What has been done

The "Live Healthy Live Well" (LHLW) program uses a variety of delivery methods to provide evidence-based health and wellness information to busy Ohioans: email wellness challenges, online programming, and social media. 3,647 participants were engaged in one of three email wellness challenges in 2016. 20 webinars were hosted for OSU employees through the university's "Your Plan for Health" wellness program; the webinars were viewed by more than 400 employees. There were 39 "Lunch and Learn" lessons offered to groups or various organizations on wellness topics, and 62 wellness events on topics like sun safety. The lunch and learn events and other wellness events (in-person events) were attended by over 7,450 individuals. Some of the topics addressed by LHLW programming include: "Sleep: Are You Getting Your Zzzzzs?", "To Salt or Not To Salt", "Cooking for One or Two", "Planning Healthy Meetings", "MyPlate and Weight Management", "Physical Activity: A Good Fit", and "Save Your Skin: Sun Safety". A blog and a Facebook page were also maintained by OSUE educators, with a reach of 15,070 and 607,000, respectively.

Results

In two of the three email challenges, 90% of participants reported they had learned new information. Further, 87% of participants from those two email challenges reported that they were using the new information learned as a result of their participation in LHLW. Behavior changes reported included: taking a break from sitting after 30 minutes by standing or moving; participating in physical activity for at least 30 minutes on at least 5 days a week; and choosing unsweetened beverages like water, tea, low-fat milk, or a spritzer on at least five days a week.

Many positive comments were shared by participants, including the following: "I just wanted to thank you for all the great ideas and encouragement you and your colleagues have given during this fall's challenge. I have the most hectic week from last Friday until this Saturday, but I am planning some me time right now! On Thanksgiving Day when my house is full of in-laws chatting and watching football in increasingly loud voices stressing me out, I plan to slip out and walk a mile or so in my neighborhood. They'll never miss me and the dishes can wait!"

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #4

1. Outcome Measures

number of individuals participating in the 'Successful Co-Parenting' program that feel more prepared to co-parent as a result of the program

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1608

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Current estimates indicate that about 40,000 Ohio marriages end each year. Of those divorces, approximately 45% involve families with minor children. The OSUE Successful Co-Parenting curriculum is designed to equip divorcing parents with the knowledge, skills, tools, awareness, and strategies which will enable them to best help their children adjust to divorce.

What has been done

The Successful Co-Parenting class is delivered in a two and a half hour session. Topics discussed include: maintaining healthy parent-child relationships through the divorce process; teaching parents to identify and deal with their own grief and loss during the divorce period and how to maintain their own mental health; how and why to avoid conflict with their co-parent; how and why to maintain healthy communication with their co-parent and child(ren); the importance of creating a stable environment for the child(ren). In 2016, there were 1,758 individuals reached with divorce education programming. As of the end of 2016, this program was being offered in 13 of 88 Ohio counties. The program was also offered to OSU employees as a webinar 3 times through the university's "Your Plan for Health" platform.

Results

Retrospective evaluations revealed that 93.4% of participants learned new information; 97% indicated they planned to use information they learned. 91.5% of participants feel more prepared to co-parent as a result of the program. Participants experienced a positive change (knowledge gain) on a variety of metrics, including: "the importance of caring for my own emotional health" (38.1%); "how the divorce process impacts my child(ren) based on his / her age" (51.7%); "the importance of healthy communication with my co-parent" (39.4%); and "how to use healthy communication techniques such as problem solving with my co-parent" (48.1%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being

Outcome #5

1. Outcome Measures

number of individuals participating in 'Healthy Finances' programming that indicated the intent to change one or more behaviors as a result of attending an educational session

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	368

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

It is not uncommon for individuals and families to experience financial troubles. Unexpected life events, such as losing a job, declining health, or loss of adequate health insurance can impact personal economic well-being. While these events are sometimes unavoidable, having financial management skills and a solid financial plan in place can help make coping with those life events more manageable. OSUE "Healthy Finances" education helps individuals and families improve their present and future economic well-being.

What has been done

OSUE Family and Consumer Science educators reached 376 individuals in 2016 with "Healthy Finances" education. Programs were delivered through face-to-face instruction with individuals and families. Healthy Finances education is also offered as training for other professionals, such as teachers or social workers, who will work directly with families or individuals on financial matters. During educational sessions, participants learned how to assess their financial circumstances; increase their financial management skills, including organizing financial records, tracking spending, and improving bill paying; reducing debt and beginning or increasing savings; and improving consumer decision-making abilities.

Results

The top three behavior changes indicated by 2016 participants were: "use written goals to guide my financial decisions" (83%), "set aside money for occasional expenses" (80.6%), and "set aside money for emergencies" (80.2%). Nearly 96% of participants either indicated "agree" or "strongly agree" when asked if they learned new information from the program. Further, nearly 98% planned to use the information they learned from the educational program, and 95% of participants indicated that they believed they would make behavior changes within 6 months of completing programming.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #6

1. Outcome Measures

percentage of youth who now feel more compassionate toward seniors

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	87

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Residents in senior facilities often feel lonely and cut off from the world. Meaningful interaction with young people and pets has the potential to provide stress relief, comfort, and companionship.

What has been done

The Ohio 4-H PetPALS program -- People and Animals Linking Successfully -- was developed to teach 4-H members the skills needed to prepare their pets to have successful intergenerational interactions with residents of health care facilities, particularly nursing homes, assisted living facilities and hospices. The program also prepares pets for visits to schools and even colleges during finals week. In 2016, 181 Ohio 4-H members were trained by adult volunteers to socialize their pets and acclimate them to public visit situations. 4-H members also received sensitivity training, to help with their interactions with seniors and people with disabilities. Ohio 4-H PetPALS participants have the opportunity to earn an American Kennel Club Therapy Dog title for their pet. To date, 4 Ohio PetPALS animals actively have that designation.

Results

4-H PetPALS brought pets to visit an estimated 5,500 Ohioans in 35 counties last year. Research on the program shows that 4-H PetPALS participants are more empathetic and compassionate towards seniors and have a keener sense of understanding, respect, and appreciation for them. From 2012 - 2016, random pre-post tests were administered to 4-H PetPALS members. Results from the evaluations showed that 98% of youth increased their awareness and knowledge and improved attitudes towards seniors; 87% felt more compassionate and understanding towards senior adults; 79% used best practices learned in their 4-H PetPALS experiences and applied

those lessons towards everyday learning.

The lessons learned from the PetPALS experience stay with 4-H youth. One Franklin County 4-H member, Lauren, had this to say about her experience with 4-H PetPALS: "I would have never joined 4-H if it weren't for the PetPALS project. I wanted to find a way for Milo and me to help others, and that's how I got my start in 4-H. I gained confidence and bonded with Milo even more because he loved 4-H PetPALS visits too. So, we then took dog projects while still making 4-H PetPALS visits. I am more compassionate and understanding of others, have grown so much because of meeting great people regardless of their age and abilities, and now also visit hospices, libraries, and people with disabilities with Milo. I plan to continue as an adult 4-H PetPALS volunteer leader when I am out of 4-H."

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being

Outcome #7

1. Outcome Measures

number of community health assessments conducted, which will inform community and health industry leaders about the needs and assets of the community

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Access to health care is one of the key topics of discussion not only at the national and state levels, but at the local level as well. A community health assessment can help inform community and health industry leaders about the needs and assets of the community as it relates to health care and the health of the area's residents.

What has been done

In order to identify community resources and capacities to address local needs, as well as set priorities, OSU Extension worked with Highland County to gather and analyze data on local health concerns and challenges. In Highland County, there were 433 residents and 114 health professionals who responded to the web-based community health survey.

Data from the web based surveys has been thoroughly analyzed and summarized, resulting in a 61 page report, which compares data collected through web-based surveys to other sources of qualitative and quantitative data, including information from the U.S. Census, the 2016 County Health Rankings, the U.S. Centers for Disease Control and Prevention, the Ohio Department of Health, and the Appalachian Data Portal Health Landscape.

Results

The Highland County health survey revealed that, overwhelmingly, residents weren't primarily concerned about cancer or obesity, but illegal drug use. In fact, 51% of respondents personally knew someone who uses illegal drugs, such as marijuana (70%), heroin (51%), or methamphetamine (37%) or who abuse prescription drugs (49%). Respondents also indicated that the county doesn't have adequate resources to deal with these drug abuse issues. When health care respondents' responses were compared with resident respondents, a divide was seen: 95% of health professionals rated the county resident health as "poor" (7%), "fair" (44%) or "good" (44%). Residents rated their health higher, with 90% of respondents rating themselves as "good" (49%), "very good" (31%), and "excellent" (10%). 21% of female respondents indicated they smoked during pregnancies.

The report has been shared with Highland County, to help inform community leaders about the health care needs and service gaps that exist. Information from this report is being used to set goals, establish plans of action, develop health and wellness initiatives, and build collaborations among organizations and businesses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

There are other non-profits and organizations offering educational events similar to OSU Extension -- consumers have lots of choice when it comes to sources of their information. OSUE must be competitive in both price and diversity of offerings in order to maintain a steady level of participants.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The 'Strengthening Families and Communities' planned program largely aligns with OSU Extension's 'Family and Consumer Science' program area. This segment of Extension programming seeks to educate Ohioans on how to have healthy relationships, healthy finances, and to be healthy people.

The "Successful Co-Parenting" program is offered to divorcing parents, to help ease the stresses of the divorce process on the family. The program educates divorcing parents on understanding the practical and emotional processes of divorce, how to identify behaviors that can be harmful to their relationships with their children, and ways to communicate with their former spouse that are respectful and positive. 97% of participants in 2016 indicated on post-session evaluations that they plan to use the information gained during the program in their lives.

The "Live Healthy Live Well" program educates Ohioans on nutrition, physical activity, and wellness issues. The program largely makes use of social media and email to maintain contact with participants, and as a way to provide constant information and encouragement. Three email wellness challenges were issued in 2016, reaching 3,647 individuals. Following the wellness challenges, email surveys were sent out to participants. Results showed that 90% of participants learned new information, and 87% were actually using the new information learned during the email challenges.

Participants in OSUE's healthy finances programming learned a variety of positive skills and behaviors, including: using written goals to guide financial decisions (83%), setting aside money for occasional expenses (80.6%), and setting aside money for emergencies (80.2%). Nearly 96% of participants either indicated "agree" or "strongly agree" when asked if they learned new information.

Finally, a community health assessment conducted in one Ohio county revealed trends and concerns, which will guide future programming efforts for OSUE.

Key Items of Evaluation

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes with climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
0	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.