2016 University of Illinois Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

The University of Illinois at Urbana-Champaign [UIUC]

The impetus to develop public land-grant universities, including the University of Illinois, was the Morrill Act of 1862. Founded in 1867, the University of Illinois is celebrating its sesquicentennial in 2017, enhancing the lives of people in Illinois, across the nation, and around the world through leadership in learning, discovery, engagement, and economic development. With the land-grant heritage as a foundation, the University of Illinois pioneers innovative research that tackles global problems and expands the human experience. Transformative learning experiences, in and out of the classroom, produce alumni who desire to make a significant societal impact. Now a system that includes three main campus sites in Urbana-Champaign, Chicago, and Springfield, the University of Illinois reaches every county and community in Illinois in some dimension. More than 44,000 students from all fifty states and more than 100 countries study on the campus in Urbana-Champaign.

As Illinois envisions its 21st century land-grant mission, the central pillars remain - research readily translated into practice, driven by public support, done by scholars to address issues at a local level - and access to high-level education for students from all backgrounds. Embrace of the land-grant mission is most evident in the College of Agricultural, Consumer and Environmental Sciences, in accessible and transformative academic programs, in research activities spanning fundamental to applied dimensions, and in vital public educational outreach. The Illinois Agricultural Experiment Station and University of Illinois Extension reside in the college.

The College of Agricultural, Consumer and Environmental Sciences [ACES]

The College of ACES is finding solutions to the world's most critical challenges in order to ensure abundant food and energy, a healthy environment, and successful families and communities. Program reviews and other parameters recognize excellent scholarship and program quality in ACES, the Illinois Agricultural Experiment Station, and University of Illinois Extension. Even though Illinois is the largest food and agriculture economy in the region, state support is flagging in Illinois relative to Midwestern peer institutions with comparable programs. Premier faculty and programs yield robust external funding in terms of grants and contracts, local support, development activity, and scholarship awards. Student placement and other indicators reflect excellent program quality in ACES, despite erosion in faculty and staff capacity. Undergraduate student enrollment in ACES peaked three years ago, even though academic domains in the college remain fertile ground for study.

To strengthen the College of ACES, the IAES, and U of I Extension, the leadership expects to: [1] Improve the profile and visibility of the College of ACES to internal and external stakeholders; [2] Stabilize and expand our funding portfolio to reduce dependence on state resources; [3] Build a 21st Century Extension program, strengthening the gap between discovery and application; [4] Create proactive advancement strategies that add value with the alumni and donor base; and [5] Create a high-touch, proactive student recruitment approach, emphasizing high-value education and career readiness.

State support for higher education has generally decreased for many years, but a more acute financial crisis in Illinois has resulted from the state's budget impasse over the past two years. The State of Illinois has failed to enact full-year budgets for FY 2016 or FY 2017, creating unprecedented uncertainty with respect to recurring state support for the University of Illinois. While funding continued for many state programs due to specific legislative and court actions, higher education was not appropriated any state funds for FY 2016, and only a partial year stop-gap appropriation was made for FY 2017. Reductions in state agency budgets and a backlog of unpaid state obligations [more than $10 billion] have also resulted in failure to fund significant grants for Extension and other programs.

The university took measures to contain costs, pending resolution of the state budget situation, while also holding the line on further tuition increases. No salary program occurred in FY 2016, but the university will internally fund a mid-year 2% merit-based salary program for FY 2017. Additional cash rescissions and permanent reductions in state funding are expected. The University of Illinois and the College of ACES covered current costs from cash reserves and other sources of revenue for a finite period. During FY 2016, aggregate expenditures by the college increased slightly by 0.2% [+$318,154] over the previous year, reflecting some increase in research expenditures and central investments, offsetting reduced spending in Extension and academic programs. Expenditures will be constrained in the current and subsequent years due to rapidly declining state support and cyclical economic conditions affecting industry support and commodity sales. For several consecutive years, ACES exercised fiscal discipline, increased student enrollment, and managed contraction of its human capacity and statewide organizational structures.

The Illinois Agricultural Experiment Station [IAES]

The Office of Research aligns the research mission of ACES with the Illinois Agricultural Experiment Station [IAES], which operates as a statutory state-federal partnership, strategically promoting investment in research that balances between discovery and application, and between long-term and short-term outcomes, to increase fundamental knowledge and ensure relevance to the state's food, agricultural, environmental, and human interests. This encompasses research projects in ACES and in other academic units, including the Colleges of Veterinary Medicine, Engineering, LAS, and Law, as well as the Prairie Research Institute. The IAES also supports research with partners in other institutions and cooperates with the USDA's Agricultural Research Service [ARS], which has permanently assigned a number of scientists to the Urbana campus.

The IAES administers federal formula funding provided to Illinois through the USDA National Institute of Food and Agriculture [NIFA]. The Office of Research/IAES prorates Hatch Act formula funding, which it invests centrally or allocates to academic departments for program support. Illinois does not invest capacity [formula] funds for permanent salaries, except for critical needs. Even in those cases, the college eventually intends to move those salaries to other sources. The Office of Research also oversees the research programs funded from grant, contract, donor, and university sources. The IAES coordinates with other state agricultural experiment stations across the country and with USDA/NIFA, effectively utilizing federal capacity to undertake research and education related to food, agriculture, communities, and the environment. Congressional appropriations give USDA the authority to maintain funding for formula and competitive research programs. A continuing resolution is funding the federal government until April 28, 2017. From all sources, public and private, the combined research activities of IAES/ACES accounted for $63,534,991 [36%] of the FY 2016 expenditures in the college. External funding has shifted in recent years from reliance on state and traditional USDA support toward industry gifts and grants, a broader array of federal granting agencies, and involvement in multi-disciplinary centers and initiatives. The mission of the IAES includes research to support stakeholders in Illinois, in partnership with USDA and industry entities in the state.

The research infrastructure maintained by the IAES and the College of ACES includes field research and

education centers. These centers, operated on the main campus south farms and in other locations in the state, provide capacity for field-scale research that takes advantage of various environmental conditions represented in Illinois. The respective academic departments where programs reside take responsibility for the operational management of the field research and education centers. The Office of Research participates as necessary in the effective operation and maintenance of these critical field-scale laboratories. Due to financial constraints and strategic directions, the college and the Department of Crop Sciences made the decision last year to cease crops research operations at four of the field research and education centers and consolidate those activities at the remaining facilities. As development occurs on the south campus [related to expansion of the U of I Research Park] the facilities for the Division of Intercollegiate Athletics, and the neighboring communities, the college cooperates to both facilitate development and to maintain excellent field research facilities. The Office of Research also manages central research support units on campus, such as the plant care facility. A new research facility, the Integrated Bioprocessing Research Laboratory, will be operational by next year. Funded by the State of Illinois, construction resumed after an interruption caused by the cessation of state payments for the project.

University of Illinois Extension

Until now, University of Illinois Extension [Extension] has been able to maintain its field-based multi-county Extension county directors and Extension educators that include grant-funded positions and statewide 4-H Extension educators and 4-H Extension specialists. In addition, normal/expected staff turnover levels have allowed for continued infusion of staff that bring new expertise through their academic and work experiences. Extension also enhanced educational outreach through several new programs developed by teams of educators, as well as interdisciplinary programs that are required to address the issues reflected in this annual report.

Use of synchronous and asynchronous distance delivery continued to increase in FY 2016. Extension websites generated 188,000 average daily page views. Direct teaching contacts for FY 2016 declined to 1,149,970 as compared to 1,574,330 in FY 2015. Field Extension staff professionals receive support for their scholarship, but they are not part of the university tenure system. Most field professionals pursue scholarship-related opportunities for educational delivery via websites, webinars, online modules, YouTube videos, and social media, rather than publication in scholarly journals. Extension professionals regularly identify program impact [knowledge, practices, and condition changes] and gather information from distance delivery participants.

Illinois is the most populous state in the North Central Region, but Illinois's Extension faculty capacity is less than that of our peer land-grant universities in the region: Illinois has 12.07 FTE state Extension specialists [tenure-system faculty with departmental appointments in Extension]. Research translation and program delivery from campus-based specialists is vitally important in filling the gap between discovery and application. Maintaining a critical mass of campus-based specialists to provide the educational content for programs is a long-term problem. The IAES and Extension have cooperated to create three critical specialist positions as non-tenure-track faculty in the agriculture and natural resources program area, initially funded with Hatch and Smith-Lever formula funds. The intention is to convert these positions to permanently funded tenure-track faculty lines as other recurring funding sources become available. Another successful pilot approach was the University of Illinois Extension and Outreach Initiative, which built relevant Extension programs exploring new areas of outreach education with faculty from non-traditional units. Eight projects were selected to achieve four purposes: [1] Raise the visibility and relevance of outreach across university units and among stakeholders in the state, with the purpose of developing stronger and more meaningful connections with stakeholders; [2] Create a model for working across campus units to support and expand the university's land-grant mission of outreach; [3] Develop collaborative, change-oriented projects that address a need evident or identified at the community level; and [4] Foster or develop outreach from interdisciplinary work. These projects involved collaborations with

the College of Business, Graduate School of Library and Information Science, Illinois Sustainable Technology Center, School of Art and Design, Spurlock Museum, Department of Computer Science, College of Education, and Department of Recreation, Sport and Tourism, along with multiple community entities. Although the three-year fiscal support ended for most of these partners, those who had not used all of their allocation continue to do so.

Total funding revenue for the Extension organization fell dramatically [-26%] in FY 2016 from the previous year, mainly attributable to a reduction [-55%] in state funding received [-$13,277,204]. This was a combination of reduced state base funding through the university's allocation process [-$1,457,513] and non-payment by the state of Extension appropriations passed through the Illinois Department of Agriculture [-$11,819,691]. Local funding received for Extension also declined again in FY 2016 [-7%] due to a reduction in non-matchable funding contributions. Dedicated appropriations through the Illinois Department of Agriculture were as yet unfunded in FY 2016, despite the stop-gap appropriation, and no funds have been received for FY 2017. Extension has relied heavily on the drawdown of reserves that accumulated concomitant with the last statewide reorganization. Federal funding for Extension programs remained relatively constant during the past federal fiscal year.

Changes In The College Of ACES

In November 2016, Dr. Kimberlee Kidwell became dean of the College of ACES [and also holds the inaugural Robert A. Easter Chair]. Previously, Dr. Kidwell served as executive associate dean of the College of Agricultural, Human and Natural Resource Sciences at Washington State University [and served as acting dean in 2015 - 2016]. A graduate of the University of Illinois and the University of Wisconsin-Madison, Dr. Kidwell's research has focused on plant breeding and genetics. She succeeds Dr. Robert Hauser, who was dean from 2009 to 2016.

In July 2016 Dr. Prasanta Kalita became associate dean for academic programs. Dr. Kalita also serves the college as a professor in the Department of Agricultural and Biological Engineering and as director of the ADM Institute for the Prevention of Postharvest Loss. Dr. Laurie Kramer served as associate dean for academic programs prior to Dr. Kalita.

In October 2015, Mr. Charles Vogel joined the College of ACES as associate dean for development. Mr. Vogel was previously the senior director of development at Iowa State University.

FTE Calculations

Previously the FTE's for each individual planned program represented effort that was directly supported by Capacity funds while the FTE's listed in the summary represented all effort contributed to the planned programs regardless of how that effort was funded. At NIFA's request starting with this Annual Report the planned programs also contain all FTE's that contributed to that planned program regardless of how they were directly supported.

The Planned Programs

Agricultural and Biological Engineering - Research activities in FY 2016 included work to optimize the design of vegetative filter strips to prevent the transport of infective microbial pathogens, the development of a new testing system for nozzle spray analysis, a study with the goal of significantly impacting the climate change impacts of agricultural activities by turning the residual bio-waste products into a carbon sink to offset emissions, and ongoing improvements to a quality fan testing laboratory. Extension activities in 2016 continued to focus on manure management, training on pesticide applicator equipment use, use of unmanned aerial vehicles [drones], and new **Extension Livestock Facility Workshops** that addressed the following topics: [1] How to ventilate and then manage/control ventilation in buildings; [2] Aerial disease

development and transmission; and [3] Identifying good air quality and concerns that affect air quality.

Agricultural and Consumer Economics - Research activities in FY 2016 included research on millennials' delayed homeownership, an examination of how pipeline incidents have affected lenders' risk perceptions and risk management strategies, analysis of local, state, federal, and selected international laws that constitute the legal environment for agriculture, work to estimate the value of natural resources and environmental amenities, an investigation into the communication technologies and information outlets used by communities to share information about soy protein applications in the developing world, and research providing greatly needed information on likely future of farmland prices. Extension agricultural and consumer economics programs focused on profitability outlook and management challenges. Extension specialists completely revamped the crop insurance section of the University of Illinois **farmdoc** website and created two new web-based decision tools. **Financial Planning for Young Adults** is a new free, online financial planning course that introduces participants to basic financial planning concepts. **Annie's Project**, a farm management course for farm women previously offered several years ago, was once again conducted at 17 locations in Illinois.

Animal Health and Production - Research activities in FY 2016 included work on the emerging problem of porcine epidemic diarrhea, an investigation of the biological mechanisms underlying germ cell and embryonic development, research with the long-term goal of improving our understanding of the regulation of muscle development, growth, and metabolism to improve the efficiency of meat production, work to determine the functionality of the microbiome across species, research that seeks to determine whether direct osterix expression in equine osteo-progenitor cells stimulates bone formation and by extension fracture repair, and an effort to improve our understanding of the mechanisms whereby environmental and/or physiological stressors modulate immune responses to various pathogens. Extension annual statewide programs addressed animal production and health for swine, beef, dairy, sheep, goats, poultry, and horses for owners, producers, and 4-H youth. New youth livestock programs included a **4-H Livestock Conference** attended by 99 youth who gained knowledge and skills and learned more about careers related to livestock. Youth were also recruited to serve as the newly established **4-H Livestock Ambassadors.**

Community Resource Planning and Development - Extension activities included data gathering and providing planning process management assistance to residents of municipalities, counties, and regions engaged in decision-making. Efforts continued to educate residents of the value of "buying local". Curriculum related to fostering youth creativity and entrepreneurship progressed and was piloted with additional age groups and added a new feature -- the implementation of a Shark Tank Competition that placed students in teams to create business ideas and then present them. The University of Illinois Extension **Local Government Information and Education Network** [LGIEN] webinar series was expanded and addressed using data and analytics to drive government innovations and engaging participants in learning more about comprehensive economic development strategies. Research activities in FY 2016 included an investigation that seeks to contribute to existing research on school readiness among low-income African American and Latino/a families of preschoolers, work designed to explore the extent to which different types of intimate partner violence are associated with different patterns of judicial involvement, a study examining the complex relationships between family socioeconomic conditions, daycare, schooling experiences, and cognitive, behavioral, and socio-emotional growth and development during childhood, and the development of an afterschool physical activity curriculum and template designed to support healthy weight among Latino school children.

Food Safety and Food Security - Research activities in FY 2016 included the development of strategies to make Hispanic-style fresh cheeses safer to help meet market demand, efforts to model the effect of incorporating hydrolyzed protein on the resulting sensory and physical characteristics of a high protein snack system, the identification of methods that extend the shelf life, improve the nutritional quality, and enhance the safety of fresh cut produce, work to study the potential for agroforestry systems to contribute

to food production while also providing additional ecosystem services, and the utilization of dynamic infrared imaging to provide a relatively simple, robust means of ensuring seal, bond, and weld integrity in a range of materials and applications. Extension activities continued to focus on food safety for volunteers that prepare or serve food to the public and training for producers and employees of those producers regarding safe food production and handling to prevent food contamination. Online and supplemental programs entitled **Yes, You Can -- Preserve Food Safely** were conducted during the summer. Food security programming encompassed fieldcrop and fresh produce management and production and hunger mediation for limited resource families. Four new one-day berry production schools were offered in Northern Illinois. Compared to the previous year, 4-H youth and volunteers doubled the number [249,168] of meals of soy-fortified rice distributed to families in need. Impact evaluations were collected from participants in fruit and vegetable schools and trainings, food safety programs, and programming for small farms owners or renters exploring local foods production.

Human Health and Human Development - Extension programs have and will continue to address the challenges associated with aging, chronic diseases, parenting and childcare, financial management, and healthy behaviors for all ages. New additions to program offerings this past year included **I am Moving I am Learning**, a program for childcare providers of children of military families. **Hold That Thought**, delivered for the first time this year, provided information on strategies and techniques for building a better memory and is now available in Spanish. **Someday is Today -- Live Your Bucket List** is another new program that taught participants to be intentional and live life to the fullest. Of particular note, Extension entered into a three-year grant partnership with the Illinois State Board of Education to develop and deliver the **ABC's of School Nutrition** training and assistance to school nutrition professionals. Research activities in FY 2016 included research to zero in on the processes that enhance and erode relationships over time, work to establish an evidence-based school-friendly intervention to prevent overweight and diabetes in adolescence, an exploration of how Latino parents balance old and new ideas and ways as they raise adolescents, work to develop a more efficient method for delivering critical nutrition information, an examination of the health, well-being, and economic opportunity of LGBT persons in rural Illinois, an investigation into the ability of tomato powder, broccoli powder, and soy germ to reduce the progression of prostate cancer, and studies that will improve our understanding of how the aromatase inhibitor Letrozole can reduce metastatic breast cancer progression.

Natural Resources and Environmental Sciences - Research activities in FY 2016 included research focusing on quantifying the changes in watershed hydrology [water quantity and quality] under changing climate and land use conditions, work to develop capacity for applied uses of eDNA in freshwater ecology and management, a study to improve our understanding of atmospheric inputs in combination with fertilizer and fixation inputs to improve nutrient utilization in these ecosystems, work that will advance our knowledge of the socio-economic contribution forests and trees on farms have made in the past and may make in the future, a study of the implications of climate change for agricultural policies and projects with a focus on regions affected by civil conflict, and ongoing work under the **National Atmospheric Deposition Program** that seeks to monitor the nation's precipitation for a range of chemical constituents. Extension activities encompassed soil and water management, forestry, environmental stewardship, and climate change addressed through workshops, conferences, expansion of Master Naturalist training, and youth conservation days. The addition of a second forester enabled handling of nearly 4,000 direct contacts with landowners, homeowners, Master Naturalists, natural resource paraprofessionals, loggers, and students. Extension staff joined the **Illinois-Indiana Sea Grant** staff in informing audiences about establishing medicine collection programs to keep pharmaceutical and personal care product disposal from impacting water quality. Impact evaluations for youth in the **I Think Green** curriculum documented knowledge and practice changes with respect to protecting the environment.

Plant Health, Systems and Production - Research activities in FY 2016 included ongoing support for the testing of waterhemp and Palmer amaranth plants for resistance to glyphosate and to herbicides that inhibit the enzyme PPO, an evaluation of the impact of sustainable modern maize crop production

practices, ongoing monitoring of seasonal and year-to-year patterns of pest abundance, continuing work to develop improved winter wheat varieties adapted to Illinois, work to attract more customers to the farm by helping growers identify rootstocks that will reduce tree height without compromising fruit quality, a long-term study and life-cycle assessment accounting for the inputs [fertilizer, compost, and pesticides], outputs [crop yield], and associated benefits [cultural and ecosystem services] of various soil management systems, and work to improve our understanding of the intrinsic structural, chemical, and biological changes in the corn kernel and in soybean seed during storage and processing. Extension activities encompassed a significant number of websites and webinars addressing horticulture topics. **First Detector Workshops** and **University of Illinois Plant Clinic** are excellent sources for identifying pests and unusual, exotic, and invasive species. Promoting pollinators was the area of emphasis in 2016. **Pollinator Pocket Program** is a new statewide program designed to encourage gardeners to plan a space dedicated to pollinators in their yards as well as in common areas of housing subdivisions. Master Gardeners and Master Naturalists were instrumental in delivering this program.

Sustainable Energy - Extension activities in FY 2016 included presentations, demonstrations, tours, and displays focused on biomass [both feedstocks and woody] and residential energy efficiencies. Over 1,500 people who attended the **Southern Illinois Sustainable Living Expo** had opportunities to learn more about alternative energy. Presentations were also made at two **Renewable Energy Conferences** held in Illinois. Research activities in FY 2016 included an investigation into the technical and economic potential for sugarcane ethanol production in Brazil, an examination of the effects of riskiness of energy crops compared to conventional crops, work to identify and develop high yielding dedicated energy crops for various land types, the utilization of mycotoxin contaminated for non-food fermentation based applications for the production of value added chemicals, efforts to identify and promote the most effective management for M. x giganteus, switchgrass, and other perennial grasses for bioenergy production, and the development of near-infrared spectroscopy as an inexpensive and high-throughput method for evaluating quality characteristics of Miscanthus genotypes.

4-H Youth Development - Activities in 2016 focused on and successfully expanded youth involvement that continued an intentional outreach to urban and Hispanic youth, expanded opportunities to engage teens, and volunteer training to ensure positive youth development experiences. Delivery systems and educational curricula were enhanced and expanded to increase the number of youth involved in educational priorities focused on college and career readiness; food access; environmental stewardship; leadership; and health. Expansion of teen leadership roles included the following opportunities -- advocates for change, planning activities, promoting 4-H impact, advising at Extension council meetings, mentoring peers, or teaching of others.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	150.0	0.0	180.0	0.0
Actual	178.0	0.0	194.6	0.0

II. Merit Review Process

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

- Internal University Panel

- External Non-University Panel
- Combined External and Internal University Panel
- Expert Peer Review
- Other (Extension Staff Program Teams)

2. Brief Explanation

In the Department of Natural Resources and Environmental Sciences, faculty members submitting Hatch proposals are asked to provide the names of two or three individuals to conduct a peer review. While the majority of the reviewers are within the department, other university colleagues may serve as reviewers. Reviewers are asked to comment on the following six areas with recommendations and suggestions as well as a final remark on how the proposal could be improved: [1] Is the subject of the proposal important? Is the proposed research adequately justified? [2] Are the objectives well-focused and subject to easy measurement of progress? [3] Can the objectives be attained within the proposed duration of the research? [4] Are the best sources of fruitful collaboration, within and outside of the department, identified? [5] Does the proposed research duplicate other projects of which you have knowledge? If so, is the duplication warranted? [6] Are the users of the results identified and how will they access results of the proposed work?

In the Department of Agricultural and Biological Engineering proposals are reviewed by two external peers with knowledge in the subject area. The reviewers are provided with specific instructions regarding the ultimate goal of enhancing the proposal as opposed to seeking the recommendation to accept or reject. Faculty researchers take the reviewers' comments into consideration in revising their proposal to prepare a final version for submission to USDA/NIFA via REEport. In the Department of Animal Sciences Hatch proposals are reviewed and evaluated by a standing research committee. The PI makes appropriate revisions based on the committee's review and returns the proposal to the committee which determines approval or non-approval. That decision is then forwarded to the PI and to administration by the committee chair.

In the Department of Human Development and Family Studies, Hatch proposals are usually reviewed by the department head. Under select circumstances [such as for a specialized field of study], the department head would request input or review by another full professor in the department. The review seeks to ensure that the proposed research addresses an issue of scientific and societal significance, uses appropriate research methods, includes some focus on rural populations, and would have applied or practical implications. The review also confirms that the scientist submitting the proposal is capable of conducting the proposed project and that the timeline is feasible. In the Department of Food Science and Human Nutrition proposals are reviewed internally by two peers.

Extension county directors are expected to seek input from Extension multi-county unit councils regarding identifying priority issues for educational programming. In one unit Extension is partnering with a community college and agriculture-related entities in creating the Agriculture Education Program Community Agriculture Steering Committee who seek to identify and discuss agriculture related needs and educational responses. Directors formally reported seeking input from their multi-county council members regarding prioritizing issues to be addressed, reviewing data, and conducting discussions regarding underserved audiences. This input was used to update local Plans of Work.

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
- Other (Department Advisory Committees)

Brief explanation.

The college office of News and Public Affairs [NPA] plays a crucial role in informing the public and its stakeholders about the most recently published research and other activities in the college. NPA maintains an e-mail list of over 1,000 media outlets to which it selectively distributes approximately 400 news releases each year with over 2,000 placements in publications such as The Atlantic, ChemEurope, Shape, Prairie Farmer, Corn and Soybean Digest, Community Concierge, Farmweek, Agri-News, and Farm Journal. NPA stories also appear in the Chicago Tribune, New York Times, Huffington Post, St. Louis Post Dispatch, NPR, L.A. Times, the BBC, and the Daily Mail. These placements are in part due to memberships in two subscription services for journalists - Eurekalert [a distribution service with AAAS] and AlphaGalileo [a British news distribution service].

NPA also assists ACES Communications and Marketing by writing stories for the college magazine. ACES@Illinois is a 36-page magazine that is delivered in print or electronically twice each year to ACES alumni, donors, potential students, and others who are interested in the college. A pdf of the most recent issue is available at https://aces.illinois.edu/sites/aces.illinois.edu/files/Fall-Issue_2016_web.pdf.

In 2016, NPA also produced a 60-page full-color publication entitled AdvanCES in Research to share 35 research projects and findings with the public and invite feedback. The publication was distributed at Agronomy Day on the U of I South Farms and was mailed to legislators, agricultural organizations, and media outlets. It is also distributed to campus visitors. A pdf is available at http://research.aces.illinois.edu/ under Publications.

Another vital contribution from NPA is connecting ACES researchers with media. Journalists contact NPA writers every day for help in setting up an interview with an ACES faculty member in response to a press release on their research. NPA staff are also contacted daily by media seeking an expert to comment on a current issue in the news.

In the Department of Food Science and Human Nutrition, an external review of programs, including research, takes place once every seven years. The department annually asks the external advisory committee to provide formal feedback on departmental activities including research. The department head reviews the priority areas of NIFA and offers comment as requested by the college and/or by USDA-NIFA. In the Department of Natural Resources and Environmental Sciences researchers

continue to work with state and federal environmental agencies to discuss research areas and learn of needs within the organizations. For example, land management personnel at the Shawnee National Forest provided input related to invasion by non-native species. Another example is a series of workshops offered at the Illinois Specialty Crops Organic and Tourism Conference held in Bloomington, Illinois. In the Department of Agricultural and Biological Engineering faculty members interact actively on issues that may be addressed using engineering and technical methods. ABE research has been heavily funded by partners in industry, and so a substantial effort is made to engage with industry. ABE researchers also participate in meetings with broader stakeholders of the College of Agricultural, Consumer and Environmental Sciences, the College of Engineering, and at the campus and university system levels.

Extension county directors are expected to seek input from Extension multi-county unit councils regarding identifying priority issues for educational programming. In one unit Extension is partnering with a community college and ag-related entities in creating the Agriculture Education Program Community Agriculture Steering Committee who seek to identify and discuss agriculture related needs and educational responses. Directors formally reported seeking input from their multi-county council members regarding prioritizing issues to be addressed, reviewing data, and conducting discussions regarding underserved audiences. This input was used to update local Plans of Work.

In addition to Extension council discussions, other formal methods were identified and used to gather data regarding program offerings. Multi-county units gathered input from stakeholders by distributing a survey to identify customer satisfaction and to assess needs. Responses were then discussed by the Extension council. With respect to 4-H expansion and recruitment, all but one unit engaged stakeholders in the required Expansion and Review Committee to discuss ways to reach new youth, train leaders, and carry out future programing. End-of program evaluations are used to collect data on the quality of their programs and additional educational needs. Extension educators and county directors continued networking and interacting with agencies, organizations, and other external groups and individuals in their unit to stay abreast of emerging issues and programming opportunities.

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
- Open Listening Sessions
- Needs Assessments
- Use Surveys

Brief explanation.

The dean of the College of ACES [Dr. Robert Hauser through October 2016, Dr. Kimberlee Kidwell beginning in November 2016] and the associate deans for research [Dr. Neal Merchen] and Extension [Dr. George Czapar] interact frequently and significantly with a number of stakeholders, both individual and organizational, external to the College of ACES. Key stakeholders include groups both within Illinois and across the nation. In general, stakeholders include individual producers, commodity organizations, state and federal legislators, academic and corporate partners, international partners, and other individuals and organizations within the University of Illinois. The dean and associate deans provide reports to the College of ACES External Advisory Committee; this diverse group includes participants from the agricultural production community, natural resources management groups, human sciences, and agribusiness. This group meets annually and creates an excellent opportunity for presentation and review of the activities of the AES to an

external audience of broad cross-section.

For the Department of Natural Resources and Environmental Sciences networks from the National Great Rivers Research and Education Center, Illinois-Indiana Sea Grant, and the Illinois Water Resource Research Center have been utilized. Faculty have participated in national and statewide events and committees throughout the year. In addition, local contact with various organizations continues. Increased capacity and outreach at the Dixon Springs Agricultural Center have significantly increase interactions with stakeholders in southern Illinois. In the Department of Food Science and Human Nutrition the external advisory committee plays a critical role in identifying interested stakeholders [members represent academia, government, industry, and small businesses]. In the Department of Agricultural and Biological Engineering input is sought from faculty members who are in frequent contact with stakeholders as well as from the ABE external advisory committee. The development, corporate relations, and public engagement offices at the college and campus levels are also extremely valuable in collecting input.

Extension Advisory Council members and local Extension volunteers played a key role in providing advice on who should be targeted for an invitation to a specific program and how to reach out to underserved audiences. Multi-county staff meetings and Extension educator meetings with colleagues who had the same expertise responsibilities were helpful in generating ideas and information on stakeholders they should contact. Extension staff members also relied on meeting with community collaborations and key leaders who were both targets for input and for identifying other representative stakeholders to contact in identifying program opportunities. Community planning and economic development Extension activities also by their very nature involved stakeholder input through surveys and community discussions. Extension's web-based volunteer client management system provided access in contacting individuals and groups of stakeholders regarding program participation.

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
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting 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

Brief explanation.

The Associate Dean for Research/Director of the Illinois Agricultural Experiment Station Dr. Neal Merchen spends a great deal of time meeting with stakeholders and seeking their input. Examples in FY 2016 included: [1] Participating in the first ADM Institute International Congress on Prevention of Post-Harvest Loss in Rome in October 2015 [the ADM Institute is housed in the College of ACES]; [2] Serving on the Board of Directors for the North Central Region Center for Rural Development and participating in the annual board meeting in April 2016; [3] Meeting or teleconferencing with leaders and members of the Illinois Farm Bureau and local stakeholders about changes in programming at ACES off-campus research and education centers; [4] Participating in the June 2016 meeting of the Illinois Agricultural Legislative Roundtable sponsored by the Illinois

Farm Bureau; [5] Attending meetings and making presentations to the Board of the Illinois Soybean Association; [6] Visiting with the Illinois Department of Agriculture and meeting with the Director of IDOA; [7] Extensive participation in activities of the Dudley Smith Research Program including attendance and participation in on-site meetings in July and August of 2016 [this is an endowed program in sustainable agricultural production centered on the Dudley Smith Farm in Christian County, Illinois]; [8] Meeting with representatives from several commodity organizations at the Illinois Ag Legislative Day in March of 2016; [9] Collaborating with the Illinois Corn Growers Association on a grant that was awarded by the NRCS Regional Conservation Partnership [this $5.3 million award supports a collaborative effort involving about 30 partners and we are collaborating with the Corn Growers on applied research as part of this project]; [10] Meeting with representatives of the Illinois Vegetable and Specialty Crops Growers in April 2016; [11] Meeting with representatives of the regional Sustainable Agriculture Research and Education [SARE] program in August 2016; [12] Meeting with leadership from the U.S. Pork Center of Excellence about research and education programming in swine science; [13] Serving on the advisory council for the Illinois-Indiana Sea Grant Program; [14] Serving as a member of the joint steering committee of the University of Illinois/Dow AgroSciences partnership [to coordinate collaborative efforts in research and outreach between the two organizations]; [15] Reaching out to corporate partners including ADM, Agrible, Monsanto, AgCo, Kraft-Heinz, and DuPont Pioneer; [16] Attending the annual CARET meetings in Washington, D.C. in March and meeting with several federal legislators from Illinois; and [17] Participating in meetings of the North Central Regional Agricultural Experiment Station Directors in April of 2016.

In the Department of Natural Resources and Environmental Sciences input is collected through an external advisory committee comprised of four representatives from environmental agencies including state government, consulting, and conservation. In the Department of Agricultural and Biological Engineering input is collected through direct interactions between faculty and stakeholders, through publication of departmental newsletters, and through professional, technical, and social events hosted by ABE. The Department of Animal Sciences has an ongoing relationship with the major commodity groups and industry partners that are the stakeholders to Animal Science's research, outreach, an detaching programs. Faculty members regularly participate as liaison or ex-official board members for the beef, swine, dairy, and equine state associations. In addition, the department has an external advisory committee of 8-12 members that represent various corporations, commodity groups, and the general public. Stakeholders also speak in classes, serve on graduate research committees, and serve on faculty search committees.

As mentioned in section III, the process most often used by Extension to collect input involved informal conversations proactively initiated through professional staff contact with current funders, key community leaders, Extension Council members, and Extension volunteers. In some instances, Community and Economic Development Extension educators assisted with survey distribution and analysis that revealed needs and opportunities to develop an educational response. In addition, the majority of Extension programs included end-of-program evaluations and surveys that sought suggestions for additional topics for future programs.

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

Brief explanation.

As in previous years, the College of ACES strives to incorporate stakeholder input and evaluation into decision making at all levels. Areas include the allocation of resources, the development of Extension programs, the determination of areas of focus for college publications and other outreach materials, identification of opportunities to improve communication with stakeholders [or to identify stakeholders who were previously underrepresented], and the identification of new faculty hires who will address currently-unmet needs identified by stakeholders. Through their funding decisions grant awarding agencies play a very significant role in guiding research activities [and indirectly in promotion and tenure decisions for faculty].

In the Department of Food Science and Human Nutrition external advisory committee input, graduate survey data, informal stakeholder feedback, and external program reviewers' comments are incorporated into discussions during departmental faculty and advisory committee meetings. The strategic planning committee also uses stakeholder input to make decisions on strategic directions. In the Department of Natural Resources and Environmental Sciences input was used to reallocate resources and modify research questions to better address scientific and stakeholder needs. The input received from NRES stakeholders allows the department the opportunity to evaluate current programs within teaching, research, and Extension. As an added benefit, stakeholder input provides a guideline for trends that impact course content for our undergraduate and graduate students. In the Department of Agricultural and Biological Engineering departmental meetings, faculty/staff meetings, administrative committee meetings, faculty advisory committee meetings, external advisory committee meetings, and future committee and council meetings are held to discuss stakeholder input and develop plans of action. The discussions frequently play a role in shaping decisions regarding research activities.

Extension staff members were once again encouraged to involve Extension councils in reviewing, and if warranted, revising the 3-5 priorities to be reflected in a FY 2016 multi-county plan of work. In one Extension multi-county, the county director led the council members through a mind map activity where issues, solutions, programing partners, and resources were all identified. Input from program evaluation responses has been used by Extension staff to make adjustments in both the content and program delivery method to better meet the needs of participants. Consequently staff have engaged in determining how to more effectively market programming and use various methods of technology. Input through evaluations has also been used to develop new programs that are reflected in annual plans of work. Data was also used to identify staffing needs when vacancies arose.

Brief Explanation of what you learned from your Stakeholders

Stakeholder input during FY 2016 involved many conversations and interactions abut transitions in support for some of our off-campus research and education centers. We have experienced serious state funding declines in Illinois for the past several years and we have had to confront changes in programming in response to loss of resources.

As we entered FY 2016, we were implementing reductions in some research activities at several of our off-campus centers in response to budget restrictions. While budgetary factors were the immediate driver for those changes, we used this as an opportunity to strategically assess the kinds of activities that would continue to provide relevant information to our stakeholders. Regular conversations and correspondence occurred with stakeholder audiences represented by the Illinois Farm Bureau and several commodity groups [the Illinois Corn Growers Association, the Illinois

Soybean Association, and the Illinois Vegetable and Specialty Crops Growers]. There continues to be strong interest in work conducted in applied agricultural sciences at our field research stations, particularly in studies on agronomic factors and in some areas of applied animal science [primarily beef cattle production]. We have maintained our beef cattle systems work at our off-campus sites in response to stakeholder priorities.

Cropping systems work has been reduced in terms of direct activities at the off-campus centers. However, we have expanded other directions to continue to conduct regional research that is important in defining optimal practices. We are conducting more research in collaboration with farmers in several areas of Illinois [and even internationally]. We have made investments and installed new infrastructure at some locations [such as an innovative field tile system to facilitate water quality and nutrient management research at our Dudley Smith Research Farm]. It is critical for us to continue to work with our stakeholders to develop new paradigms in response to shifting resources for applied agricultural research and outreach.

NRES stakeholders are interested in cooperating with conservation efforts. A clear example is a new initiative known as "SCARC" or the Shorebird Conservation Acreage via drainage water Runoff Control [funded in part by the Natural Resources Conservation Service]. Commodity groups are supportive of effective methods of reducing nutrient runoff but seek solutions that minimally affect productivity. ABE stakeholders are very interested in research addressing the pressing societal issues in agriculture, food, energy, and the environment. Current and emerging issues emphasized by ABE stakeholders are: [1] Agricultural and Biological Systems and Technology - Precision and information agriculture, plant and animal production, sustainable agricultural intensification, big data, informatics, and analytics, health, and safety; [2] Food and Bioproducts - Processes and products, security, and safety; [3] Energy - Renewable energy and energy efficiency; [4] Water - Land and water resources and water quality and use; [5] Environment - Air, soil, and water quality and built environment; and [6] Biological Engineering - Biotechnology and biosensors. Key recommendations from stakeholders provided to the Department of Animal Sciences occurred in the areas of student recruitment, enhancing student internship opportunities, advancement strategies, and marketing the broad mission of Animal Sciences on campus, to legislators, industry leaders, producers, and society as a whole. Key research findings addressed by stakeholders included beef cattle efficiency in response to various feedstuffs, genomic testing of cattle and dogs for recessive traits, immunological responses to stress in animals and humans, utilization of corn co-products by swine and poultry, and the impact of growth enhancers on meat quality in swine. Stakeholders stressed to the Department of Food Science and Human Nutrition the importance of university-industry partnerships and the need for increased funding in foundational areas to allow investigators to explore a wider variety of important topics [rather than just targeted areas or challenge areas].

Recent customer satisfaction surveys indicate that Extension stakeholders who serve as Extension volunteers remain strong supporters for the 4-H Youth Development program and the Master Gardener program and are advocates for a local physical Extension presence in each county. They are willing to allocate financial resources to sustain that presence. In addition, they recognize Extension as a community resource in providing educational opportunities that are research-based. They support programing that prepares youth for tomorrow's jobs and to become effective leaders and community engaged citizens. Stakeholders also value programming that addresses health and wellness related to individuals, communities, and the environment.

Responses to end-of-program evaluations indicated that participants are pleased with the quality of the programs in which they participate and vary with respect to their comfort in using educational technology, but are becoming more comfortable over time. They are also interested in and willing to support efforts to increase public awareness of Extension's educational offerings as evident in the establishment of Publicity and Promotion Specialists positions in several Extension multi-county

units.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
9800780	0	6879515	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	5422834	0	7254343	0
Actual Matching	5422835	0	7254343	0
Actual All Other	35736556	0	42556727	0
Total Actual Expended	46582225	0	57065413	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	5422835	0	2586626	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Agricultural And Biological Engineering

☑ 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
112	Watershed Protection and Management	25%		10%	
133	Pollution Prevention and Mitigation	20%		10%	
141	Air Resource Protection and Management	5%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		5%	
315	Animal Welfare/Well-Being and Protection	5%		5%	
401	Structures, Facilities, and General Purpose Farm Supplies	25%		10%	
402	Engineering Systems and Equipment	10%		15%	
403	Waste Disposal, Recycling, and Reuse	0%		15%	
404	Instrumentation and Control Systems	5%		10%	
405	Drainage and Irrigation Systems and Facilities	5%		15%	
	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	0.0	0.0	3.0	0.0
Actual Paid	0.5	0.0	11.0	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**
10906	0	426654	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
10906	0	426654	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
71473	0	2728719	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included work to optimize the design of vegetative filter strips to prevent the transport of infective microbial pathogens to receiving waters while maintaining effective removal of nutrients and pesticides, the development of decision support tools for agricultural producers that improve agroecosystem performance by both economic and environmental measures, the establishment of a living laboratory that provides "plug and play" capabilities for studying the advances in agricultural production and technological components, the development of a framework and methodology for evaluating field-based supply chain logistics with a global perspective, efforts to increase corn yield by aiding the breeding process using an agricultural engineering perspective, and an evaluation of the best management practices for water quality improvement at various scales [focusing on the effectiveness of erosion and sediment control practices].

Activities also included the development of a new technology to rapidly assess the impact of perturbations due to nanoparticles on complex microbial ecosystems [such as those found in anaerobic waste processing], the development of a new testing system for nozzle spray analysis [the purpose of this test system is to determine the complete distribution of a spray pattern deposited from nozzles mounted on a multi-rotor unmanned aerial system under various input and environmental conditions], the calibration of the HYDRUS-3D model [which is being used to simulate the impact of climate change on drainage design], a study with the goal of significantly reducing the climate change impact of agricultural activities by turning the residual bio-waste products that currently cause significant greenhouse gas emissions into a carbon sink sufficient in size to offset all the other emissions of the agricultural enterprise, and ongoing improvements to a quality fan testing laboratory for manufacturers and researchers [the **BioEnvironmental and Structural Systems Laboratory** continues to be the primary testing facility for agricultural ventilation and mixing fans].

Conference presentations included the Geological Society of America, Clay Mineral Society, International Conference on Nanotechnology Applications and Implications of Agrochemicals, American Association of Agricultural and Biological Engineers, Third International Conference on CyberGIS and Geospatial Data Science, American Society of Agricultural and Biological Engineers, American Society of Chemistry, American Society of Chemical Engineers, and the Gordon Research Conference.

Extension activities related to this planned program are interdisciplinary in nature and relate to other planned programs featured in this report [Sustainable Energy, Natural Resources and the Environment, and Animal Health and Production]. Much effort was devoted to education focused on livestock manure management through eight statewide **Certified Livestock Manager Training** workshops that covered not only the basics of nutrient management, but also new technologies, research, and trends. The training and completion of an online five-part quiz series satisfies state livestock waste management training

requirements for producers. Livestock producers with 300 or more animal units must be recertified through training and/or exam passage every three years.

With limited Extension specialist FTE's, Extension has chosen to expand outreach through websites. These websites experienced more than 192,000 page views this past year and consist of several sections that include: **Certified Livestock Management Training** materials and an **Illinois Manure Management Plan** designed to help livestock producers develop manure management plans to more efficiently and safely use manure as a fertilizer. The website allows customization of the plan to meet a given producer's needs and facilitates any required annual updates. Other sections of the website include: **Manure Share**, an exchange program that brings gardeners and landscapers searching for organic materials for use in composting or field applications into contact with livestock owners with excess manure. The **Small Farms Manure Management** website is designed for individuals with less than 300 animal units. **EZregs** is a site for users who have established accounts to store their questions and receive Extension responses related to identifying environmental regulations that pertain to specific agricultural and horticultural operations and practices in Illinois. **Compost Central** features resources for composting of livestock manure, food scraps, and yard waste.

Extension field and campus specialists in the Department of Agricultural and Biological Engineering collaborated to organize and moderate two **Livestock Facility Workshops** in the north and south parts of Illinois. Each site drew about 25 participants and 6 vendor representatives. Topics addressed included how to ventilate and then manage/control ventilation in buildings, aerial disease development and transmission, identifying good air quality, and concerns that affect air quality.

With respect to education regarding agriculture equipment, a transition occurred in the Extension pesticide safety education staff position responsible for conducting **Operation S.A.F.E. Fly-ins** to ensure aerial applications of fungicides to corn are accurately applied and to provide information related to spraying equipment. As a result of the staff transition, the scope of Fly-ins was reduced but should increase in the current year.

A Commercial Agriculture Extension Educator continued to conduct research and educational outreach regarding unmanned aerial vehicles [drones] and their potential use in crop scouting and management and this past year presented information at the **Soil and Water Management** webinar on using drones for water management. In addition, the **Agriculture Safety and Health website** provides access to fact sheets and programs that address safety practices and information for individuals who have disabilities resulting from an agriculture related accident.

2. Brief description of the target audience

Members of the target audience included agricultural engineers, researchers in the livestock industry, animal scientists, livestock producers, researchers in both agricultural robotics and crop sciences, students, producers, scientific communities, state and federal agencies, pork producers, the asphalt and wastewater treatment industries, drainage contractors, equipment manufacturers, and Extension specialists.

Extension target audiences included crop producers, certified crop advisers, livestock producers, custom manure haulers, pesticide applicators, landscapers, and individuals who have disabilities resulting from an agriculture-related accident.

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	903	1312	2502	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	26	26

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2016	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. **Outcome Measures**

Maximizing Efficiency And Minimizing Drift For Agricultural Aerial Applications

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Improving Emission Control Technologies For Livestock Buildings

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Implementation Of Global Engineering Solutions Using Agricultural Machinery

2. **Associated Institution Types**

- 1862 Research

3a. **Outcome Type:**

Change in Action Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2016	0

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)
The goal of this project is to increase corn yield by aiding the breeding process using an agricultural engineering perspective.

What has been done
We have developed a new imaging system that allows us to obtain images of corn ears, both as a complete ear as well as a detail in the center of the ear. We have also developed software that separates each kernel in the ear. Once the images of individual kernels are available, we calculate up to 16 morphological parameters of each kernel [the most prominent being location in the ear, perimeter, area, and equivalent diameter]. These parameters are currently being

evaluated for their use in Quantitative Loci Mapping by crop scientist Dr. Martin Bohn and his group. The aim is to find out which genes in the maize genome are responsible for the trait being measured.

We have also created a new Corn Root Imaging Box [CRIB] to be used as a 3D root analyzer. Here, a corn root is mounted upside down and a slanted laser beam is passed by it. The areas lit by the laser sheet are then detected by a camera, and since we know the exact laser sheet angle we can determine where this lit area is located in a 3D space. This allows us to create rudimentary 3D models of corn roots in an attempt to further generate more data for quantitative trait loci analysis. We have also created a new robot to be used as a ground-based platform for field measurements in 2017 and beyond. The new robot is much lighter than earlier versions, and it has been fitted with the latest in electronics for sensing and guidance. We are now implementing a highly precise but low-cost real time kinematic global positioning system for its guidance.

Results
We have also experimented with drones for phenotyping in experimental plots, but we have come to the conclusion that drones are too limited to be used in experimental plots because they cannot penetrate a canopy and even the slightest wind will make precise measurements impossible. We have also worked with two PhD students in mathematics, guided by Dr. David LeBauer, to start producing mathematical models that accurately describe the morphology of corn roots underground. In addition, we have worked with graduate student Tryston Beyer, whom we have lent a CRIB to study the influence of stripped nitrogen applications on the development of roots. We are using the same method to determine how roots develop under compaction [as part of a Michelin funded project where we evaluate the influence of their low ground pressure tires]. We are also working with Dr. Randall Nelson [USDA] to extend the root work to soybean, which has proven to be quite difficult in the past.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems

Outcome #4

1. Outcome Measures

Development And Use Of A Manure Management Plan

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	93

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Improper manure management has negative societal impacts on neighboring communities and the environment. Livestock and poultry producers face challenges in understanding and minimizing these negative impacts.

What has been done
Educational efforts included continued maintenance and updating of the Illinois Manure Management Planner website which is used by stakeholders to learn about manure management and to access resources to create Manure Management Plans for facilities. Annual training for the Certified Livestock Manager Training program was conducted at eight sites across the state. This state program requires livestock and poultry producers to attend training and become certified once every three years. The curriculum includes key information on best management practices, nutrient management information, and updates on regulations and associated information related to agricultural air quality and safety issues.

Results
The Illinois Manure Management Planner website received 7,884 accesses this past year. Two hundred and fourteen [214] individuals attended the Certified Livestock Manager Training programs. In response to a survey taken at the training, 165 [80%] indicated they had a manure management plan and 93 [43.5%] indicated their plans were written and updated annually and constantly used. In response to other multiple-choice questions, 92% indicated the Organic N form of Nitrogen is the slow release fraction, 70% indicated manure application was the most important record to keep, and 52% indicated perimeter tiles need to be sampled every three months.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

Outcome #5

1. Outcome Measures

Development Of Nanofertilizers To Improve Agricultural Production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the last few decades, there has been rapid growth in the number of nanotechnology applications for industrial uses and consumer products. Along with nanosilver and TiO2, metal nanoparticles like Cu[0] and nano iron[oxides] [such as magnetite, zero valent iron, and ZVI] are commonly used in the global market. In recent years, development of nanofertilizers has been considered to improve agricultural production. The possibility for slow-release micronutrients resulting from the nano-sized solid state of these products is appealing for some agricultural systems. In particular, hydrological regimes impacted by climate change could alter the mobility of micronutrients, influencing plant growth and the microbially mediated biochemical cycles of nutrients. The advent of nanotechnology could increase the feasibility of the long-desired agricultural goal of slow-release fertilizers, which are both more cost-efficient and more environmentally sound.

What has been done
Granular iron oxides including ZVI have attracted the attention of environmental soil remediation industries. As demonstrated in granular ZVI based permeable reactive barrier [PRB] technology, the benefit of this technology to alter the chemical state of contaminants has been proven in many field-to-laboratory case studies. In recent years, the high surface area of nano iron oxides allows us to improve the efficiency of the remedial process of contaminants' toxicity and mobility in soil-water environments. The high surface area provides more reactive sites allowing for more rapid degradation of contaminants when compared to the previous gradual products.

Results
The study conducted in this period consists of two parts, assessing the impact of Cu[0] NPs to soil nitrifiers and nano magnetite/ZVI for the remediation of Tc-99 using a chemical analogue, rhenium[Re]. Previous investigations suggest both beneficial and toxicological effects of Cu nanoparticles, but it remains difficult to extrapolate such results to evaluate the potential use of

metal nanoparticles as nano-fertilizers since agricultural soils are often ignored in most experimental systems. The physical state of nanoparticles as nano-sized solid metal rather than dissolved ions may have the potential to allow for a controlled release over time in soil solutions. The first part of this study investigates the effects of metallic CuNPs as a nano-fertilizer component on the complex nitrogen cycle in agricultural soils. The nitrogen cycle in soil systems is essential to the growth of successful crop species. In particular, the nitrification process is of particular importance. The outcome of this study should be of interest to fertilizer industries that are adapting the nano-fertilizer concept. The second part was to assess the reactivity of magnetite/ZVI to reduce Cr[VI] to Cr[III] and Re[VII] to Re[IV] is the key to immobilizing such metals. The results of this study have implications for evaluating the use of nano iron oxides as potential reductants to reduce the toxicity and mobility of Cr[VI] and 99T [VII], resulting in the reductive precipitation of Cr[III][OH]3 and Tc[IV]-oxides and -sulfides. This should provide insight regarding the use of nano iron oxide particles in soil remediation technology.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Commercial Pesticide Applicator Training

Using the results of a survey of practice changes that was mailed to a random sample of participants in the 2011-2012 Commercial Pesticide Applicator training, it might be presumed that of the 9,788 participants in this year's training, 6,431 [65.7%] improved calibration procedures [frequency, accuracy, and measurement], 5,266 [53.8%] improved equipment maintenance [inspecting, cleaning, and replacing worn nozzles], and 5,168 [52.8%] improved changing the type, size, or materials of the nozzles used as a result of attending the training.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Agricultural And Consumer Economics

☑ 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	20%		10%	
603	Market Economics	10%		10%	
604	Marketing and Distribution Practices	15%		10%	
605	Natural Resource and Environmental Economics	0%		15%	
606	International Trade and Development	5%		10%	
607	Consumer Economics	20%		10%	
610	Domestic Policy Analysis	15%		20%	
801	Individual and Family Resource Management	15%		15%	
	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	0.0	0.0	5.0	0.0
Actual Paid	4.0	0.0	14.5	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**
114509	0	575684	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
114509	0	575684	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
750468	0	5717251	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included research that seeks to identify the market microstructure noise present in high frequency data and its implications for realized volatility of returns in live cattle futures markets, research on Millennials' delayed homeownership [we found that the empirical evidence from a natural experiment in China suggests that automatic enrollment, tax-exempt savings, matching contributions, mental accounting, and self-discipline all play a role in incentivizing savings and promoting homeownership], an examination of how pipeline incidents have affected lenders' risk perceptions and risk management strategies, work to incorporate a behavioral genetics approach to partition the genetic and environmental components of financial behaviors and personality traits respectively, analysis of local, state, federal, and selected international laws that constitute the legal environment for agriculture [evaluating their impact on agricultural production and agri-business and the protection and conservation of the environment], and an assessment of journalistic coverage of two contentious agriculture issues: the application of genetic engineering in crops and the use of antibiotics in farm animals.

Activities also included work to estimate the value of natural resources and environmental amenities [this is critical for guiding resource management decisions, designing environmental policy, and evaluating the costs and benefits of policies that are proposed], work to develop conservation tools that make efficient use of society's resources by managing uncertainty associated with climate change, managing threats to aquatic habitat from urban storm water which have previously been neglected, and tailoring protected area policy to account for human responses that could cause intensified destruction in areas outside those which are protected, a project that analyzes the policy design for programs in each of the three related titles of the farm bill: commodities, conservation and crop insurance, an investigation into the communication technologies and information outlets used by communities to share information about soy protein applications in the developing world, research seeking to provide new evidence on how households react to investment incentives for energy efficiency improvements, a study of the economic impacts of policies and interventions designed to help developing world small farmers cope with inefficiencies caused by poorly functioning input and output markets [exploring both the drivers and the consequences of these inefficiencies and the economic effects of public and private sector initiatives to resolve market failures], measurement of the impact on economic outcomes of policy changes and new technologies in the food and agricultural system [this research explores both the consequences of such changes, measuring the impacts of those changes on issues of direct interest to food producers, consumers, and processors and the causes of the changes, analyzing the political and social forces that bring them about], research providing greatly needed information on the causes, consequences, and likely future of farmland prices, and the ongoing development and updating of a crop insurance decision tool to aid farmers in making risk management decisions.

Conference presentations included the North American Regional Science Council, Association of Environmental and Resource Economists, Agricultural and Applied Economics Association, Mind, Messages, and the Media: Improving Understanding About How to Communicate Biotechnology and Biosafety in Northern Ghana, Asian Consumer and Family Economics Association, Certified Financial Planner Board 2017 Academic Research Colloquium for Financial Planning and Related Disciplines, Industrial and Commercial Bank of China, Institute of International Finance, Brookings Institution, American Economic Association, National Bureau of Economic Research, Energy Policy Institute of Chicago, Chicago Council on Global Affairs, American Association of Agricultural Economists, National Defense University, and the International Food Policy Research Institute.

The big story in Illinois agriculture in 2015-2016 was the "margin squeeze" faced by crop producers. Extension specialists conducted five regional **Illinois Farm Economics Summits** and explored the farm profitability outlook and management challenges from several perspectives, including the 2016 outlook for prices, farm income prospects, land rents and valuation, long-term credit cycles, nutrient management, and the outlook for conventional bio-fuels.

The crop insurance section of the University of Illinois **farmdoc** website was completely revamped and two new web-based decision tools were introduced. The **farmdoc Premium Calculator** provides farmer-paid premiums for insurance products on a per acre basis. The **farmdoc Insurance Evaluator** provides performance evaluations of alternative crop insurance products for a case farm within a county. **Financial Planning for Young Adults** is a new free, online financial planning course.The Massive Open Online Course or MOOC was developed through a three-way partnership between the Center or Financial Planning Board, the Department of Agricultural and Consumer Economics, and University of Illinois Extension. The courses provides an introduction to basic financial planning concepts and for individuals who are interested in the field of financial planning.

University of Illinois Extension brought back and joined forces with **Annie's Project** to present a successful six-session farm management course for farm women. Twenty Extension staff were trained as facilitators who conducted their discussion-based workshops held in 17 locations. Two hundred twenty [220] women met at the various locations to learn about business plans, marketing, farm leases, insurance, estate planning, property titles, and financial management.

Extension educators with consumer economics as their area of expertise conducted programs this past year that included the **Financial Wellness Peer Educator** program that involved 12 trained college student interns in providing financial educational outreach by talking with 1,040 college students. Sixty percent of these students attended an in-depth workshop or presentation. Other outreach programs included the **Plan Well, Retire Well** blog and **Get $avvy: Grow Your Green Stuff** webinar series.

A revised and updated version of **All My Money - Change for the Better**, a train-the-trainer curriculum for working with limited resource audiences was introduced at professional development national conferences. The Extension educators are delivering the curriculum to individuals at a detention center and homeless shelter as well as to the staff at the shelter. **Money Mentors,** a volunteer program that matched mentors with mentees who sought help with basic money management, was conducted in five counties this past year.

Extension Educators gave leadership in partnering to deliver a wide variety of financial information during **Money Smart Week** [April 23-30]**.** Financial topics included estate planning, credit, identity theft, investing, making the most of benefits, and cutting electricity costs. An added opportunity was provided for kids to participate in an essay contest this past year. Using social media, **America Saves Week** provided an opportunity to communicate that saving money is important and that setting a saving goal helps you.

Financial literacy for youth involved staff and volunteers in over 24 counties who conducted and evaluated knowledge gained by participants in **Welcome to the Real World**, a simulation that gives students [age12 through young adults] a taste of future income and expenses [discussed in further detail in the evaluation section of this planned program]. **Scottie Dog Plays with Money Madness**, a program focused on elementary youth, was conducted in several schools by volunteers from partner organizations.

2. Brief description of the target audience

Members of the target audience included cattle producers and live cattle futures markets participants, practicing and academic lawyers in the U.S. and abroad, government regulatory agencies, farmers, processors and retail distributors of agricultural inputs and products, environmental non-profits and environmental consulting companies, central banks, development banks, government agencies, world organizations, private-sector entities, NGOs, population groups who have been traditionally disadvantaged socially, economically, and educationally, farm interest organizations, agribusinesses, soybean growers, food manufacturers, livestock feed manufacturers, academic researchers, policy makers, public and private utility companies, professional farm managers, financial managers in the agricultural investment community, agricultural lenders, academic economists, and agricultural production students.

Extension professionals focused on the crop insurance industry [agents and companies], the farm credit/banking industry, USDA officials, landowners, community groups, producer organizations, schools in the state of Illinois, graduate and undergraduate students, leaders in agricultural finance and members of institutions involved in providing credit to agricultural interests, farm managers, financial managers in the agricultural investment community, agricultural lenders, academic economists, and agricultural production students. Also targeted were crop and livestock producers, landowners, financial advisers, tax consultants, youth, college students, senior citizens, and consumers and families facing financial challenges.

Extension programs addressing financial wellness can be found in the Human Health and Development planned program.

3. How was eXtension used?

Two Extension staff members are members of the Financial Security for All Community of Practice and have connected with staff in other states to share information about the Illinois Money Mentors program and the completion of the All My Money - Change for the Better train-the-trainer curriculum.

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	9976	52014	1276	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	47	47

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2016	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Page File Requests Made To Farmdoc
2	Number Of Web Hits On The Varietal Information Program For Soybeans Website
3	Toward A Better Understanding Of The Causes, Consequences, And Likely Future Of Farmland Prices
4	Educating Farmers On What The Provisions Of The Farm Bill Mean To Them
5	Number Making Decisions To Reduce Risk In Agriculture Production
6	Improving Our Understanding Of The Factors That Influence Household Financial Decisions
7	Number Of Individuals Improving Financial Capability And/Or Adapting Consumer Behavior Skills [45 Estimated]
8	Increased Knowledge And Skills In Managing Income And Expenses

Outcome #1

1. Outcome Measures

Page File Requests Made To Farmdoc

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	19500000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The goal of these tools is to provide farmers with expert advice on insurance product selection. These second-generation tools will be part of the iFARM collection of tools that are available in the crop insurance section of farmdoc [www.farmdoc.uiuc.edu]. The tools will include a yield analyzer, an insurance plan selector, and a marketing-crop insurance selector.

What has been done
Since its inception over a decade ago the farmdoc project has consistently delivered unbiased and timely economic information to agricultural producers and businesses. The farmdoc website sets the standard for round-the-clock access to seamless and integrated information and analysis. There is no doubt that agricultural producers and managers will continue to need sound answers to tough economic questions in the future. The goal of the farmdoc project is to be at the forefront of harnessing the power of the internet to bring those answers right to their desktop.

Results
In 2016 well over 19 million page requests and over 3 million visits were made to farmdoc [http://www.farmdoc.illinois.edu/] or to farmdoc daily [http://www.farmdocdaily.illinois.edu/]. The goal of the farmdoc project is to provide crop and livestock producers in the U.S. Corn Belt with round-the-clock access to integrated information and expertise to better manage their farm businesses. While the goal has remained constant, the technology available to meet that goal has undergone enormous changes during the last dozen years. Smart phones, iPads, blogs, and social networks are now commonplace. The farmdoc daily site has an eye towards not only the technology people are using to access information but also the desired form of the information. Information needs to be easily accessible across a variety of platforms [desktops, laptops, and mobile devices] and in a condensed format that fits the needs of busy people with hectic schedules.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
603	Market Economics
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Number Of Web Hits On The Varietal Information Program For Soybeans Website

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Toward A Better Understanding Of The Causes, Consequences, And Likely Future Of Farmland Prices

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Educating Farmers On What The Provisions Of The Farm Bill Mean To Them

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Number Making Decisions To Reduce Risk In Agriculture Production

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Improving Our Understanding Of The Factors That Influence Household Financial Decisions

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The U.S. government has made great efforts to promote credit access. However, little attention was paid to influencing household finance. As a result, many households were trapped in mortgage loans they could not afford. This project explores the possibility of government influence on household finance and home purchase using a comparative approach. Unlike the United States, countries in Asia typically enjoy both high homeownership rates and low mortgage default rates. Besides cultural differences, does financial incentive also play a role in better financial planning? Can national governments implement policies that foster healthier household finance? For instance, Asian countries like China, Thailand, India, and Singapore have established deposit and loan funds for housing purchases. Those funds collect deposits from contributors and their employers during the employment period. They can grant loans as large as 10-15 times the contributors' cumulative deposits in the fund. As an alternative to commercial credit expansion, these loans are self-funded from deposits. The programs incorporate both tax and interest incentives for housing consumption. Hence, they may influence households' saving and home purchase decisions. This project will examine this possible influence using China as a comparison to the United States.

What has been done
The first phase of this project focuses on the housing and credit decisions of households and individuals. This line of research continued into this reporting period. The PI has been recognized for research on millennials' delayed homeownership in that the 2015 paper written by Xu, Johnson, Bartholomae, and Gutter won Best Paper in Housing Economics at the Family and Consumer Research Journal. We found that the empirical evidence from a natural experiment in China suggests that automatic enrollment, tax-exempt savings, matching contributions, mental accounting, and self-discipline all play a role in incentivizing savings and promoting homeownership. We also found that the psychological trauma of witnessing a parental foreclosure lowered young adult children's homeownership rate. The research revealed a

reinforcement effect of housing demand spinning down through a younger generation's avoidance of homeownership. It also added a unique perspective on intergenerational transmission of housing wealth.

Regarding mortgage credit access, we examined how pipeline incidents have affected lenders' risk perceptions and risk management strategies. We showed that an average loan in the pipeline-present areas is 1.6% less likely to be originated. Whenever new incidents happen, lenders further decrease the origination likelihood by 1.8%. Moreover, the effect emerges mainly on low- to middle-income borrowers, suggesting that advancing pipeline hazards mitigation policy could improve the credit availability to lower-income borrowers. In a study of the alternative credit of payday loans, we found that the payday loan regulation of Illinois decreased theft in the Chicago neighborhoods where payday loans used to be prevalent, but there were no measurable declines in burglary, robbery, drug-related crimes, or violent crimes. The empirical evidence suggested the lending restrictions that protected consumers from repeated borrowing and aggressive debt collection successfully prevented financial damages that could motivate crimes in extreme cases.

Results

We also expanded our early work to incorporate a behavioral genetics approach to partition the genetic and environmental components in financial behaviors and personality traits respectively. We integrated methods and theories in economics with those in psychology to study factors that determine the individual differences in financial behaviors. Using biologically informative sibling data from the Add Health study [National Longitudinal Study of Adolescent To Adult Health], we showed that financial distress is considerably genetically influenced. The genetic behavior approach applied here bridged the behavioral genetics approach used in psychology with economic analysis of human behaviors and hence opened up a new horizon for research in psychology, economics, and health. We also made considerable progress in understanding the financial decision-making of young adults. The paper on student loan decisions won the Best Paper in Personal Finance/Consumer Economics at the Family and Consumer Research Journal. We also compared Millennials' perceived value of a college education to Generation X, and we found that Millennials value the social capital investment more than Gen X. In examining how social network affects decision-making, we found that adolescents were disproportionally more likely to make friends who have the same immigration status and ethnicity and that the peer effects on misbehaviors are stronger from similar friends than from dissimilar friends. Finally, we used Twitter chat as an innovative research tool to conduct a survey about young adults' financial decision-making. We showed that Twitter chats provide a synchronous environment for participants to answer a structured series of questions and to respond to both the chat facilitator and to each other.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
603	Market Economics
607	Consumer Economics
610	Domestic Policy Analysis
801	Individual and Family Resource Management

Outcome #7

1. Outcome Measures

Number Of Individuals Improving Financial Capability And/Or Adapting Consumer Behavior Skills [45 Estimated]

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)
Farming operations require skills in financial management and using decision making tools in the complex, dynamic, and continuously evolving agricultural environment. Women need to learn how to partner with their spouse or family members who operate or own a farming operation.

What has been done
University of Illinois Extension brought back and joined forces with Annie's Project to present a successful six-session farm management course for farm women. Twenty Extension staff were trained as facilitators who conducted these discussion-based workshops held in 17 locations. Two hundred twenty [220] women met at the various locations to learn about business plans, marketing, farm leases, insurance, estate planning, property titles, and financial management. An evaluation was distributed and completed by 180 of the Annie's Project participants at the beginning of the program and was completed by 120 participants at the end of the program. Participants provided information on knowledge gained and actions taken in five areas: Financial, human resources, legal, marketing, and production.

Results
The largest gains in knowledge by the women included the following: Where to find research-based estimates for costs of production, learning how estate plans impact farm/ranch families, learning how to use the cost of production to set price targets, and where to find information on cash rental/leasing rates in Illinois. The largest gains regarding actions taken included the following: Preparing their business balance sheet, choosing or updating a family insurance policy and rental/leasing agreements, and modifying forms of property ownership. Additional results may be found in the Evaluation section of this planned program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
603	Market Economics
604	Marketing and Distribution Practices
610	Domestic Policy Analysis

Outcome #8

1. Outcome Measures

Increased Knowledge And Skills In Managing Income And Expenses

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	2057

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Older youth need knowledge and skills to assist them in selecting careers and managing their income and expenses in order to live as an independent adult.

What has been done
Annually, Extension field staff members provide Welcome to the Real World training and curriculum materials for teachers and a simulation for their middle and high school students that allow them to explore careers and money management [balancing income and expenses] in adult life. The simulation allows students to start with a monthly income and visit various booths to spend their income on items typically found in a family budget such as housing, utilities, food, transportation, insurance, and childcare. Youth then complete an evaluation following the simulation.

Results
At the end of the Welcome to the Real World simulation, evaluation forms were completed and collected from 2,607 youth participants located across Illinois. The evaluation was designed to identify increased knowledge of financial management. The evaluation asked students to evaluate five money management skills choosing between 'learned how to do' or 'already knew how to do'. Of the 2,607 youth respondents, 2,055 [79%] indicated that they learned at least one of the five skills with the largest number reporting learning how to balance income and expenses.

See the evaluation section of this planned program for additional evaluation results.

4. Associated Knowledge Areas

KA Code	Knowledge Area
607	Consumer Economics
801	Individual and Family Resource Management

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Annie's Project participants met at 17 locations to learn about business plans, marketing, farm leases, insurance, estate planning, property titles, and financial management. Respondents had four options to select from for the various items under the five areas of knowledge gained. The four-part rating scale follows: I know little or nothing about this; I know something about this; I know quite a bit about this; and I am completely familiar with this.

The largest gains in **financial knowledge** included where to find research-based estimates for costs of production and women's roles in managing personal and business assets. The largest gain in **human resources knowledge** was learning about their personal communication style. The largest gain in **legal knowledge** was learning how estate plans impact farm/ranch families. The largest gain in **marketing knowledge** was learning how to use the cost of production to set price targets. The largest gain in **production knowledge** was learning how to participate in programs or obtain loans from the USDA Farm Service Agency and where to find information on cash rental/leasing rates in Illinois.

A different set of response options regarding actions taken included: 1 = Have completed or currently do this; 2 = In progress; 3 = Haven't started yet; and 4 = I don't intend to do this.

The largest gains in **financial actions** taken [Option 1 or 2] were prepare or review my/our personal or business balance sheet; calculate or review my/our farm /ranch financial ratios; compare my/our farm/ranch financial ratios to benchmarks; and compare the profitability of one farm/ranch product or enterprise to another. The largest gain in **human resources actions** was choosing new or updating a current family insurance policy. The largest gain in **legal actions** was modifying forms of property ownership to reduce liability or meet other

goals. The largest gain in **marketing actions** included exploring ways to manage price swings in the marketplace. The largest gain in **production actions** included reviewing and/or updating my/our cash rental/leasing agreements. The largest gain in **production actions** included reviewing and/or updating my/our cash rental/leasing agreements.

At the end of the **Welcome to the Real World** simulation, evaluation forms were completed and collected from 2,607 of the youth participants located across Illinois. The evaluation was designed to identify increased knowledge of financial management. The evaluation asked students to evaluate five money management skills choosing between "learned how to do" or "already knew how to do." Of the 2,607 youth respondents, 2,055 [79%] indicated that they learned at least one of the five skills.

- 1,629 [63%] reported learning how to balance income and expenses
- 1,462 [57%] learned how to open a savings account
- 1,371 [53%] learned how to balance a checkbook
- 1,213 [47%] gained skill in keeping track of savings
- 782 [30%] learned how to write a check

Students were asked to indicate their awareness or knowledge of three items related to a future career after as compared to before they participated in **Welcome to the Real World** by checking "Not much", "A little", or "A lot." Of the 2,493 students who completed this set of questions 1,403 [56%] of the respondents indicated increasing their awareness or knowledge for at least one of the three items after participating in the program. Levels of students who indicated increases for a given item follow.

- 1,096 of 2,493 [44%] indicated increasing their awareness or knowledge of the relationship between education and job.

- 970 of 2,490 [36%] of the students indicating increasing their awareness or knowledge of the relationship of job and money.

- 691 of 2,488 [28%] of the students indicated increasing their awareness or knowledge of the importance of getting more education after high school.

Key Items of Evaluation

When **Annie's Project** participants were asked about the most important thing they learned, estate planning was most frequently mentioned. In responses to sharing the most important action they had taken, they reported a broad array of actions. Enhanced and expanded communication with family members, tenants, and attorneys or financial advisors was an over-arching theme.

Simulations help **Welcome to the Real World** youth participants recognize the challenges of independent living.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Animal Health And Production

☑ 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
301	Reproductive Performance of Animals	10%		15%	
302	Nutrient Utilization in Animals	10%		15%	
303	Genetic Improvement of Animals	0%		15%	
305	Animal Physiological Processes	0%		10%	
307	Animal Management Systems	20%		10%	
311	Animal Diseases	15%		20%	
315	Animal Welfare/Well-Being and Protection	25%		15%	
806	Youth Development	20%		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	0.0	0.0	8.0	0.0
Actual Paid	1.0	0.0	27.5	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**
27264	0	1456823	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
27264	0	1456823	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
178682	0	8343340	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included work on the emerging problem of porcine epidemic diarrhea [PED was recently introduced in the U.S. and spread to many swine farms; during the epidemics PED caused up to 100% mortality in young piglets less than a week of age and caused significant economic losses to the pork industry], the development of a cooperative, multistate research group comprised of basic and applied scientists to investigate the biological mechanisms underlying germ cell and embryonic development so that these processes could be manipulated for the improvement of livestock, research with the long-term goal of improving our understanding of the regulation of muscle development, growth, and metabolism to improve the efficiency of meat production and also to combat obesity in humans, and work to determine the functionality of the microbiome across species [this will expand opportunities aimed at developing monocultures for application in animals and humans, harvesting enzymes or bacteria to use in improving livestock production and efficiency by developing novel feed additives and potential forage treatments, and targeting key organisms to reduce greenhouse gas emissions and reduce the environmental impacts of fermentation].

Activities also included a study seeking to determine if a modified laryngoplasty technique is superior to the standard laryngoplasty technique to restore normal airway function, an investigation of the hypothesis that Standardbred pacers and trotters share genetic risk factors for osteochondrosis but that biomechanical differences in their natural gait patterns influence which early lesions heal and which become permanent, a study that will help to improve our understanding of intricate signaling mechanisms that operate between distinct cellular compartments of the uterus during early pregnancy, work to determine whether direct osterix expression in equine osteo-progenitor cells stimulates bone formation and by extension fracture repair, an effort to improve our understanding of the mechanisms whereby environmental and/or physiological stressors modulate immune responses to various pathogens as well as how stressors influence the pathogenesis of infection [this research has great potential for influencing disease pathogenesis and agricultural productivity], and the development of preliminary findings that some goat ERVs are insertionally polymorphic and thus could be used as genetic markers [the relatively lower degree of genetic marker development in the goat suggests that retrotype markers would add to our knowledge of a livestock species of growing importance to U.S. agriculture].

Conference presentations included the Conference of Research Workers in Animal Diseases, American Society for Virology, International Pig Veterinary Society Congress, Federation of Analytical Chemistry Spectroscopy Societies, International Embryo Transfer Meetings, International Congress of Meat Science and Technology, Reciprocal Meats Conference, Midwest Animal Science Meetings, North American Congress for Conservation Biology, International Annual Symposium of the American College of Veterinary Surgeons, Veterinary Orthopedic Society, Psychoneuroimmunology Research Society Meeting,

Harvard Probiotics Meeting, Adisseo Amino Acid University, IX FINCA Jornada Ganadera, American Society of Agricultural and Biological Engineers, Society for Theriogenology, American Association of Equine Practitioners, American Dairy Science Association, American Society of Animal Science, Beef Improvement Federation, Society for Molecular Biology and Evolution, Animal Behavior Society, and the National Research Institute for Veterinary Virology and Microbiology.

Two key programmatic thrusts characterize Extension Livestock Production -- increasing reproductive efficiency and reducing livestock production input costs. Two Commercial Agriculture Extension Educators located in research stations provided leadership for a number of programs that focused on beef production and that included the statewide **Beef Quality Assurance Certifications**, **Beef Sire Selection**, **Illinois Performance Tested Bull Sale and Illinois Beef Exposition**, **Illinois Forage Institute**, **Driftless Regional Beef Conference** [with the latter attended by participants from Illinois, Iowa, Minnesota, and Wisconsin], and a **Beef Cattle Reproductive Technologies Workshop**. Other local and regional programs included pasture walks, winter cattle feeders meetings, research farm field days, and regional **Cow/Calf Seminars** [the evaluation section features impact findings for the **Beef Cattle Reproductive Technologies Workshop**].

Three **Dairy Summit** meetings were held throughout the state for dairy producers and included presentations on silage quality, heifer development and calf raising strategies, dairy checkoff, and milk quality and antibiotic residue avoidance. **Certified Livestock Manager Training Workshops** targeted at manure management were delivered by Extension staff at eight locations in the state to keep producers current on industry practices. Topics covered included nutrient management, as well as new technologies, research, and trends [see the Agriculture and Biological Engineering planned program for additional information].

The University of Illinois College of Veterinary Medicine also offered the **Executive Pork Producers Program** which addressed essential skills for excellence in swine business management and the **Executive Veterinary Program in Swine Health Management** which covered the essential aspects of swine production medicine for veterinarians.

A number of Extension campus faculty and staff members helped conduct the annual horse, poultry, dairy, meats, and livestock judging contests for 4-H members. Other 4-H activities included the state **Dairy Quiz Bowl**, regional and state **Horse Bowl/Hippology**, and speech contests. The Extension faculty specialist in poultry taught teachers how to use the curriculum and incubators for the 4-H chick incubation and embryology project. Teachers conducted the project in 137 classrooms that included 9,925 youth during the 2015-2016 school year [see 4-H Youth Development planned program]. In addition, 2,786 Illinois 4-H and FFA members completed the seven modules of the online **Quality Assurance and Ethics Certification** training and quiz for beef, dairy, goats, horses, sheep, swine, rabbits, and dogs covering topics related to care and administration of medicine for livestock. New youth livestock programs included a **4-H Youth Livestock Conference** attended by 99 youth who gained knowledge and skills and learned more about careers related to livestock. Fourteen youth were also recruited to serve as newly established **Livestock Ambassadors**.

Pet columns are provided on a variety of topics and species by the University of Illinois College of Veterinary Medicine. The **Shelter Medicine Program** partners with the community to reduce pet overpopulation, enhance veterinary education, and improve the lives of dogs and cats [for more see http://vetmed.illinois.edu/animal-care/shelter-medicine-program-illinois/#sthash.KnTFnIZP.dpuf]. Extension's Illinois Summer Academies included one conducted by the College of Veterinary Medicine for high school age youth and one conducted by the Department of Animal Sciences focused on exploring careers related to animal care and health.

2. Brief description of the target audience

Members of the target audience included researchers focusing on animal health and infectious diseases, swine Extension educators, veterinarians, pork producers, policy makers at the state and federal levels, the pharmaceutical industry, poultry producers, animal scientists, nutritionists, feed formulators, swine integrators, soybean producers, veterinary surgeons, musculoskeletal/orthopedic researchers, immunologists, graduate and undergraduate students, researchers in the agricultural and biomedical sciences, nutritionists, the dairy community, producers who produce niche pork, larger swine integrators, and farmers who finish beef cattle.

Extension targets livestock producers, regulatory agency representatives, livestock commodity group representatives, veterinarians, horse owners and breeders, the livestock feed industry, companion animal owners, and youth.

3. How was eXtension used?

Five Extension staff are members of various animal-related eXtension Communities of Practice including Animal Welfare, Beef Cattle, Companion Animals, HorseQuest, Livestock and Poultry Environmental Learning Centers, Goats, and Sheep.

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1713	8584	12696	1689

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

Patent Applications Submitted

Year:	2016
Actual:	1

Patents listed

TF08099-US - Microfluidic Systems And Methods [Issued Patent].

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	66	66

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2016	9

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Increased Knowledge Of Livestock Care And Management

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	2786

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Priorities in livestock production focus on production management [addressing new issues involving health, feeding, reproduction, genetics, and risk management associated with production that enhances producers' profitability and provides quality and safe meat products for consumption]. Humane care of animals is a concern as is a safe food supply.

What has been done
The second State 4-H Youth Livestock Conference was held in February of 2016 and attended by 99 youth. The conference agenda included five sessions: A meat science experience exploring a variety of meat cuts and the animal from which the cuts originated; an opportunity to learn more about simple surgical procedures for livestock; and livestock biosecurity and breeding. In addition, the youth learned how to use social media to promote the livestock industry as a whole. A fifth activity, the Livestock Quiz Bowl, kept everyone thinking on their feet about what they had learned.

Results
At the end of the conference 68 of the 7th through 9th grade youth completed an evaluation to share what they learned and their opinions of their overall livestock experience in 4-H. With respect to their conference experience, all 67 participants agreed that they gained knowledge and skills that they can use at home with their own livestock projects. With respect to their overall livestock experience in 4-H, all participants agreed [30%] or strongly agreed [68%] that caring for and exhibiting livestock projects in 4-H has taught them what it means to be responsible and ethical. Required livestock ethics online module training records indicate that 2,786 youth were successfully certified in 2015-2016 and are included in this state outcome measure along with the 68 4-H Youth Livestock Conference attendees.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection
806	Youth Development

Outcome #2

1. Outcome Measures

Improved Control Of Porcine Reproductive And Respiratory Syndrome

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The substantial increase in total brain volume in piglets the first few months after birth suggests that this is a period when disruption of neurodevelopment by environmental insults may affect brain structure and function, changing the trajectory for normal behavioral development. One hypothesis suggests that the postnatal period is a sensitive time during which exposure to environmental insults programs biological systems in a manner that persists and accentuates vulnerability to stress later in life. This hypothesis is predicated on environmental insults influencing structural and functional plasticity of the brain and subsequent resilience. A loss of resilience is important to pig production because an exaggerated stress response negatively impacts animal well-being, reduces production efficiency, and leads to pre- and post-slaughter losses. This project seeks to test the hypothesis that postnatal viral infection and subsequent activation of brain microglial cells disrupts neurodevelopment resulting in reduced resilience.

What has been done
Maternal infection during pregnancy increases the risk for neurodevelopmental disorders and reduced stress resilience in offspring, but the mechanisms are not understood. We hypothesized that piglets born from gilts infected with a respiratory virus [PRRSV] that induces acute illness lasting two weeks during pregnancy would exhibit aberrant microglia activity and reduced stress resilience, manifesting as cognitive deficits and reduced sociability. Pregnant gilts were inoculated

at gestational day 76. Piglets born from infected and control gilts were weaned at postnatal day [PD] one and assigned to two groups. One group was challenged with LPS [5 ug/kg body weight i.p.] or saline; the second group was tested in a T-maze task to assess spatial learning, and in a three-chamber arena with unfamiliar conspecifics to assess social behavior. At PD 28, microglia [CD11b+ CD45low] were isolated and challenged ex vivo with LPS; a subset of cells was analyzed for MHCII expression.

Results
Maternal infection did not affect piglets' TNF-alpha, IL-10, or cortisol levels basally or four hours post-LPS challenge, nor did it affect performance in the T-maze task. There was no effect of maternal infection on microglial MHCII expression or LPS-induced cytokine production. However, both sociability and preference for social novelty were decreased in piglets from infected gilts. Taken together, these results suggest the reduced social behavior elicited by maternal infection is not due to aberrant microglia activity postnatally. The effects of maternal immune activation on microglia activity in the fetal brain remains to be investigated.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #3

1. Outcome Measures

The Development Of New Therapeutic Agents To Treat Toxoplasma Gondii And Cryptosporidium Parvum

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Determining The Concentration Of Digestible Energy And Nutrients In Soybean Meal To More Accurately Formulate Diets For Pigs

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Determining Which Measures Of Performance Recorded On Developing Heifers Are Good Indicators Of Their Efficiency As Brood Cows

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Identification Of Molecular Pathways Involved In The Regulation Of Hypothalamic-Pituitary-Adrenal [HPA] Activity

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Reducing The Spread Of Porcine Epidemic Diarrhea

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Porcine epidemic diarrhea virus [PEDV] is an emerging virus in the U.S. first identified in April 2013. PEDV is highly contagious and has spread quickly to most pig producing states in the country. The mortality rate reaches up to 80-100% in new-born pigs, and in a little over one year of the first outbreak PEDV had resulted in more than eight million deaths of pigs. During virus infection, innate immunity of hosts plays a critical role for the first line of defense and produces cytokines and chemokines in response to viral infection for protection. Among them, type I interferons are the most important mediators of host defense against viral infections. PEDV has evolved to counteract and disarm the host IFN system, and thus the understanding of a viral strategy for immune evasion holds a great potential for new vaccine developments. This study aims to identify specific viral proteins responsible for IFN suppression and determine the molecular mechanism for viral antagonism. This study will lead to a novel design for a future vaccine candidate for PEDV.

What has been done
During the reporting period, we have made two major achievements: the identification of viral proteins antagonizing the host innate immunity and the basis for IFN suppression mediated by PEDV. To determine the suppression of IFN by PEDV, we first developed a gene-based reporter

assay and a replicating virus-based bioassay. Vesicular stomatitis virus [VSV] is extremely sensitive to IFNs and in the presence of IFNs, VSV growth is readily inhibited. VSV-GFP is a recombinant virus expressing green fluorescence, and thus VSV replication can be determined by measuring the intensity of green fluorescence expressed during the growth of VSV-GFP, and thus the relative amounts of IFN present in samples. Using the bioassay, we found that type I IFN response was suppressed during PEDV infection. We then wanted to identify viral proteins responsible for IFN suppression. All 24 viral coding sequences of PEDV were individually cloned and expressed. Of 16 nonstructural proteins [nsps] of PEDV, nsp1, nsp3, nsp7, nsp14, nsp15 and nsp16 were found to inhibit the IFN-beta production. The sole accessory protein ORF3 and three structure protein including envelope [E], membrane [M], and nucleocapsid [N] protein were also found to inhibit such activities. Since nsp1 was one of the most potent antagonists, nsp1 was chosen to study further. Interestingly, nsp1 was found to interrupt the enhanceosome assembly by degrading CREB-binding protein [CBP] in the proteasome-dependent manner.

Results
Our data demonstrated that PEDV modulated the host innate immune responses by degrading CBP and suppressing the expression of downstream antiviral proteins. We then began to examine the role of NF-kB during PEDV infection. PEDV was found to inhibit NF-kB activation and regulated the expression of proinflammatory cytokines and chemokines. Our studies revealed the molecular basis of the innate immune modulation by PEDV and the information contribute to the understanding of viral strategy for viral pathogenesis and immune evasion.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #8

1. Outcome Measures

Performing Proof-Of-Concept Studies For The Detection Of Avian Influenza Virus

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The overarching objective of this research is to perform proof-of-concept studies for detection of AIVs in two different novel diagnostic platforms. These novel diagnostic platforms allow for rapid detection of AIVs; one of these platforms also has multiplexing capability for detection of multiple influenza virus hemagglutinin subtypes simultaneously.

What has been done
In previous work, we have identified several optimal anti-hemagglutinin antibodies to apply to dynamic light scattering [DLS] and surface-enhance Raman spectroscopy [SERS] platforms via screening against panels of AIVs using ELISA. We also screened anti-M1 or anti-NP antibodies that would be broadly cross reactive for different subtypes influenza A viruses for a universal detection marker. We have demonstrated that there is excellent correlation between ELISA and DLS results examining binding affinity of anti-H1 antibodies with a panel of H1 subtype influenza viruses. Importantly, DLS results were obtained rapidly [30 minute assay].

Results
Our most recent work also evaluated the SERS platform using an identified optimal anti-H3 antibody with a panel of AIVs. These results demonstrate excellent correlation with ELISA results. Moreover, the entire sample preparation for the SERS assay only took 60 minutes. Recent work also identified a promising anti-M1 antibody for universal detection of AIVs. We have developed an optimized lysis buffer that also preserved high affinity binding with anti H1-antibodies post lysis, to allow for multiplexing of both universal and subtype specific AIV detection. The results of the past year's work demonstrate the excellent potential for universal and subtype specific, rapid, sensitive detection of AIVs using the SERS platform.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #9

1. Outcome Measures

Investigating The Biological Mechanisms Underlying Germ Cell And Embryonic Development To Improve Livestock

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2050, the expected size of the human population is nine billion, the demand for food will increase, and the demand for milk will increase along with it. Genetically modifying animals is a tool that can be used to meet this growing demand. In the United States Holstein is the leading breed for milk production and produce on average 24,291 pounds of milk per year while Jerseys, the other major dairy breed, produce on average 16,997 pounds. Their ability to produce large quantities of milk is linked to two mutations. These mutations are on the a-lactalbumin [a-lac] gene; the a-lac exon [+1] corresponds to the transcription start point of a-lac, [+15] and [-1689] are the positions corresponding to the single nucleotide polymorphism associated with increased milk production. Holstein cows have an adenine at both of these positions in contrast to the other cattle breeds with lower milk production, which have either a cytosine or guanine at either position. Inserting an adenine at position [+15] and [-1689] to cows without this mutation could lead to increased milk production and a better response to market demands.

What has been done
The purpose of this experiment was to test the cutting efficiency of candidate clustered regularly interspaced short palindromic repeats [CRISPRs] that will later be used in knock-in experiments. CRISPRs were used because the CRISPR-Cas 9 system is inexpensive, easily programmed, and efficient. In this preliminary study we worked with Holstein Mac-T cells which already contain the mutation at both positions. CRISPRs were used on this cell line to cut the DNA at a site near the mutation. Based on the genomic DNA sequence of these MAC-T cells, three guide RNAs were designed. Cells were then transfected with the designed CRISPRs by a variety of transfection methods, including Fugene, electroporation, and Lipofectamine. Green florescent protein was used to determine the efficiency of transfection, 30% efficiency was seen for Fugene, while electroporation and Lipofectamine had 70% efficiency. To select for successfully transfected cells, puromycin selection was applied. The DNA was later extracted and sent in for sequencing. Next, the website TIDE was used to compare the transfected Mac-T cells to normal Mac-T cells. TIDE software measures the editing efficiency and looks for major insertions or deletions in pools of DNA by comparing two sequences to quantify the editing efficacy of CRISPR-Cas9.

Results
Our results showed that CRISPRs successfully cut the DNA near the a-lac mutation region with a total efficiency of 13.8%. The desired next step will be to insert a single strand oligonucleotide [ssODN] donor to make a single base pair mutation. The ultimate aim of this research would be to insert these mutations into other cattle species in order to increase their milk production.

4. Associated Knowledge Areas

KA Code	Knowledge Area

301	Reproductive Performance of Animals
303	Genetic Improvement of Animals
315	Animal Welfare/Well-Being and Protection

Outcome #10

1. Outcome Measures

Determining If A Modified Laryngoplasty Technique Is Superior To The Standard Laryngoplasty Technique To Restore Normal Airway Function

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The main objective of the study is to determine if a modified laryngoplasty technique is superior to the standard laryngoplasty technique to restore normal airway function. Therefore, the testing model was slightly changed from the originally proposed one [one cycle-to-failure and cyclic testing model]. The new objective was to compare the effects of two laryngoplasty [standard and modified] techniques [performed in cadaveric equine larynges] on translaryngeal flow, pressure, and impedance using the airflow chamber described by Cheetham [Equine Veterinary Journal 2008]. The in vitro laryngeal model used can mimic the airflow and pressures experienced by horses at maximal exertion.

What has been done
For both surgical techniques the prosthetic suture was passed through the cricoid cartilage and through either the muscular process [standard] or the muscular process and body [modified] of both arytenoid cartilages. Each larynx was positioned in a flow chamber after placement of the standard laryngoplasty and modified laryngoplasty and subjected to cyclic airflow. Tracheal flow, translaryngeal pressure, translaryngeal impedances, right to left quotient abduction angles, and internal rima glottides cross-sectional areas were determined and compared for both techniques. The data obtanied had normal distributions. Internal rima glottidis cross-sectional area, right to left abduction angle quotient, tracheal airflow, translaryngeal pressure difference, and translaryngeal impedance were compared between LP techniques using a paired-t test.

Results
The right to left abduction angle quotient and internal rima glottidis cross-sectional areas were

similar [P=0.460 and P= 0.266, respectively] between laryngoplasties indicating that comparable degree of left arytenoid cartilage abduction was achieved with both techniques. At maximal cyclic airflow [53 L/s], the surgical constructs had similar [P=0.307] translaryngeal pressures [standard= 15.81± 4.68 mmHg and modified =14.84 ±2.84 mmHg, respectively] and translaryngeal impedance [standard= 0.23± 0.09 mmHg/L/s and modified=0.28± 0.05 mmHg/L/s, respectively]. Based on these results it appears that a modified laryngoplasty technique is comparable to the standard technique to improve airflow in cadaveric larynges. This information along with previous research that showed that the modified laryngoplasty technique can prevent failure of the suture anchor point in the cartilage provides preliminary data that support future investiagation of the modified laryngoplasty technique in live horses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #11

1. Outcome Measures

Improving Our Understanding Of The Synthesis And The Roles Of Estrogens In The Porcine Gut

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Peyer's patch is a lymphoid tissue localized in the intestine of all mammalian species. In a recent collaboratory effort, we found that a neonatal pig's Peyer's patch [Pp] contained more than 20 fold higher 17 beta-estradiol [E2], the most potent naturally synthesized estrogen, than peripheral blood. The unusually high E2 concentration in the Pp indicates that these lymphoid tissues may serve as a local site of de novo E2 synthesis. In fact, recent studies find that estrogens also play important roles in regulating the immune system, cancer development, and other biological processes that are critical for health in humans and animals alike, other than its traditionally known roles as a sex hormone.

What has been done
Currently there are no published reports of E2 synthesis in the Pp, nor in any lymphoid organ, in any species. As such, it is critically important to provide definitive evidence that E2 is synthesized de novo in the Pp. If Pp were a novel de novo estrogen synthetic organ, it is important to conclusively identify the specific cell type that is responsible for the E2 synthesis. In this project, tissues were collected from pigs aged 10 days and 90 days. We collected Pps, ovaries, and testes from piglets, and the E2 synthetic capacity was measured in vitro in the presence and absence of androstenedione [E2 precursor]. In addition, proteins were extracted from the Pps and western blotting was performed to determine presence of aromatase, an enzyme converting androgens to estradiol, in the isolated Pps. Ovaries and testes will be used as a positive control for aromatase expression.

Results
Our research with three- and twelve-week old piglets has found that Peyer's ileal patches and mesenteric lymph nodes have the estrogen synthetic capacity as early as three weeks of ages, and the capacity increases as they grow. These data are from a direct measurement of estradiol contents in those tissues and also after culturing the tissues in vitro. Double immunostaining of Peyer's patches with aromtase [Cyp19] and HEV endothelial cell markers [MECA76] lead to a conclusion that HEV endothelial cells are responsible for the estradiol synthesis in those lymphoid tissues. Steroid gene expression assays and steroid hormone profiling with RT-PCR and GC/MS in the Peyer's patches showed that this tissue expresses not only enzymes responsible for estradiol synthesis but contains precursors for estradiol synthesis, indicating Peyer's patches are the sites of de novo estradiol synthesis.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #12

1. Outcome Measures

The Use Of High-Throughput Technologies To Identify And Quantify Peptides And Proteins In Livestock

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2016 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The use of high-throughput technologies to identify and quantify peptides and proteins in livestock samples are experiencing a similar trend to massive parallel DNA and RNA sequencing technologies. Research resulting in impactful advances in understanding and improving animal performance and health use sequencing technologies to simultaneously identify and profile thousands of genes and transcript or mass spectrometry technology to simultaneously identify thousands of proteins. Molecular identification is tightly linked to detection of differential abundance across conditions and network reconstruction. Challenges in studies using nucleic acid sequencing or proteomic mass spectrometry are the uncovering of true positive associations between the genes, transcripts, peptides or proteins and differences in performance, genetic merit, physiology, health status, or behavior while minimizing false positive results. There is an urgent need to develop analytical approaches to accurately detect and profile genes, transcript, proteins, and peptides.

What has been done

The objective of this study was to investigate simultaneously health and genetic factors influencing the lactation curve. Test-day milk records on more than 6,000 Holstein cows across four states [California, Florida, Minnesota, Texas] and nine herds were evaluated. The trajectory of the lactation curve was modeled using nonlinear mixed effects models including Wood's and Wilmink's functions. The effects of environmental and health indicators on the level of milk yield, increase in milk production early in lactation [Wood's] or milk yield at peak [Wilmink's], and persistency thereafter were evaluated. These effects included: season [summer or winter], state, parity, vaginal mucus score at seven days postpartum, metritis at seven days postpartum, mastitis cases within the first 60 days postpartum, blood beta-hydroxybutyrate [BHBA] indicating subclinical ketosis, body condition score at 35 days [BCS35], displaced abomasum [DA] by 60 days postpartum, respiratory illness by 60 days postpartum [Resp], and lameness at 35 days.

Results

Estimates from the Wood's model indicated that multiparous cows have significantly higher levels of milk yield immediately after calving and lower persistency than primiparous cows. Metritis had a negative effect on milk yield level immediately after calving as well as on persistency. Mucus score and DA had a negative impact on milk yield immediately after calving. Consistent with Wood's estimates were Wilmink's. Our findings demonstrate the need to incorporate disease indicators on the assessment of the genetic component influencing the trajectory of the lactation curve. These findings contribute to a long-term multistate project database for direct measures of fertility.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
311	Animal Diseases

Outcome #13

1. Outcome Measures

Evaluating Hen Responses To Atmospheric Ammonia

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Hen responses to varying exposure concentrations and durations of atmospheric ammonia were investigated in laboratory and field studies. The intent is to better understand the severity of consequences of environmental conditions on health and welfare of hens, as well as the prevalence of these environments in commercial production settings.

What has been done
Based on the preliminary results of the laboratory studies, hen physiological responses observed at 45 weeks of continuous exposure to 30ppm atmospheric ammonia were not as severe as those observed after 25 weeks of continuous exposure. This result contradicts previous research that has linked the same responses to similar ammonia exposure. This may be an indication that adaptive measures at work in the biological regulation of laying hens offer hens the capacity to tolerate exposure to atmospheric ammonia when other stressors are not present. In this controlled laboratory study, thermal conditions, noise, dust, and social stressors were more tightly controlled than in a commercial production setting.

Results
The preliminary indications of the study imply that the impact of multiple stressors on the biological coping mechanisms may be a more significant issue for managing poultry flocks than individual environmental stressors. Data analysis is ongoing for behavioral, production, and pathological indicators, as well as additional physiological indicators, which will further supplement these preliminary results. Additional observations after two and seven weeks of moderate exposure and two weeks of severe exposure will add to our understanding of the adaptive responses under varying exposure conditions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #14

1. Outcome Measures

Increased Knowledge Of Livestock Reproduction

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	22

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Priorities in livestock production focus on production management [addressing new issues involving health, feeding, reproduction, genetics, and risk management associated with production that enhance producers profitability and provides quality and safe meat products for consumption]. Humane care of animals is a concern as is a safe food supply.

What has been done
A University of Illinois Extension Beef Specialist conducted a Beef Cattle Reproductive Technologies workshop held at the University of Illinois Dixon Springs Agricultural Center. The workshop was designed for beef producers and college students who are studying livestock reproduction. The latest developments in cattle breeding and synchronization were highlighted. Topics included synchronization of estrus in cattle, anatomy and reproductive diseases, embryo transfer and advances in bovine reproduction, and semen handling and placement. At the end of the program, the 22 participants were asked to respond to questions designed to assist in improving future programs and determining changes in knowledge regarding topics that covered a variety of health risks during the program. Twenty-two participants responded.

Results
At the end of the Beef Cattle Reproductive Technologies program beef producers and college students studying livestock reproduction were asked to indicate to what extent their knowledge of beef cattle reproduction increased using a five-part scale with 1 = Nothing, 3 = Somewhat, and 5 = A lot. Twenty-two participants responded with 16 indicating "A lot", five choosing a "4" and one

choosing "Somewhat". Additional results for the eight topics that were covered in the workshop are included in the Evaluation Results section of this planned program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

An evaluation was distributed to participants in the **Beef Cattle Reproductive Technologies** workshop. In response to a question seeking to determine how much they learned from this session, 16 of the 22 who responded checked "A lot", five checked a "4", and one checked "Somewhat". Following the workshop the evaluation asked the participants to rate their knowledge of eight topical presentations.

Using a five-part scale anchored with 1 = Low and 5 = High, participants were asked to indicate their self-perceived level of knowledge both before and after the workshop. The percentage of those who indicated increasing their knowledge of the eight topics after as compared to before scores follows.

- Reproductive Anatomy -- 19 of 22 [86%] increased knowledge
- Reproductive Disease and Prevention -- 17 of 22 [77%]
- Bovine Estrus Cycle and Heat Detection -- 18 of 22 [82%]
- Finding the Inseminator's Target -- 19 of 22 [86%]
- Estrus Synchronization and Timing of AI -- 21 of 22 [95%]
- Advances in Bovine Reproduction -- 18 of 21 [86%]
- Semen Handling and Tank Management [lab session] -- 20 of 22 [91%]
- Identification of Female Reproductive Anatomy [lab session] -- 19 of 22 [86%]

The second two-day state **4-H Youth Livestock Conference** was held in February of 2016 and attended by 99 youth. With respect to their conference experience, all 68 participants who completed an evaluation agreed that they gained knowledge and skills that they can use at home with their own livestock project. All but one [67] youth agreed or strongly agreed that they learned more about livestock careers. Nearly equal numbers of youth strongly agreed [36] or agreed [32] that they were more interested in a future career in the livestock industry. More youth agreed [41] than strongly agreed [26] that they felt more prepared to respond to questions from the public about livestock.

With respect to their overall livestock projects in 4-H, all participants agreed [32%] or strongly agreed [68%] that caring for and exhibiting livestock projects in 4-H has taught them what it means to be responsible and ethical. All participants agreed [46%] or strongly agreed [54%] that their 4-H experience has helped them build confidence and social skills. Sixty-three [91%] reported teaching others about something related to livestock.

With respect to their overall livestock experience in 4-H related to science, all but two youth agreed [57%] or strongly agreed [41%] that their 4-H experience helped them think that science is useful for solving everyday problems. Likewise all but three youth agreed [51%] or strongly agree d [45%] that they want to learn more about science as it relates to the livestock industry. Although six disagreed or strongly disagreed, more than half of the youth [55%], strongly agreed that the experiences helped them think science, engineering, or technology will be important in their future, and another 15 youth [36%] agreed. Fifty-six of the youth agreed or strongly agreed that their 4-H livestock experience did influence them to like science.

Key Items of Evaluation

All but one of the 22 participants in the **Beef Cattle Reproductive Technologies** workshop who completed the evaluation indicated that their knowledge increased with respect to at least one of eight areas of beef cattle livestock reproduction. When asked how much they learned based on a 5-part scale with 1 = Nothing and 5 = A lot, three-fourths [16] indicated they learned "A lot". The weighted average score for the 22 respondents was a 4.68.

Most notable was that all 68 of the 2016 **4-H Livestock Conference** participants who completed an evaluation agreed [29%] or strongly agreed [71%] that they gained knowledge and skills that they can use at home with their own livestock projects. All but one youth agreed or agreed strongly that they learned more about livestock careers. All but three youth agreed [51%] or strongly agreed [45%] that they want to learn more about science as it relates to the livestock industry.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Community Resource Planning And Development

☑ 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
608	Community Resource Planning and Development	45%		30%	
802	Human Development and Family Well-Being	0%		20%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	15%		10%	
805	Community Institutions, Health, and Social Services	15%		20%	
806	Youth Development	25%		20%	
	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	0.0	0.0	1.0	0.0
Actual Paid	22.3	0.0	3.3	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**
616170	0	87881	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
616170	0	87881	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4038231	0	281167	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included an investigation that seeks to contribute to existing research on school readiness among low-income African American and Latino/a families of preschoolers transitioning to kindergarten by examining how families and schools can better collaborate to enhance children's school readiness [there is a critical need to promote the school readiness of low-income African American and Latino/a children who, relative to their White peers, continue to demonstrate lower levels of school readiness], work designed to explore the extent to which different types of intimate partner violence are associated with different patterns of judicial involvement, interventions, and legal outcomes over time and how these patterns relate to ongoing threats to mothers' safety and adjustment, a study examining the complex relationships between family socioeconomic conditions, daycare, schooling experiences, and cognitive, behavioral, and socioemotional growth and development during childhood, and the development of an afterschool physical activity curriculum and template designed to support healthy weight among Latino school children.

Conference presentations included the American Educational Research Association, International Congress of Qualitative Inquiry, National Council on Family Relations, and the International Family Violence and Child Victimization Research Conference.

Extension activities included a wide variety of methods focused on community planning, building entrepreneurial communities, leadership development, and workforce development.

Community planning education in 2016 included work with communities in developing, implementing, and/or updating 26 action plans by providing assistance with surveys, focus groups, interviews, public meetings, goal formation, and implementation monitoring that successfully involved diverse participants and stakeholders. These assistance processes were used to explore and address municipal, county, and regional issues and projects related to managing disasters, park development, transportation, community revitalization, housing, and economic development. In addition, several communities received University of Illinois student assistance with projects through the **Community Matters** program, a partnership between University of Illinois Extension and the University of Illinois Department of Urban and Regional Planning. The **USDA Stronger Economies Together** [SET] multi-year program focused on developing high-quality regional economic development plans in four Illinois multi-county locations.

Community and Economic Development Extension Educators also provided programs related to economic development. The **On the Front Line for Customer Service** curriculum was used to educate employees of businesses, agencies, and government entities as well as students on customer service skills and best practices. **Age Matters**, a four module program addressing generational values and historical information focused on building participants' skill in working with consumers, employees, and volunteers was ongoing.

Staff members also helped individuals plan for starting or sustaining small businesses. **Buy Local: A Sustainable Communities Initiative** was delivered via presentations to groups that included elected officials, planning commission members, business owners, community leaders, and residents. A shopping simulation created by an Extension educator to demonstrate the value of buying local was used in high schools engaged in job shadowing programs.

Building Entrepreneurial Communities continued to be a focus associated with economic development and workforce preparation. Educators [both those with 4-H responsibilities and those with community development responsibilities] were active in workforce preparation for youth through high school career days, job shadowing, and week-long camps focused on entrepreneurship and starting small businesses. Partnering with schools, Extension staff members conducted simulated job interview experiences and taught workplace soft skills**.** The **iDREAM-iCREATE** curriculum, focused on fostering youth creativity and entrepreneurship and continued to be offered in school settings. A new opportunity was the implementation of the first Shark Tank Competition that placed students into teams to create a business idea and then present the idea to a panel of local community leaders who graded the student teams on critical "soft skills". Interest by an adult community in **iDREAM-iCREATE** has been identified and will be pursued in the coming year.

Leadership development programming included continued support for two local adult **Leadership Academie**s and several youth **Leadership Academies** often conducted in partnership with other community organizations. A multi-year leadership series for high school youth over their four years of attendance was delivered by leadership teams of student and adult advisory planning groups. Leadership programming for public officials and leaders included the University of Illinois Extension **Local Government Information and Education Network** [LGIEN] series of eight statewide webinars on topics such as comprehensive economic development strategies and using data and analytics to drive government innovation. A six-session **Extension Leadership Academy** sponsored by United Counties Council of Illinois was conducted by Extension for county-elected and appointed officials including county board members and administrators.

2. Brief description of the target audience

Members of the target audience included scholars, preschools and elementary schools, families, policy makers, mothers who co-parent after separation [including those who do and do not experience intimate partner violence], professionals working with mothers in the process of divorce [including family court judges, family law attorneys, custody evaluators, and parent educators], Hispanic families, researchers, scientists, graduate students, and family practitioners.

Community leaders, business leaders, agencies and organizations, and local government officials involved in community and economic development are key Extension target audiences. Other target audiences include residents interested in starting small businesses and youth.

3. How was eXtension used?

Nine Extension staff are members of various Community Resource Planning and Development related eXtension Communities of Practice including Entrepreneurs and Their Communities, Enhancing Rural Capacities, and/or Extension Disaster Education.

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	37970	24135	36556	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	10	10

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2016	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Number Of Individuals Reporting New Leadership Roles And Opportunities Taken

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number Of Plans Developed/Adopted/Adjusted By Communities Through Resident Engagement

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	47

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Illinois communities face a host of challenging issues, such as declining populations and shrinking economies. To address these and other issues, community leaders and residents need assistance to identify strategies to engage residents in managing the rapidly changing social and economic landscape.

What has been done
Several Extension educators focusing on community and economic development used a variety of processes to assist community leaders and residents in developing, implementing, and/or updating 47 action plans to guide the future of their municipality, county, or region.

Results
Educational assistance was provided for customizing disaster preparedness plans for the Quad Cities non-profit organizations and their sites, many of which were spread throughout Western Illinois and Eastern Iowa. Of the 20 organizations who attended an Extension workshop, 9 submitted disaster preparedness plans to the Community Foundation of the Great River Bend for grant funding. Four more organizations are in the process of submitting disaster plans. Assistance was also provided for a farmers market-planning and developing the framework for year one of the market.

Six municipalities received assistance in developing plans to create a not-for-profit housing assistance program, starting a comprehensive plan update for a municipality, and assisting with a plan for a village to help prioritize community projects. One of the larger cities in Illinois engaged Extension in planning assistance for the development and adoption of an historic preservation district, adoption of a model project for schools and city transportation, and identification of networks to support potential recreation opportunities. On-going community planning projects also included recognizing health environments affecting three neighborhoods of the city. It is worth noting that college students were involved in several of the planning processes in the above locations. Three counties received assistance in developing countywide plans.

Three of five regional planning processes associated with the USDA Rural Development Stronger Economies Together [SET] program focused on developing a regional economic development plan to build on unique assets and regional strengths. The SET planning process encompassing 11 counties in Southeastern Illinois completed their planning process. Two additional regions have submitted their plans and are awaiting USDA approval. Leaders in Economic Alliance for Development [LEAD], a USDA pilot program, supports a fourth regional planning process. The fifth regional planning process engaged in the Comprehensive Economic Development Strategy [CEDS].

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions, Health, and Social Services

Outcome #3

1. Outcome Measures

Percentage Of Community Plans/Goals Implemented

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number And Dollar Value Of Volunteer Hours Invested In Community-Related Projects

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

   Number Of Community/Organization Programs/Activities Initiated

   Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

   Number Of Jobs Created By New Businesses

   Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

   Improving Programs For High School Students Through A Better Understanding Of The Strategies Used By Effective Program Leaders

   Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

   Exploring The Extent To Which Different Types Of Intimate Partner Violence Are Associated With Different Patterns Of Judicial Involvement, Interventions, And Legal Outcomes

   Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

   Promoting School Readiness Of Low-Income African American And Latino/a Children

2. **Associated Institution Types**

   - 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The goal of this project is to conduct qualitative interviews with low-income African American and Latina mothers of preschool children transitioning to kindergarten and the preschool teachers of these children to examine the meaning of school readiness, expectations for child school readiness, expectations for parent involvement in school readiness preparation, expectations concerning the role of preschool teachers in facilitating school readiness, and related home and school practices that facilitate school readiness. The project also considers the role of the community context [urban-rural] that families and children live in, and its impact on school readiness and parent involvement. We focus on low-income, African American and Latina mothers of preschoolers transitioning into kindergarten because they are children's first teachers and influence how children are socialized for school. Using a resilience framework and qualitative methods, we seek to better understand first-hand the challenges faced in facilitating school readiness in these two contexts as well as the resources that parents and schools possess to promote school readiness. A second and applied goal is to explore ways to further enrich the collaboration between homes and schools through the development of parent workshops that reflect parental/family strengths and cultural resources. Our findings have the potential to contribute to a substantive and conceptual discussion on school readiness beliefs and practices and on parent involvement. The application of the findings to the development of parent workshops suggests concrete ways to enhance collaborations between parents and preschools that can help low-income, African-American, and Latino/a children to be better prepared for the kindergarten transition.

What has been done

We conducted qualitative interviews with African American and Latina mothers [caregivers] of preschoolers transitioning into kindergarten. Additional interviews were conducted with Head Start teachers. We used an interview protocol comprised of open ended, semi-structured questions that focused on mother's beliefs about school readiness and home-based practices used to prepare children for kindergarten. Similarly, we examined preschool teachers' views concerning school readiness and related classroom practices. Mothers and teachers were asked additional questions concerning neighborhood resources, local kindergarten programs, and the role of Head Start in preparing children for kindergarten. We also conducted a photo elicitation interview in which mothers took photographs of home-based school readiness activities. Mothers then described the photos as part of the recorded interview. All of the interviews were transcribed verbatim and checked for accuracy. To facilitate analyses, narrative and photo data were organized into visual data displays to help identify patterns within the data. Based on the data displays, we wrote summary memos which identified preliminary themes.

Results

Our preliminary analyses reveal that all study mothers are concerned with their children's early academic success. They believe that children need to do well early in life as a foundation for future success. All study mothers were involved in some form of home-based literacy activity such as reading to children, assisting with homework, and engaging children in literacy-promoting conversations. Mothers also believed that school readiness entailed sending children to school clean and well rested.

Most mothers relied on a variety of family members to assist them with their children's literacy development, including extended kin and siblings. Our early findings also suggest some differences between African American and Latina mothers. Latina mothers, because of language challenges, more often reported uneasiness engaging with the preschool. Additionally, because of their immigrant status and early school experiences, Latina mothers tended to be less familiar with the American school system. In many instances preschool teachers and mothers shared the view that early literacy skills [writing their name, recognizing letters and numbers] were important indicators of school readiness. However, preschool teachers, relative to mothers, tended to focus on a larger number of socio-emotional skills [self-control, independence, concentration, getting along with other children] as indicators of school readiness.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions, Health, and Social Services
806	Youth Development

Outcome #10

1. Outcome Measures

Examining The Complex Relationships Between Family Socioeconomic Conditions, Daycare, Schooling Experiences, And Socioemotional Development

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Despite decades of policies and programs aimed at reducing educational inequality, significant race and class gaps in achievement and attainment persist. The goal of this research project was to examine how family, school, and neighborhood conditions influence childrens' early cognitive, behavioral, and socioemotional development. In particular, we focused on residential and school mobility, stratification processes in schools [such as ability grouping for instruction], racial and poverty concentration, parental practices such as racial socialization, and maternal work conditions as key mechanisms to explain educational inequality. In our project, we used several nationally representative, longitudinal data sets from the U.S. Department of Education including the Early Childhood Longitudinal Study - Birth and Kindergarten Cohorts, the Education Longitudinal Study, and the National Longitudinal Survey of Youth, as well as geographical data on neighborhood quality from the U.S. Census.

What has been done
There were several noteworthy findings from our research. First, we found that students who experience non-routine school changes, especially coupled with residential changes, were more likely to develop internalizing and externalizing behavior problems, were less engaged in classroom activities, and had slower reading growth compared to stable students. Since low income and racial minority students are more likely to move during the early years of schooling and to enter kindergarten already behind their peers, they may be at further risk of early disengagement from school and slower reading growth because of the additional disadvantages that tend to come with a move. Our results suggest that while schools should support all students who are experiencing transitions during elementary school, special attention, particularly with respect to engagement and reading supports, should be given to students who are experiencing both residential and school moves coupled with other factors such as greater economic disadvantage.

Results
A second major finding from our research highlights the impact maternal work schedules have on early child development. Our results show that preschool children whose mothers work nonstandard hours are at greater risk of developing behavioral problems and have poorer beginning math and early literacy skills, compared to similar children whose mothers were employed in jobs with standard work hours [Monday through Friday from 9am to 5pm]. These effects persisted even after taking into account a host of maternal characteristics [such as education], family socioeconomic status, and prior behavior. These findings highlight the important source of potential conflict and strain working nonstandard hours may place on working mothers with young children and informs policy efforts to promote flexible work schedules, particularly for mothers of young children.

Lastly, our research showed that stratification processes within schools including the use of ability grouping for instruction can exacerbate educational inequality, particularly between racial groups. Our findings suggested that African American students were more likely to be placed in lower groups for reading instruction compared to similar White students during elementary school. Rather than a rising tide that lifts all boats, our findings showed that lower grouped students not only had slower reading growth but also developed more behavioral problems and diminished attachment to school by the end of third grade when compared to similar students who were not placed in higher ability groups for instruction or were in classrooms where grouping was not used. These results challenge the widespread practice of ability grouping for instruction in elementary schools across the U.S. and demonstrate how the practice may actually exacerbate racial gaps in

educational outcomes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions, Health, and Social Services
806	Youth Development

Outcome #11

1. Outcome Measures

Taking Action To Increase Buying In Local Communities

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	300

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Revenue is declining in many rural communities and is affected by many factors related to overall state and national challenges, as well as local challenges to sustain economies, such as the loss of businesses which in turn affect unemployment rates and out-population migration. A Retail MarketPlace Profile Study of the sixteen-county Southern Illinois region was conducted in the fall of 2012 using data obtained from ESRI® Business Analyst to compare an analysis of consumer spending and business revenues resulting in a retail gap. The analysis indicated that a $272 million net leakage for Southern Illinois existed in contrast to retail surpluses in the sections of neighbor states bordering Illinois.

What has been done
Extension staff assisted community leaders participating in creating a USDA Rural Development Stronger Economies Together [SET] High Quality Economic Development Plan. Attendees at the Plan Rollout Session were made aware of the plan's required goals and strategies which

emphasize the importance of supporting "locally first", small business and entrepreneurship, and regional thinking. Other efforts aimed at increasing local purchasing included preparing messages developed by the SET "Spending Locally First" committee. Messages included "Spending Locally First ensures the highway departments will be able to keep the road in good working order this winter" and "Spending Locally First ensures the ambulance will be there in the event of an emergency". In addition, a University of Illinois Extension Community and Economic Development Educator continued to deliver this information by conducting simulated shopping experiences that reached 285 youth from five high schools.

Results

At the conclusion of the SET program rollout, participants were asked: "How likely are you to implement the knowledge gained from the meeting on a scale from 1-5?". Thirty-eight percent [38%] responded with a "5" and 62% responded with "4". When asked to "Please rate the overall usefulness of the information presented using the same scale?", 77% responded with "5", and 23% responded with "4". When asked the open-ended question: "How will you use this information you learned today?", responses included "making a better commitment to buy local", "get the word out about spending locally", "promote more local involvement", and "develop a plan to communicate with the community".

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

At the conclusion of the SET program rollout, participants were asked: "How likely are you to implement the knowledge gained from the meeting on a scale from 1-5?" Thirty-eight percent [38%] responded with a "5" and 62% responded with "4". When asked, "Please rate the overall usefulness of the information presented using the same scale", 77% responded with "5" and 23% responded with "4". When asked the open-ended question: "How will you use this information you learned today?", responses included "making a better commitment

to buy local", "get the word out about spending locally", "promote more local involvement", and "develop a plan to communicate with the community".

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food Safety And Food Security

☑ 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
205	Plant Management Systems	5%		0%	
501	New and Improved Food Processing Technologies	0%		10%	
502	New and Improved Food Products	0%		15%	
503	Quality Maintenance in Storing and Marketing Food Products	15%		10%	
504	Home and Commercial Food Service	20%		5%	
701	Nutrient Composition of Food	0%		10%	
702	Requirements and Function of Nutrients and Other Food Components	0%		10%	
704	Nutrition and Hunger in the Population	20%		10%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	15%		15%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	15%		15%	
806	Youth Development	10%		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	0.0	0.0	6.0	0.0
Actual Paid	23.4	0.0	13.5	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**
687057	0	674948	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
687057	0	674948	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4502806	0	2333623	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included work to study the potential for agroforestry systems to contribute to food production while also providing additional ecosystem services [agroforestry systems incorporating nut- and fruit-bearing trees and shrubs could make a substantial contribution to food security when established on lands that are marginal for annual row crops], the development of strategies to make Hispanic-style fresh cheeses safer to help meet market demand and prevent Listeria outbreaks, efforts to model the impact of incorporating hydrolyzed protein into a formulation on the resulting sensory and physical characteristics of a high protein snack system, an investigation into potent odorants [aroma-active compounds] in foods, food ingredients, and various other complex materials, and work to assess the efficacy of novel nanoemulsion systems created from ultrasonication of common and underutilized legume protein sources.

Activities also included the development of strategies and technologies that will assess nutrition status of and maximize nutrition delivery to individuals and populations at different stages in the nutrient/energy adequacy continuum [the technologies will be low-cost, stealth or culturally accepted, simple to use, adaptable to current deficiencies, of limited energy input, and environmentally friendly], the identification of methods that extend the shelf life, improve the nutritional quality, and enhance safety of fresh cut produce, and research with the goal of describing transport mechanisms and thermomechanical behaviors of food biopolymers using a general mathematical model solved with numerical simulations [this would allow the description of a diverse range of processes such as drying, frying, sorption, fluid and species transport in biological tissues, controlled release applications, and heat-flavor interactions using predictive modeling].

Activities also included work focusing on examining food microstructure and evaluating its changes due to food processing [new products expected to stem from this research are foods with increased nutrient bioavailability, foods with increased stability, dried foods with increased rehydration ability, and edible films with increased thermal and mechanical stability], the development of a pilot-scale ultrasonic washing system for inactivation of food-borne pathogens and natural flora to secure produce microbial safety, and the utilization of dynamic infrared imaging to provide a relatively simple, robust means of ensuring seal, bond, and weld integrity in a range of materials and applications [and as a result improving food system safety in packaging, distribution and storage].

Conference presentations included the Institute of Food Technologists, Interpore Porous Media Society, Ecological Society of America, Corn Utilization and Technology Conference, Experimental Biology, Illinois Vegetable Growers Association, Illinois Horticultural Society, American Society of Agricultural and Biological Engineering, Association for Packaging and Processing Technologies, and the Council of Food Engineers.

Extension's food safety training for employees of establishments, foodbank managers, and volunteers that prepare or serve food to the public was delivered primarily through the following programs: The 8-hour **Food Handlers** course was conducted to meet the five-year certification requirements for food service sanitation managers. **Serve it Safely** is the title of a food class offered to volunteers who serve food for fundraisers, community organizations, and family events. In addition, a website provided information on the Illinois Cottage Food Operation Law regarding low-risk foods that can be prepared in the private home and sold at Illinois Farmers Markets. New online and supplemental programs entitled **Yes, You Can -- Preserve Food Safely** were conducted during the summer. The **Supplemental Nutrition Assistance Program - Education** [SNAP-Ed] curriculum for both youth and adults included an emphasis on proper handwashing and cleanliness habits when preparing food. Programs addressing **Good Agriculture Practices** [GAPs] continued to be offered online and face-to-face to ensure that fresh produce is free from contamination by microorganisms that cause foodborne illnesses and complies with regulations dealing with food safety.

State and regional Extension crop conferences/clinics and field days reached large numbers of corn and soybean producers with information on fertility and pest management. **Regional Crop Management Conferences** were held in four locations in 2016 and attended by 435 registrants who were primarily certified crop advisers. Extension of research to the public also included the **Varietal Information Program for Soybeans**, a website and publication that provided information on yield, protein and oil, and disease and pest susceptibility. Three of the University's agronomy research farms were closed this past year. Four of the remaining research farms held field days to showcase the results of research plots to producers.

The Bulletin is an online series of posts [45 this past year] primarily posted throughout the crop-growing season [early April to mid-August] and additional times in the off-season to announce programs and current pest management information provided by entomologists, agronomists, and plant pathologists. The majority of the 2,604 plant samples diagnosed by the **University of Illinois Plant Clinic** in 2016 were agronomic field crop and field crop soil samples. Approximately 127 involved fruit and vegetable crops. Pesticide safety education was conducted using presentations at numerous locations that resulted in 9,788 commercial pesticide applicator certifications and 2,618 private pesticide applicator certifications.

Total attendance at statewide Extension conferences related to produce production was approximately 380 and included several multi-state conferences such as the **Southern Illinois Tree Fruit Schools**, **Stateline Fruit & Vegetable Conference**, and the **Gateway Fruit and Vegetable School.** Additional Illinois state or regional conferences focused specifically on growing horseradish, berries, or strawberries [discussed in more detail in the evaluation section of this planned program]. Extension also provided leadership for the **Specialty, Agri-tourism and Organic Conference** that encompassed a trade show and hosted preconference workshops on pollinators, high tunnels for greenhouse production, wholesale marketing, and roots and tubers. In addition, biweekly issues [20] of Volume 22 of the **Fruit and Vegetable News** were published and distributed.

This past year Extension staff again collected weekly fruit and vegetable prices from 13 farmers markets and posted them on a website created and shared by Kentucky Extension staff to help farmers, especially new farmers, to decide how they might price their products. For a fourth year Extension educators with assigned responsibility for small farms and local foods education offered **Putting Small Acres to Work**, a one-day program that addressed a variety of topics that included issues important to local food production. The programs were offered to help people who have a few acres learn ways that they can put them to use. Forty-one individuals attended one of the two programs [see the evaluation section of this planned program]. In addition, the series of 12 weekly one-hour webinars directed at small farm owners or operators was offered in the winter of 2016 to 665 Illinois residents and 229 residents of 32 other states and countries [Canada, Italy, and the United Kingdom] who participated in one or more sessions. Several

interdisciplinary efforts among Extension educators with responsibility for local foods, horticulture, foods and nutrition, community economic development, and/or 4-H development were targeted in supporting community gardens that raised produce to feed the hungry through the **Illinois 4-H Feeding & Growing Our Communities** initiative.

Extension activities that addressed hunger within Illinois were conducted by **Expanded Food and Nutrition Education Program** [EFNEP] staff and **Supplemental Nutrition Assistance Program Education** [SNAP-Ed] staff members for adults with limited incomes. The activities included information on using food stamps, meal planning, wise shopping, and use of food pantries. **SNAP-Ed** Extension staff members also conducted activities for children in after-school and summer programs. Approximately 580,000 direct education contacts were made through the **SNAP- Ed** program and 9,700 direct education contacts were made through **EFNEP** in 2016. In addition to direct education, staff focused on policy, systems, and environmental [PSE] interventions with other organizations. The goal of PSE interventions is to improve the environment where limited-resource people live, eat, and play. PSE interventions focus on organizational collaboration and helping community partners to leverage their funding and resources to optimize services provided to their target audiences.

2. Brief description of the target audience

Members of the target audience included scientists and graduate students in the fields of industrial microbiology and biotechnology, the dairy industry, food industry professionals who work with extruded snack and cereal products, U.S. and international food producers, food processors, ingredient manufacturers, flavor companies, food industry scientists, the international food and nutrition scientific community, members of the general public who have an interest in the delivery of nutrients and nanoencapsulation, biosensors, diagnostics, undernutrition, and fortification of foods, Illinois fruit and vegetable growers, the fresh cut industry, students, researchers in economics, public health, and nutrition, policymakers charged with improving the well-being of low-income Americans, and program administrators overseeing food assistance programs.

Extension targeted volunteers who serve food to the public, certified food handlers, individuals interested in home canning and home preparation for farmers markets, producers of food distributed through local systems, producers of commercial fruit and vegetable crops, 4-H youth, producers of feedstuffs for livestock, certified crop advisors, and limited resource youth and families that are food stamp eligible.

3. How was eXtension used?

Eight Extension staff are members of various food safety and food security Communities of Practice including Community Nutrition Education, Community, Local, and Regional Food Systems, and Small and Backyard Flocks.

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	51334	23131	50477	0

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

Patent Applications Submitted

Year:	2016
Actual:	1

Patents listed
TF14120-02[US] - Inclusion Complexes And Methods For Making The Same.

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 Completed Hatch Research Projects

Year	Actual
2016	8

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number Increasing Knowledge Of New Corn And Soybean Crop Management Techniques
2	Number Of Pounds Of Food Produced Or Donated For Consumption By Vulnerable Populations
3	Number Of Food Preparers Reporting Using Proper Time And Temperature Controls
4	Number Of Food Preparers Reporting Taking Steps To Reduce Cross-Contamination
5	Number Of Growers, Producers, And Employees Completing GAPS, GMPs, HACCP, Food Safety Certification, And Onfarm BMP Programs To Increase Food Safety
6	Development Of Fortification Technologies For Developing Countries
7	Enhancement Of Microbial Safety In Fresh Produce
8	Development Of Effective Methods For The Investigation Of Potent Odorants In Foods
9	Determining The Potential Of High-Pressure Processing To Improve Fresh And Processed Meat Quality
10	Making Hispanic-Style Fresh Cheeses Safer To Help Meet Market Demand And Prevent Listeria Outbreaks
11	Establishing An Integrated Computational And Experimental Pipeline For Analyzing Metabolites And Metabolic Fluxes From Various Model Systems
12	Modeling The Effect Of Incorporating Hydrolyzed Protein On The Resulting Sensory And Physical Characteristics Of A High Protein Snack System
13	Commercially Relevant Processing Methods And Their Impacts On The Stability, Quality, And Storage Conditions Of Amorphous Sugar-Based Products
14	Reducing The Number Of Foodborne Disease Outbreaks Linked To Leafy Green Consumption
15	Increased Knowledge Of Small Farm Production Options
16	Increased Knowledge And Application Of Fresh Fruit And Vegetable Production Practices

Outcome #1

1. Outcome Measures

Number Increasing Knowledge Of New Corn And Soybean Crop Management Techniques

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	133

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Crop producers and advisers are seeking ways to improve their efficiency of production leading to enhanced profitability of their enterprise.

What has been done
In response, two-day Crop Management Conferences were conducted in four Illinois locations. Specific topics among the four 2016 settings varied slightly with most addressing managing nutrients, soil and water, crop and integrated pest management. Green Stem Disorder was the pest of focus for one of the presentations. In response to the 2015 August release of the Illinois Environmental Protection Agency's Illinois Nutrient Loss Reduction Strategy, presentations highlighted voluntary adoption of best management practices for in-field and edge-of-field to reduce nitrogen and phosphorus levels in lakes, streams, and rivers.

A total of 435 participants included those primarily employed in agri-business [84%], as certified crop advisers [55%], and crop producers [39%] and those who advised, farmed, or managed farmland. These 435 participants received an email request to complete an online evaluation following the conferences. Two hundred thirty [51%] completed the survey.

Results
Nearly all [95%] of the 230 Crop Management Conference evaluation respondents reported that attending the conference increased their knowledge of new crop management techniques and 122 [58%] planned on implementing something that they learned during the 2016 growing season. Of those respondents that shared their implementation plans, 59 [48%] planned to implement best management practices to prevent nitrogen contamination of water sources. One-fourth of the respondents [31] mentioned plans to continue or increase use of cover crops. Comments from 22 participants focused on herbicide mixing to help fight off weed resistance. Four mentioned plans to improve crop scouting more often and later into the season.

As a result of their 2015 Crop Management Conference attendance, 76 [57%] of the 133 attendees reported tank-mixing herbicides from more than one site-of-action family. Sixty-one [46%] planted a cover crop, 42 [31%] focused on sudden death syndrome management, 35 [26%] adjusted soybean maturities, and 31 [23%] focused on soybean cyst nematode management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
704	Nutrition and Hunger in the Population
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Number Of Pounds Of Food Produced Or Donated For Consumption By Vulnerable Populations

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	2315

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to Feeding Illinois [the association of Illinois food banks], over 1.8 million Illinois residents [14.2%] are food insecure and households with 662,000 children [21.6%] under age 18 are considered food insecure, which means they do not have regular access to nutritious food. Thirty-eight percent of food insecure households and 34 percent of children in Illinois exceed federal poverty guidelines that would qualify them for food assistance. Hungry children are more likely to have trouble concentrating, get headaches and infections, be hospitalized, and are less likely to perform well on athletic fields and in classrooms.

What has been done
Illinois 4-H responded in amazing ways to the hunger/food insecurity challenge facing their communities. In 2016, 2,052 youth and adult volunteers provided 6,529 hours of service directed toward solutions to the problem. Through individual and collective efforts Illinois 4-H Feeding &

Growing Our Communities outreach programs assistance was provided to 1,439 families and 125,000 individuals were impacted by those efforts. Hunger responses included community gardens, meals for food pantry patrons, weekend backpack programs, can food drives, and meal packaging events.

Results

With continued funding from Evelyn Brandt Thomas, 4-H clubs and community groups responded to the call by raising and donating 2,315 pounds of fresh produce with an economic value of $4,861 to food pantries, soup kitchens, and other outlets serving families in need. More importantly, these 4-H members taught other youth in their community how to garden and partnered with developmental centers to engage developmentally disabled youth in gardening activities with their resulting harvest being donated. This in itself fostered BIG M by providing these youth with a sense of belonging, independence in deciding what to grow, generosity by donating the fruits of their labor to others less fortunate, and mastery through their success. Continuing the partnership with Illini Fighting Hunger, 4-H members packaged 249,168 soy-rice casserole meals that were distributed through food pantries in their community. Previous success by 4-H clubs with hunger awareness and meal packaging events resulted in $11,375 being donated by local organizations supporting their efforts in 2016. 4-H members and volunteers now have a better understanding of hunger in their communities and how they can improve the lives of residents in need.

4. Associated Knowledge Areas

KA Code	Knowledge Area
704	Nutrition and Hunger in the Population
806	Youth Development

Outcome #3

1. Outcome Measures

Number Of Food Preparers Reporting Using Proper Time And Temperature Controls

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number Of Food Preparers Reporting Taking Steps To Reduce Cross-Contamination

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Number Of Growers, Producers, And Employees Completing GAPS, GMPs, HACCP, Food Safety Certification, And Onfarm BMP Programs To Increase Food Safety

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Development Of Fortification Technologies For Developing Countries

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Undernutrition afflicts close to one in two children around the world, resulting in the unnecessary loss of three million children every year. In India alone, 60 million children suffer from undernutrition and are either underweight or stunted. Lipid-based nutrition supplements [LNS] are commonly used to treat moderate acute undernutrition in children. However, existing LNS products mainly focus on providing nutrients and do not address other immediate causes of undernutrition, such as parasitic infection and gut inflammation. Enteric parasites are known to reduce nutrient digestion and absorption, cause chronic gut inflammation, iron deficiency anemia, protein-energy malnutrition, and reduce growth and cognitive development in children.

What has been done
Bioactives from oregano essential oil [OEO] are known to have anti-bacterial and anti-fungal activity, however its anti-parasitic properties are poorly understood. In this study, our group systemically investigated the effect of OEO and its main bioactive, carvacrol [CV], on prevention of Cryptosporidium parvum infectivity of HCT-8 [human colon carcinoma] cells in vitro for potential incorporation of these bioactives into LNS products.

Results
From invasion assays lasting four hours after treatment, there were no differences in C. parvum infectivity of HCT-8 cells treated with several doses of carvacrol or oregano essential oil. Cells were viable under the different doses used, indicating that carvacrol and oregano essential oil are not toxic to cells at the tested concentrations over four hours. From infectivity assays, both carvacrol and oregano essential oil reduced C. parvum infection. Complete loss of cell viability was observed at doses higher than 250 mu g/mL for both carvacrol and oregano essential oil. From these studies the inhibitory dose was calculated for both OEO and CV.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
704	Nutrition and Hunger in the Population
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #7

1. Outcome Measures

Enhancement Of Microbial Safety In Fresh Produce

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The lethal effect of ultrasound on microorganisms was reported over 80 years ago. Several recent bench-top studies have reported that ultrasonication and selected chemical sanitizers can potentially provide significant improvement in the microbial safety of leafy green produce compared to the use of a chemical sanitizer alone. No reported studies have investigated the combined use of ultrasound and a sanitizer in a pilot-scale system for the purpose of ensuring the microbial safety of fresh produce. There are a few key factors to be considered in using

ultrasound in produce washing. First, degassing the washing solution is a requirement for effective ultrasonic cleaning applications. Moreover, inherent nonuniformity of the ultrasound field in the washing tank will cause variation in microbial inactivation activities in a washing tank. Thus, during a wash treatment, those leaves that have received adequate ultrasound treatment and thus have a low microbial count are subject to cross-contamination by other leaves that have received less ultrasound treatment. Lastly, produce leaves will block the transmission of ultrasound waves in water and as a result some leaves may receive less exposure than other leaves.

What has been done
In this work, we developed a pilot-scale ultrasonic washing system for inactivation of food-borne pathogens and natural flora to secure produce microbial safety. Results are reported regarding the uniformity of ultrasound intensity, the effect of ultrasound screening/blockage, and the effects of ultrasound frequency and power density on surface decontamination of spinach.

Results
The efficacy of the new wash system was assessed both by cavitation damage to aluminum foil and by inactivation of E. coli O157:H7 inoculated on spinach leaves. In addition, we found that how to wash produce is also important in ensuring food safety. By simply washing produce before cutting it achieved nearly 90% more reduction than the traditional cutting-before-washing process.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
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 #8

1. Outcome Measures

Development Of Effective Methods For The Investigation Of Potent Odorants In Foods

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Determining The Potential Of High-Pressure Processing To Improve Fresh And Processed Meat Quality

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Making Hispanic-Style Fresh Cheeses Safer To Help Meet Market Demand And Prevent Listeria Outbreaks

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Most cheese styles have not been associated with foodborne illness in the U.S. However, Hispanic-style fresh cheeses present a unique problem as evidenced by their numerous Listeria monocytogenes outbreaks. Favorable growth conditions in Hispanic-style fresh cheeses like queso fresco, including high moisture, low salt content, and near neutral pH, along with the ability of L. monocytogenes to grow under refrigeration, are primary factors contributing to increased L. monocytogenes-associated food safety risk. To date, there are few L. monocytogenes control measures during the manufacturing of these types of cheeses; as a consequence the contamination of cheese with L. monocytogenes is likely to affect consumers. As U.S. population demographics shift, the demand for these products has risen. Outbreaks of listeriosis from illicit production of queso fresco make headlines and highlight the growing market for these products, but also create hesitance to meet market demands by many manufacturers due to liability concerns. Strategies to make Hispanic-style fresh cheeses safer are needed to help meet market demand and prevent listeria outbreaks.

What has been done
Research was conducted under the following three objectives: Objective One: Develop a laboratory scale method to produce a model Hispanic-style fresh cheese. A laboratory-scale method that would enable the production of a Hispanic-style cheese in a biosafety cabinet is critical for the safe evaluation of potential antimicrobials. Objective Two: In vitro screening of antimicrobials [bacteriocins, organic acids, spice extracts, and novel ingredients] for activity against Listeria monocytogenes. Objective Three. Evaluation of selected antimicrobials in our Hispanic-style fresh cheese model.

Results
For Objective One, we have developed a model to do this and have submitted the results for publication. The publication was accepted in Fall 2015 and was in the December issue of the

Journal of Dairy Science. Our model cheese has similar composition as cheese made on a traditional scale [fat, protein, and water]. For Objective Two, we have tested several commercially-available products for antilisterial activity and found that nisin and ferrulic acid had the most promise from our initial screening. More recently, we have explored using endolysins to control L. monocytogenes in cheese. Endolysins are lytic enzymes from bacteriophages. Preliminary data suggest that endolysins can be very effective, even at refrigeration temperatures. For Objective Three, nisin [a bacteriocin produced by Lactococcus lactis and widely used by the food industry] was able to decrease the listerial population briefly but the population quickly recovered. Ferrulic acid [which is present in many plants] was bacteriostatic against L. monocytogenes in our model. Another key observation was that the activity of the various antimicrobials we tested were far different in our model cheese than they were in simple broth experiments [Objective Two]. This confirmed that it is critical to evaluate these antimicrobials in the cheese matrix. More recently, we are testing endolysins in our cheese matrix. So far, endolysins have shown to be listeriastatic in our queso fresco model cheese.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
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 #11

1. Outcome Measures

Establishing An Integrated Computational And Experimental Pipeline For Analyzing Metabolites And Metabolic Fluxes From Various Model Systems

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Recent advances in omics technology have transformed food and agricultural sciences. It is now possible to observe dynamic responses of various biomolecules in response to genetic and environmental perturbations. Fast and cost-effective genotyping and RNA sequencing based on next-generation sequencing technologies and metabolite profiling are not emerging technologies anymore but routine experimental procedures. Metabolite profiling and isotopomer analysis using stable isotopelabeled substrates are emerging technologies which might lead to deeper understanding of cellular and metabolic processes. Gas chromatography-mass spectrometry [GC-MS] is a platform instrument that enables measurements of metabolic flux, fingerprinting of target metabolites, and identification of unknown compounds in various model systems [microorganism, plant, animal, and human]. As such, we propose to develop a computational and experimental pipeline for measuring metabolites from various model systems. Additionally, we will exploit the metabolite profiling methods for developing engineered yeast strains capable of over-producing carotenoids.

What has been done
Isoprenoids are a class of natural molecules highly valued as flavors, fragrances, nutraceuticals, and pharmaceuticals. In eukaryotes, isoprenoids can be biosynthesized from cytosolic acetyl-CoA through the mevalonate [MEV] pathway. Although S. cerevisiae has been engineered as a eukaryotic workhorse strain for microbial production of fuels and chemicals, it has limited capabilities to biosynthesized acetyl-CoA derivatives due to a rigid metabolic flux toward ethanol fermentation on glucose. In the present study, we demonstrate that this fundamental defect of S. cerevisiae can be successfully solved by changing substrate from glucose to xylose.

Results
We discovered that S. cerevisiae shows higher transcriptional levels of the cytosolic acetyl-CoA biosynthetic pathway [PDHbypass] and the ethanol-assimilating pathway during xylose metabolism. After combining the efficient xylose pathway and the enhanced MEV pathway, the resulting yeasts showed higher yields of both intracellular and diffusible isoprenoids during xylose utilization than glucose. In addition, the peculiar characteristic of the xylose metabolism allowed the yeasts to avoid ethanol accumulation to detrimental levels during high cell density fed-batch fermentation using xylose without sophisticated feeding strategies.

Our novel approach of xylose utilization effectively improved the capability of isoprenoid production as well as expanded substrate range of S. cerevisiae. Xylose utilization induce dysregulation of glucose dependent repressions on the energy metabolism and the ethanol to cytosolic acetyl-CoA metabolism, which can enable the yeast to have an abundant supply of cytosolic acetyl-CoA. We envision that this strategy will make a great contribution to economically-feasible biosynthesis of isoprenoids and other acetyl-CoA-derived high value-added products.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components

Outcome #12

1. Outcome Measures

Modeling The Effect Of Incorporating Hydrolyzed Protein On The Resulting Sensory And Physical Characteristics Of A High Protein Snack System

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The overall goal of our proposed study is to model the effect of incorporating hydrolyzed protein in the formulation on the resulting sensory and physical characteristics of a high protein snack system. It is hypothesized that: [1] Enhanced expansion of the extrudates will be observed in a high protein snack system with increased amounts of hydrolyzed proteins in the formulation; [2] Enhanced expansion of the extrudates will lead to crunchier texture of the final high protein snack; and [3] The extent of expansion can be controlled based on consumer acceptance. In order to achieve the overall goal and to test the hypotheses, we propose the following four specific objectives using whey protein as the protein source: [1] Process high protein snack prototypes by varying the degree of hydrolysis and varying the amounts of whey protein; [2] Characterize the extruded high protein snack prototypes by a sensory descriptive panel and instrumental analyses; [3] Assess consumer acceptance and market potential for the high protein snack prototypes; and [4] Model the effects of the total whey protein amount and the degree of hydrolysis in the formulation on the characteristics of the snack prototype.

What has been done
Increasing awareness of obesity has increased the popularity of diets emphasizing lower carbohydrate and higher protein intakes. Consumers view fat and carbohydrate contents as their top nutritional concerns with 75% of the adults surveyed indicating they were trying to cut down or eliminate fat from their diet. Protein-centric foods and snacks have shown to be helpful in managing hunger and blood glucose level while providing satiety. This has led to rising demands in the marketplace for snack products that can provide a satiating effect to suppress hunger between meals, and calorie for calorie, protein is believed to be the most satiating of all macro-nutrients. Thus, utilizing proteins in extruded [or puffed] snack foods increases their functionality and market appeal.

Most traditional snack foods [chips, crackers, puffs] are based on ingredients with high starch

content. This is because starch-based ingredients are inexpensive and typically provide a neutral flavor profile suitable for additional flavors. Furthermore, starch-based ingredients compared to protein-based ingredients when used as a base material result in greater expansion of the extrudates, a key for creating acceptable textures in puffed snack foods.

Results
Incorporation of hydrolyzed protein blends possesses the potential key to solving the problems found with proteins inhibiting expansion by forming highly ordered matrices. From the findings from this study, we were able to determine the relationship between the degree of hydrolysis of the proteins in the formulation and the physical and sensory characteristics of the resulting high protein snack product, which further demonstrated the potential for commercialization of high protein extruded snacks and increase utilization of whey and soy protein ingredients in a novel product concept.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
704	Nutrition and Hunger in the Population

Outcome #13

1. Outcome Measures

Commercially Relevant Processing Methods And Their Impacts On The Stability, Quality, And Storage Conditions Of Amorphous Sugar-Based Products

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The dynamic vapor sorption isotherm method was employed to investigate the differences in the kinetic moisture-induced crystallization behavior of amorphous sucrose prepared by different

amorphization methods. Sugar was selected as the material of study since amorphous sugars are key ingredients in food and pharmaceutical products due to their encapsulation abilities, high dissolution rates, and high solubility; however, amorphous sugars often undergo undesirable heat and/or moisture-induced physical changes, including stickiness, caking, and recrystallization. Though the physical stability of amorphous sugars has resulted in substantial research over the past several years, one aspect of physical stability requiring further study is the effect of amorphization method on moisture-induced crystallization behavior. Thus, the objective of this research was to use the dynamic moisture sorption methods to compare the kinetic moisture-induced crystallization behavior of amorphous sucrose prepared by five commonly employed amorphization methods: freeze-drying, spray-drying, ball milling, melt-quenching, and spin-melt-quenching.

What has been done

Moisture sorption profiles of amorphous sucrose were obtained from 10 to 90% relative humidity [RH] at 10% RH increments at 25 degrees C using a Dynamic Vapor Sorption [DVS] instrument. For % RH values from 10% to 40%, samples were held at the desired % RH for 2,000 minutes; for % RH values from 50% to 90%, samples were held at the desired % RH until a dm/dt criterion of 0.0005% was achieved for 10 consecutive minutes. All % RH samples, as well as "as-is" amorphous samples prepared by each amorphization method, were analyzed for glass transition [Tg], cold crystallization [Tc], and melting [Tm] parameters using a Q2000 TA Instruments DSC. Under the experimental conditions employed, the minimum % RH for moisture-induced crystallization at 25 degrees C was found to differ by amorphization method. Ball-milled amorphous sucrose recrystallized at and above 20% RH; freeze-dried, spray-dried, and spin-melt-quenched amorphous sucrose recrystallized at and above 40% RH; melt-quenched amorphous sucrose recrystallized at and above 50% RH.

Results

Although freeze-dried, spray-dried, and spin-melt-quenched amorphous sucrose shared the same minimum % RH for recrystallization, notable differences in the shape of the moisture sorption profiles for each sample demonstrate that amorphization method influenced moisture sorption behavior. However, DSC results indicate that the thermal behavior of the resultant crystals is more dependent on % RH than amorphization method. Overall, this research provides the food and pharmaceutical industries with new connections between commercially-relevant processing methods and their impacts on the stability, quality, and storage conditions of amorphous sugar-based products.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products

Outcome #14

1. Outcome Measures

Reducing The Number Of Foodborne Disease Outbreaks Linked To Leafy Green Consumption

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Consumer demand for fresh food has stimulated the production of fresh produce and made it one of the fastest growing market sectors in the United States. Unfortunately, the increase in production and consumption has also been accompanied by a simultaneous increase in the reported number of foodborne disease outbreaks. Between 1996 and 2005, leafy green consumption increased 9.0% and leafy green associated outbreaks increased 38.6%. Foodborne illness outbreaks erode consumer confidence in the safety of fresh produce, and have adverse economic, social, and health consequences. Currently, commercial operations rely on a wash treatment with antimicrobials as the only step to reduce microbial populations on fresh produce. However, an industrial-scale operation that uses chlorinated water containing 50-200 mg/L free chlorine can only achieve a 1 to 2-log CFU/g reduction in bacterial population. As many published studies have demonstrated the health benefits of eating fresh produce, strategies to improve the microbial safety of fresh produce are clearly needed. With commonly used sanitizers such as chlorine, peroxyacetic acid, and acidified sodium chlorite, it is easy to achieve an over 5-log reduction in pathogenic bacteria count or even a complete elimination in a time scale of less than one minute when the cells are suspended in a liquid. However, when the bacterial cells are attached to a surface, the inactivation efficacy with the same sanitizer is greatly reduced. Although many sanitizer-related studies have attempted to increase the inactivation efficacy of a wash operation, the root cause for such a discrepancy in inactivation has not been systematically investigated.

What has been done
First, we investigated the effects of sonication, sanitizers, and sodium dodecyl sulfate [SDS] on the quality of fresh-cut Iceberg and Romaine lettuce. Lettuce samples were treated for one minute with and without ultrasound with one of the following solutions: tap water, chlorine, Tsunami, and a combination of Tsunami with one g/L SDS. Washed samples were packed under modified atmosphere conditions and stored at four degrees C for up to 14 days. Changes in headspace

gases, texture, color, tissue damage, visual quality, and natural flora were determined. The O2 concentrations and CO2 accumulation in Romaine lettuce were not significantly different among the treatments. In Iceberg lettuce, a lower O2 and high CO2 content in the headspace of samples treated with Tsunami and Tsunami + SDS were recorded. After 14-day storage, the tissue damage expressed by electrolyte leakage, total color difference, firmness, and total aerobic plate counts were not significantly different among treatments in two types of lettuce samples. Treatment of Iceberg lettuce with sonication in combination with Tsunami or Tsunami + SDS did not degrade quality compared to samples treated with chlorine alone, whereas for Romaine lettuce, chlorine-treated samples had a significantly higher overall quality score than that from the other treatments.

Results

We also found that the key to ensuring sprout safety is to have clean seeds. Although seed sprouts are considered health food by consumers because of their low fat and calories vs. high fiber and antioxidants, the consumption of raw sprouts has been linked to E. coli O157:H7 outbreaks. Unfortunately, the FDA-recommended calcium hypochlorite wash is unable to achieve a 5-log reduction in the pathogen populations on seeds. Thus, many studies have sought new means to secure sprout safety. A study was conducted to determine the optimum conditions for combined treatments of ultrasound and mild heat to improve the microbiological safety of alfalfa seeds while maintaining satisfactory germination rates. Alfalfa seeds [100 g] were inoculated with E. coli O157:H7 87:23. The inoculated samples [10 g each] were treated with conditions obtained from the Response Surface Methodology [RSM] with three independent variables: temperature [55, 60 and 65 degrees C], ultrasound power level [20, 40 and 60%] and time [1, 3 and 5 minutes]. Twenty combinations of these three variables were performed. The effects were evaluated by counting the E. coli populations on TSAN plates. The germination rates were determined by counting the germinated seeds after 72 hours [24 in the dark and 48 under light]. The correlations between the trial conditions and the microbial count reduction and germination rate were modeled with an RSM polynomial equation. The determination coefficient [R2] was 97.6% and 96.4% for log reduction and germination, respectively, and the levels of significance were $p < 0.0001$. The effects of temperature and treatment time were significant, while that of sonication power was less so. The optimum conditions to achieve a 5-log reduction of the E. coli population and 90% germination were determined from the overlaid contour plots.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
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 #15

1. Outcome Measures

Increased Knowledge Of Small Farm Production Options

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	40

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Owners of small acreages need assistance in determining how they can best put them to use.

What has been done
Extension Educators with assigned responsibility for small farms and local foods education conducted for a fourth year Putting Small Acres to Work, a one-day program that addressed a variety of topics and was offered to help people who have a few acres learn ways that they can put them to use. Fifty-three [53] individuals attended one of two workshops held in the state. An end-of-workshop evaluation form was distributed and collected from 41 of the participants at the two workshops.

Results
Respondents to the Putting Small Acres to Work end-of-program evaluation were asked to identify the degree to which their knowledge, confidence and abilities were changed regarding putting their small acres to work. Using a scale from one to five [1 = No change to 5 = Greatly improved], the average score for the 40 who responded was above a 3.0 for all the items. Responses to specific evaluation items addressed their: [1] Ability to effectively find and access resources to support their small acreage systems with 25 of 39 [64%] choosing a rating of 4 or 5; [2] Knowledge of concepts and principles of managing small acreage with 26 of 40 [65%] choosing a rating of 4 or 5; and [3] Knowledge about land stewardship and resource management with 18 of 39 [69%] choosing a rating of 4 or 5.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

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 #16

1. Outcome Measures

Increased Knowledge And Application Of Fresh Fruit And Vegetable Production Practices

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	199

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Fruit and vegetable producers are seeking ways to improve their efficiency of production leading to enhanced profitability of their enterprise. Ultimately, consumers benefit in accessing quality produce that enhances their health and is safe for consumption.

What has been done
A number of annual one-day Extension schools for commercial fruit and vegetable producers are held during the winter months throughout Illinois, as well as in conjunction with neighboring states. These include vegetable schools, fruit schools, strawberry, and small fruit schools. Extension educators and specialists assist in organizing, promoting, and teaching the latest research findings related to production, pest management, marketing, and safe food handling. Attendees are also able to visit with vendors and exhibitors. This past year Extension horticulture educators developed four new berry schools to add to the three ongoing Southern Illinois Tree Fruit Schools, Gateway Fruit and Vegetable School, and Stateline Fruit and Vegetable School.

Results
The approximately 380 attendees at these schools were offered an option to rate the knowledge they gained for each of the individual topic sessions using a 1-5 scale with 1 = None/Already knew and 5 = Learned a great deal. In addition, the attendees at the three Southern Illinois schools provided information on actions taken using information from the previous year's schools. A total of 172 program participants completed an evaluation.

All of the 159 fruit and vegetable producers who responded checked at least one topic as a 4 or 5. The topic rated highest in knowledge gained by Northern Berry Schools' respondents was

"Keeping the Pests Away". Topics rated highest in knowledge gained by vegetable growers included "Managing Insect Pests in Cucurbit Crops", "Preparation for a GAPS Audit", and "New Rules: Food Safety Modernization Act". Topics related to tree and small fruit growers rated highest in knowledge gained were "Apple Disease and Treatments" and "Insect Management Biofix Dates and Trapping".

When participants who attended one of the three Southern Illinois school/conferences the previous year were asked what changes they had implemented, 44 responded with 22 referencing controlling and monitoring pests using spraying and chemical handling recommendations. Another three-fifths [107] of the participants at all of the schools/conferences indicated their plans to apply the information gained as a result of attending the 2016 presentations. Additional findings can be found in the evaluation section of this planned program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
502	New and Improved Food Products
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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

New Northern Berry Schools

Four new Northern Berry Schools were attended by 105 individuals this past year with three topics taught by Extension horticulture educators. Evaluations were distributed at three of the locations and completed by 70 participants. Using a 5-part rating scale anchored by 1 = None/Already knew and 5 = Learned a great deal, all but one participant indicated increasing their knowledge of at least one of the following three topics: [1] Beginning Your Small Fruit Operation [38 of 66 [57%] scoring a "4" or "5" rating]; [2] Successful Seasonal

Management and Strategies [31 of 67 [46%] scoring a "4" or "5" rating]; and [3] Keeping the Pests Away [51 of 65 [78%] respondents scoring a "4" or "5" rating].

When asked to share something they planned to do with the information 57 of the 70 responded. Most frequently mentioned were plans to start or grow more berries or to better manage pests and fertilizer application.

Fruit and Vegetable Program Knowledge Gained and Practice Changes

Using a 5-part rating scale anchored by 1 = None/Already knew and 5=Learned a great deal, all but two of the 46 participants in the two **Southern Illinois Commercial Tree Fruit Schools** who completed an evaluation checked a "4" or "5" for at least one session topic. The list of topics that were rated "4 or 5" by the most participants who gained knowledge were: [1] Insect Management Biofix Dates and Trapping Apples -- rated "4" or "5" by 26 of 35 individuals who responded [74%]; and [2] Apple Diseases and Treatments -- rated "4" or "5" by 23 of 33 individuals [70%].

Participants who attended last year's **Commercial Tree Fruit School** were asked to indicate practices they implemented as a result of what they learned the previous year. Thirty-four individuals responded by checking one or more practices: 20 indicated they controlled or monitored a fruit pest using spraying and chemical handling recommendations; 19 indicated they purchased additional pesticides and marking disruption items; 17 indicated they implemented change in recommended pruning methods; and 12 indicated they created or revised an orchard plan.

At the two-day **Gateway Small Fruit and Vegetable Growers Conference**, participants used the same 5-part rating scale to report amount of knowledge gained regarding some 33 topics. Only one-fourth of the 159 attendees completed an evaluation. The respondents ranked the following topics as a "4" or "5" with respect to knowledge gained.

- Preparation for a GAPs Audit -- rated 5 by 8 attendees
- Considerations for Vegetable Grafting -- rated by 7 attendees
- Information Gained from the Illinois Farmers Market Price Report -- rated by 8 attendees
- Back to Basics Exploring Cover Crops -- rated by 5 attendees
- Updates to 2016 Midwest Fruit Production Guide -- rated by 4 attendees
- Extending Strawberry Production Season in High Tunnels -- rated by 8 attendees
- Bramble Weed Control -- rated by 10 attendees
- Optimizing Irrigation and Fertilization in Blueberries -- rated by 12 attendees

Participants who attended last year's **Gateway Small Fruit and Vegetable Growers Conference** were asked to indicate practices they implemented as a result of what they learned the previous year. Seven individuals reported the following changes made:

- "How we grow field tomatoes"
- "Tried new vegetable varieties" and "Began growing blackberries"
- "Growing wider variety, more sustainability"
- "Trying different mulches"
- "Timely spraying"
- "New sprays for blueberries and strawberries"
- "Document more, had workers watch safety and sanitation videos"

- "Had more hand wash areas available" and "Properly label containers"

An end-of-program evaluation was distributed to the 53 participants and collected from 40 **Putting Small Acres to Work** participants. Respondents were asked to identify the degree to which their knowledge, confidence and abilities were changed regarding putting their small acres to work. Using a scale from one to five [1 = No change; 5 = Greatly improved], the average score for the 40 respondents was above a 3.0 for all the items that follow: [1] Ability to effectively find and access resources to support their small acreage systems with 25 of 39 [64%] choosing a rating of 4 or 5; [2] Knowledge of concepts and principles of managing small acreage with 26 of 40 [65%] choosing a rating of 4 or 5; [3] Knowledge about land stewardship and resource management with 18 of 39 [69%] choosing a rating of 4 or 5; [4] Ability to develop goals for their property with 24 of 39 [64%] choosing a rating of 4 or 5; [5] Confidence in using small acreage management principles with 25 of 40 [62%] choosing a rating of 4 or 5; [6] Understanding about farming practices with 21 of 40 [52%] choosing a 4 or 5 rating; and [7] Preparedness to start a farming enterprise with 14 of 39 [36%] choosing a rating of 4 or 5.

When asked if their personal objectives for attending this workshop were met, 39 respondents provided a rating using a five part scale [1 = Not met, 3 = Satisfactorily met and 5 = Extremely met]. All of them chose a rating of 3 [Satisfactorily met] or above.

When asked to list the most important ideas they plan to put into practice as a result of participating in the workshop, 25 [64%] responded. Most often mentioned were practices addressing weed and other pest control and composting. Other responses being considered for implementation or enhancement included pruning, raising sheep, raising chickens, and bee-keeping.

Key Items of Evaluation

Fruit and Vegetable School Key Findings

Attendance and evaluation ratings ["4" or "5"] that reflect a high level of knowledge gained, especially for controlling pests, provides evidence of a successful new University of Illinois Extension **Northern Berry Schools** that targeted appreciative current and future producers of berries.

All but one of the **Southern Illinois Commercial Tree Fruit School** and **Gateway Small Fruit and Vegetable Growers Conference** topics received a "4" or "5" rating regarding increased knowledge from the 90 who completed the evaluation. Nearly three-fourths [34] of those who responded reported that they had attended last year's Tree Fruit Schools and implemented practices as a result of what they learned last year with most citing changes in controlling or monitoring a fruit pest using spraying and chemical recommendations. Seven of the 10 **Gateway Small Fruit and Vegetable Growers Conference** evaluation respondents who attended the previous year's conference reported changes they implemented after attending the conference.

Putting Small Acres to Work Key Findings

Primarily motivated by the desire to seek information to decide and gather information about options for using small acreage, all of the 40 **Putting Small Acres to Work** workshop attendees who completed the evaluation felt that their objectives were met. Most notably, their responses to the end-of-workshop evaluation indicated increases in their ability to

effectively find and access resources to support their small acreage system, knowledge of concepts and principles of managing small acreage, and increasing their knowledge about land stewardship and resource management. Twenty-five shared what they learned and their plans to compost, control weeds and other pests, and make improvements in pruning fruit trees.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Human Health And Human Development

☑ 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	20%		10%	
704	Nutrition and Hunger in the Population	20%		10%	
724	Healthy Lifestyle	10%		10%	
802	Human Development and Family Well-Being	20%		25%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	0%		10%	
805	Community Institutions, Health, and Social Services	10%		10%	
806	Youth Development	20%		25%	
	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	0.2	0.0	10.0	0.0
Actual Paid	33.8	0.0	45.9	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**
970604	0	1575391	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
970605	0	1575391	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
6361107	0	4994607	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included research to zero in on the processes that enhance and erode relationships over time [findings from this research are the first to provide empirical evidence that shows that the origins of relationship success or deterioration lie in the experiences of young couples], work to establish an evidence-based school-friendly intervention to prevent overweight and diabetes in adolescence, the development of the **App Quality Evaluation Tool** [the first valid and reliable instrument for dietitians or other professionals to evaluate the quality of apps for use in nutrition interventions], a study examining students' pre-existing conceptions of effective leadership, an investigation into how parental involvement in young adolescents' social and academic lives may provide further insight into how to promote youths' adjustment, an exploration of how Latino parents balance old and new ideas and ways as they raise adolescents in different contexts in the U.S., and the development of a measurement tool that identifies stay-at-home father families and their type [choice and non-choice] and measures the reasons leading these families to such paid-work and care arrangements, the characteristics of these families, and their well-being at the individual level [each spouse and the children], couple level, and family level in both urban and rural areas.

Activities also included the development of a more efficient method for delivering critical nutrition information and as a result reducing the prevalence of obesity, work that seeks to combine educational and behavioral economics approaches to reduce food waste, an examination of the health, well-being, and economic opportunities of LGBT persons in rural Illinois, an investigation into the ability of tomato powder, broccoli powder, and soy germ to reduce the progression of prostate cancer, work to provide an effective labeling system for consumers who have health concerns related to sodium and fat to aid in making healthy food choices, the development and testing of an evidence-based set of resources for parents who aim to improve sibling relationship quality among their four to eight year-old children, research that investigates the ideological assumptions behind and the practices that constitute the promotion of youth participation and empowerment, a study of the impact of globalization on youth cultural identity [the identities of young people predict their well-being in adulthood and having a global identity and higher cultural intelligence better prepares them to succeed in the global marketplace], and work that builds on an existing cohort study to examine the potential for family mealtime practices to moderate biological risk for childhood obesity in the first year of life.

Activities also included research seeking to translate the scientific energy balance evidence and parenting styles into practical and appropriate recommendations for training Extension health educators that work with parents, an investigation into the effects of a test meal ingested at the start of dialysis [with and without a subsequent bout of aerobic exercise] on dialysis efficiency and blood pressure during a dialysis session, an exploration of the short-term and long-term individual and family health benefits of nature-

based activities, and continuing work under the **Child Development Laboratory Research Database Project**.

Activities also included work to identify the determinants of weight gain prevention as guided by Social Cognitive Theory, efforts to better understand college students use of nutrition labels in a university dining setting, studies that will improve our understanding of how the aromatase inhibitor Letrozole can reduce metastatic breast cancer progression, the evaluation of the potential of peptides from common bean protein isolates to inhibit markers of type-2 diabetes, hypertension, and oxidative stress, a mixed methods study examining educator stress, work to improve our understanding of the mechanisms of soy products that reducing colon cancer risk, and research that is the first to use two next-generation sequencing methods to quantify genome-wide DNA methylation changes resulting from mismatched perinatal and late life diet and providing evidence that high-fat diet changes both DNA methylation of coding genes and non-coding miRNA critical to hepatic metabolic function.

Conference presentations included the National Council on Family Relations, International Association for Relationship Research, American Association for Cancer Research, Society for Research on Adolescence, Work Family Research Network, Experimental Biology, American Studies Association, International Sociological Association, Institute of Food Technologists, International Association of Cross-Cultural Psychology, XXth Biennial International Conference on Infant Studies, National Recreation and Park Association Conference, Jean Piaget Society, Society for Research on Child Development, Agricultural and Applied Economics Association, National Association of College and University Food Services, Environmental Design Research Association, National Academy of Sciences, International Symposium on Food Safety, International Society for Nutraceuticals and Functional Foods, International Symposium on Functional Food and Metabolism, American Association of Agricultural Education, North American College Teachers of Agriculture, American Society for Biochemistry and Molecular Biology, and the American Society for Nutrition.

For the past nine years Extension programming on brain health continued to expand and remains a major focus of Extension Family Life Educators. **Wit Fits** programming encompasses a series of three sessions [**Building a Better Memory for Everyday Life**, **FIT WITS**, and **Head Strong**] with the potential for adding a fourth sessions dealing with Alzheimer's dementia**.** An addition to **Wit Fits** this past year we have offered a monthly program that allows groups to meet and engage in activities to enhance memory. **Hold That Thought**, delivered for the first time this past year, provides information on strategies and techniques for building a better memory and now includes the availability of a Spanish version. **Sharing One's Life Story** is a three-part or a six-part program that provides a therapeutic approach to life renewal creating strong family bonds and a sense that participants' lives count. Resources related to aging and retirement are also available through **Plan Well, Retire Well**, a comprehensive website that includes blogs, e-news, and monthly news articles that include both family life and financial management topics for helping individuals and families plan effectively for their needs as aging adults.

Being Mindful in a Busy World was developed to define and identify the benefits of mindfulness meditation. In addition, **Simplify Your Life: Clear the Clutter and Your Stress** workshops were conducted for multiple groups throughout Illinois This past year **Someday is Today -- Live Your Bucket List**, a program that teaches participants to be intentional and live life to the fullest, was developed and delivered to 189 individuals in eight locations statewide.

Programming targeted at parenting and early childhood training and caregiving remained an area of focus**. Getting Ready to Read and Write**, delivered to parents and preschool staff, addressed the importance of effective early literacy instruction and was part of a webinar series. **Promoting Social and Emotional Competence of Young Children: Enhancing Emotional Literacy** was also explored through the webinar series to increase awareness of the kinds of interaction between adults and young children that support enhancing children's emotional competency. **Parenting Again** is a resource tool developed to

assist support group facilitators who respond to the needs of grandparent caregivers. Nine topic-based discussion guides are designed to be facilitative tools for support group leaders to use. Family Life and Nutrition and Wellness Extension Educators continued to deliver lessons from the **Childcare and Youth Training and Technical Assistance Project** [CYTTAP] supported by a grant through the U.S. Department of Defense in partnership with Pennsylvania State University and the University of Nebraska at Lincoln. The lessons are targeted to childcare providers. An addition this past year of the **I am Moving, I am Learning** CYTTAP lesson was delivered to childcare providers by Nutrition and Wellness Extension Educators.

Extension programs that address healthy food choices to prevent childhood obesity were delivered by **Expanded Food and Nutrition Education Program** [EFNEP] staff and **Supplemental Nutrition Assistance Program Education** [SNAP-Ed] staff who conducted hands-on activities with children and their parents from limited income families. **SNAP-Ed** Extension staff members reached more than 580,000 direct educational contacts who were taught healthy eating choices and 9,700 who were reached through EFNEP in 2016. In addition to direct education, staff focused on policy, systems, and environmental [PSE] interventions with other organizations. The goal of PSE interventions is to improve the environment where limited-resource people live, eat, and play. PSE interventions focus on organizational collaboration and helping community partners to leverage their funding and resources to optimize services provided to their target audiences.

In the fall of 2015, the Illinois State Board of Education entered into a grant partnership with Extension to develop and deliver professional development to school nutrition professionals. In FY 2016, 228 Illinois school districts participated in the **ABC's of School Nutrition** training and technical assistance, including 1,208 face-to-face training attendees, 120 who completed online courses, and 192 **Smarter Lunchrooms** assessments in schools. School nutrition staff were trained on menu planning, school wellness, offering smart snacks and beverages, nutrition, food production and serving food, federal meal pattern guidance, food safety, and communications and marketing.

For a third year **4-H Food Smart Families**, an interdisciplinary program involving 4-H in conjunction with the Supplemental Nutrition Assistance Program Education, engaged teens to teach youth to make healthy food choices. A grant-funded **Junior Chef** program engaged 464 teens and 934 youth. A second **4-H Food Smart Families** program engaged 47 teens who taught the **Health Jam** program that focused on exercise, wellness, nutrition, and health careers information to 2,979 youth. Through after school programs and summer camps the youth learned to prepare healthy food choices and other behaviors to maintain their health. Additional programming related to youth health and development included **Breaking the Code**, a research-based prevention simulation and guided discussion for junior high and senior high youth supported by statistical research on bullying among teens**. 4-H Health Rocks!**, a national healthy living program aimed at 8-16 year olds with the goal of bringing youth, families, and communities together to reduce tobacco, alcohol, and drug use was conducted for 305 youth.

Extension programs also focused on chronic diseases including heart disease and diabetes. **I on Diabetes** was taught as a multi-part Extension program that combined lecture, food demonstrations, activities, and samples of healthy foods. The **Meals for a Healthy Heart** program is a two-part series focused on increasing participant awareness of the risk factors of coronary heart disease, hypertension, high blood cholesterol, and other warning signs. Activity levels and weight management information, as well as food demonstrations, taste testing, and recipes were provided at each session. As a means to target overweight and obesity, Putting Wellness to Work [a worksite wellness series] covered important topics such as nutrition, food trends, fitness, stress management, and healthy relationships to benefit both employees and employers.

2. Brief description of the target audience

Members of the target audience included leadership educators who work in secondary and post-secondary educational institutions, researchers, practitioners, policy makers, stay-at-home father families, obese populations, populations with poor economic status, nutritionists, graduate students, academic professionals, academics in the agricultural economics and food and nutrition circles, LGBT individuals and their families who reside in rural communities, gestating women and those breastfeeding newborns, food industry professionals, practitioners interested in improving child health, product developers who are interested in enhancing health benefits using microencapsulation technology, and parents of toddlers and young children.

Individuals at-risk for or coping with diabetes, obesity, or heart disease will be a priority recipient of Extension programming, as will families living in low-income and high-risk neighborhoods where programming will be adapted to reach racially, ethnically, and culturally diverse audiences and youth. Other target audiences include school nutrition professionals, retirees, aging adults and their caregivers, childcare providers for children of off-installation military families, grandparents responsible for young children, and youth.

Members of the target audience also included research scientists interested in obesity prevention, early childhood educators, parents of young children, Extension educators, clinicians and practitioners who serve children and families, patients with kidney failure undergoing chronic hemodialysis treatment, nutrition and dietetics professionals, nutrition Extension specialists, undergraduate and graduate students, the child development and early childhood education communities, young adult and midlife women, K-12 educators, administrators, breast cancer survivors and breast cancer researchers, health care professionals, and policy makers at the state and national levels.

Individuals at risk for or coping with diabetes, obesity or heart disease will be a priority recipient of Extension programming, as will families living in low-income and high-risk neighborhoods where programming will be adapted to reach racially, ethnically, and culturally diverse audiences and youth. Other target audiences include parents and childcare providers, grandparents responsible for young children, caregivers of aging adults, college students, adolescent youth, agencies and organizations working with limited resource audiences, and volunteers interested in mentoring those who seek to build financial skills.

3. How was eXtension used?

Fifteen Extension faculty or staff are members of eXtension Communities of Practice that include Alliance for Better Child Care, Families, Food, and Fitness, Families and Child Wellbeing Learning Network, Family Caregiving, Healthy Food Choices in School, Just in Time Parenting, and Military Families.

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	35542	9287	22769	0

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

Year:	2016
Actual:	1

Patents listed
2015-149-01[PRO] - Estrogen Derived Compositions And Methods Of Using The Same.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	90	90

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2016	12

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number Of Research Projects Utilizing The Child Development Laboratory Research Database
2	Increased Knowledge Of Children's Behavior At A Given Stage Of Development And Parenting And Childcare Providers Practices To Foster That Behavior
3	Numbers Of Individuals Taking Recommended Actions To Manage Heart Disease And Diabetes.
4	Number Of Children/Youth Who Reported Eating Healthier Foods [Those Low In Fat And High In Fiber]
5	Number Of Families/Caregivers That Gained Knowledge About Eating Healthier Foods [Those Low In Fat And High In Fiber]
6	Number Of Adults That Apply Skills As They Age In Maintaining Brain Fitness And Cognitive Health
7	Extension Of A Successful, Evidence-Based Approach For Strengthening Prosocial Sibling Relationships
8	Evaluating The Effect Of Dietary Botanical Estrogens On Breast Cancer Growth And Progression
9	Identifying The Determinants Of Weight Gain Prevention As Guided By Social Cognitive Theory [SCT]
10	Exploring How Latino Parents Balance Old And New Ideas As They Raise Adolescents In The United States
11	Translating Scientific Energy Balance Evidence And Parenting Styles Into Practical Recommendations For Training Extension Educators
12	Number Of College Students And Adults That Increased Knowledge And Skills In Managing Income And Expenses.
13	Identifying The Processes That Enhance Or Erode Relationships Over Time
14	Determining How Prenatal Choline Status Alters Cognition In An Age-Dependent Manner
15	Reducing Sodium In Snack Products
16	Determining The Potential Of Phenolic Compounds From A Fermented Blackberry-Blueberry Beverage To Reduce Diet-Induced Obesity
17	Number Of Youth That Increased Knowledge Of Bullying And Actions to Take In Dealing With A Bullying Situation

18	Increased Knowledge Regarding Setting Goals To Enhance a Healthy Lifestyle
19	Increased Knowledge Of Healthy Lifestyle Choices And Consequences Of Actions with Respect to Healthy Lifestyle Choices

Outcome #1

1. Outcome Measures

Number Of Research Projects Utilizing The Child Development Laboratory Research Database

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	19

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Infrastructure supports have been identified as a key element in the ability of laboratory schools to facilitate and support teaching, research, and outreach/engagement activities. Through the years the CDL has established an infrastructure for facilitating research projects while at the same time providing services for enrolled children and their families. Although the CDL has consistently served as a supportive arena for conducting faculty and graduate student research, it wasn't until the development and implementation of the CDL Research Database Project that such efforts moved beyond one-time data collection efforts. These one-time projects were completed on a semester or yearly basis with little or no cross-communication between investigators or systematic compilation of data. Such an approach failed to capitalize on the shared research interests and expertise of faculty within the Human Development and Family Studies Department and the College of ACES, and limited the ability of the CDL to facilitate a programmatic research agenda designed to address important developmental issues facing children and their families. Since its inception, the development and implementation of the CDL Research Database Project has played a significant role in influencing and shaping the nature of the research being conducted at the program. As a result of the resources provided through the database project, many of the studies being implemented at the CDL now take an applied developmental science approach to data collection and capitalize on the reciprocal exchange of data that is made available to investigators implementing projects. This has allowed researchers to develop a more comprehensive approach to generating data on the topics which they are investigating while expanding the types of data available for use in their projects.

What has been done
A total of 19 research projects were conducted at the CDL during the current reporting period. Sixteen of the 19 studies accessed information from the CDL Research Database project as part of their data collection. These 19 projects represent a diverse array of disciplines [such as Human Development and Family Studies, Advertising, Psychology, Art and Design, Nutritional Sciences, Communications, Community Health, and Music Education] and all focused on various aspects of children's growth and development [social/emotional development, cognitive functioning, and physical growth and health]. Nine of the projects were investigations conducted by graduate students working under the direction of a faculty advisor, while ten of the projects were faculty-led investigations.

Results
The target audiences for the current year were faculty and graduate and undergraduate students on the University of Illinois at Urbana-Champaign campus that were interested in collecting research data using CDL children, their families, CDL staff, and CDL classrooms as participants. The CDL website was the main mechanism used for encouraging investigators from across campus to explore the use of the CDL program as a viable site for data collection as part of their research projects. In addition, members of the CDL administrative team would work with researchers [via individual consultations] at various stages in developing their projects to explore options for data collection within the CDL program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions, Health, and Social Services
806	Youth Development

Outcome #2

1. Outcome Measures

Increased Knowledge Of Children's Behavior At A Given Stage Of Development And Parenting And Childcare Providers Practices To Foster That Behavior

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	76

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As more women and mothers enter the workforce, childcare has become an increasingly important public policy issue. These issues include the growing need for childcare, childcare affordability, and childcare quality. In addition, professional education for childcare providers is important in creating and sustaining quality childcare.

What has been done
Nutrition and Wellness Extension Educators provided training for 101 childcare providers who care for children from birth to age five. Childcare providers participated in one or more of the "I am Moving I am Learning" training curriculum topical sessions addressing practices and strategies related to children's physical activities and healthy food choices. At the end of the training, a retrospective pre-post evaluation to identify changes was distributed to and collected from 101 participants.

Results
The end-of program evaluation surveys were collected from 101 participants. The evaluations included both questions related to program satisfaction and improvements and knowledge and confidence in implementing childcare practices and strategies. Using a 4-part scale with "Very little" = 1 and 4 = "A lot", all but five of the 101 respondents indicated that they learned "Much" [48] or "Very much" [48] that applies to their work in childcare settings and that "Much" [41] or "Very much" [55] of what they learned they will be able to use in their childcare setting.

Of the 94 respondents, 76 [80%] increased their knowledge of one or more of the 11 topics. More than half [53] indicated increasing their knowledge of how moderate to vigorous physical activities support preschool readiness. Using the same rating scale, 63 of the 95 respondents [66%] indicated their intentions to implement one or more of the six practices and strategies. More than one-half of the 93 respondents [48] indicated plans to encourage families to use developmentally appropriate activities with children at home.

Three-fourths of the participants reported planning to take what they learned and apply it in their childcare facility. Often mentioned actions included more structured movement and music in the classroom, adding new movements when available, using language along with movement, incorporating nutrition as part of the curriculum on a regular basis, and sharing this information with parents.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Numbers Of Individuals Taking Recommended Actions To Manage Heart Disease And Diabetes.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	123

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Diabetes is the eighth leading cause of death in Illinois and, according to the 2011 Illinois Behavioral Risk Factor Surveillance System [BRFSS], approximately 969,000 adults [18 years of age or older] in the state have diabetes. According to the U.S. Centers for Disease Control and Prevention [CDC] the estimated medical cost of diabetes in Illinois is $8.98 billion, which includes $6.6 billion in direct medical costs and $2.4 billion in indirect costs such as disability, work loss and premature mortality.

What has been done
University of Illinois Extension's I on Diabetes is a series of 2½-3 hour face-to face sessions designed for anyone interested in preventing or managing diabetes. During the series held in Illinois this year, 136 participants received information on diabetes treatment goals as well as on self-monitoring, managing carbohydrates, sodium, cholesterol and fat portions, planning meals, and reading food labels. Food demonstrations, taste testing, and recipes assisted participants in using artificial sweeteners, low-fat products, and herbs and spices. Participants also completed a program evaluation designed to determine the impact of the program. Participants were asked to provide answers to four series of questions prior to and at the end of the I on Diabetes sessions.

Results
All but two of the participants who completed all or sections of the pre- and post-evaluations indicated increasing their confidence, skills, or practices in managing their diabetes. Specifically: [1] Using a four-part scale ranging from "Strongly disagree" to "Strongly agree" 110 of 136 participants [81%] who completed the series of questions indicated that they improved their ability to manage diabetes in one or more areas; [2] Using another four-part scale ranging from "Not confident" to "Very confident" 115 of 136 participants [83%] indicated that they improved their confidence in managing their diabetes in one or more areas; and [3] Using a four-part scale ranging from "Never" to "Almost always" 123 of 136 participants [90%] reported increasing their

frequency in taking at least one recommended action to manage their diabetes. Additional information regarding specific areas of changes in skills, confidence, and practices related to participants' management of diabetes are included in the evaluation section.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior

Outcome #4

1. Outcome Measures

Number Of Children/Youth Who Reported Eating Healthier Foods [Those Low In Fat And High In Fiber]

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Number Of Families/Caregivers That Gained Knowledge About Eating Healthier Foods [Those Low In Fat And High In Fiber]

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number Of Adults That Apply Skills As They Age In Maintaining Brain Fitness And Cognitive Health

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	445

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

With continuing growth in this country's aging population, concerns about maintaining one's memory as well as recognizing and managing brain disease are issues of great interest to the aging and their families in maintaining their quality of life.

What has been done
Continuing to draw on research being done at the University of Illinois and other research institutions, University of Illinois Extension Family Life Educators developed a new workshop on brain health that addresses techniques in maintaining one's memory. Four hundred and fifty-nine [459] participants attended one of the 18 Hold That Thought workshops held in various locations in Illinois in 2016. At the end of the program, participants were asked to complete a one-page evaluation consisting of seven questions including two open-ended questions that required qualitative analysis.

Results
Using a five-part scale with 1 = Nothing, 3 = Some, and 5 = A lot, the participants were asked to indicate how much they learned related to brain health and techniques in retaining one's memory. All but fourteen of the 459 participants checked a "3", "4", or "5" rating. Using a retrospective pre-post format and another five-part scale from one to five with 1 = Low, 90% [445] of the participants responded to three additional questions. Results indicated that 361 [80%] increased their awareness of memory strategies and techniques. Results also indicated 361 [79%] increased their knowledge of the different types of memories. In addition, 337 [73%] increased their understanding of lifestyle choices that contribute to brain health and function.

When asked what they plan to do because of information shared during the program, their responses indicated that 341 [74%] of the participants who responded intended on implementing a skill or strategy that they learned at the workshop. Most frequently mentioned were plans by the participants to stay focused on one thing at a time/to pay attention. Other frequently mentioned actions encompassed plans to engage in more physical exercise, practice memory exercises that were shared during the program, verbalizing and repeating things out loud, writing notes or journaling, and trying new and challenging activities.

When asked "What was the single most valuable thing they learned from the program?", 293 [64%] participants responded. Nearly one-half [133] of them cited learning about techniques to improve their memory that included enhancing their physical health, actions that challenge the brain, and controlling stress. Others valued learning that forgetting is normal and that memory can be improved. A few mentioned that learning about how the brain functions and about the different types of memories was most valuable.

This participant feedback suggests that the series successfully addressed ways to alleviate concerns about aging and maintaining one's quality of life.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Extension Of A Successful, Evidence-Based Approach For Strengthening Prosocial Sibling Relationships

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Evaluating The Effect Of Dietary Botanical Estrogens On Breast Cancer Growth And Progression

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Breast cancer [BC] is the leading cancer in women worldwide. Metastasis occurs in stage IV BC with bone and lung being common metastatic sites. Here we evaluate the effects of the aromatase inhibitor letrozole on BC micro-metastatic tumor growth in bone and lung metastasis in intact and ovariectomized [OVX] mice with murine estrogen receptor negative [ER-] BC cells inoculated in tibia.

What has been done
Forty-eight BALB/c mice were randomly assigned to one of four groups: OVX, OVX+Letrozole, Intact, and Intact+Letrozole, and injected with 4T1 cells intra-tibially. Letrozole was subcutaneously injected daily for 23 days at a dose of 1.75 ug/g body weight. Tumor progression was monitored by bioluminescence imaging [BLI]. Following necropsy, inoculated tibiae were scanned via uCT and bone response to tumor was scored from zero [no ectopic mineralization/osteolysis] to five [extensive ectopic mineralization/osteolysis].

Results
OVX mice had higher tibial pathology scores indicative of more extensive bone destruction than intact mice, irrespective of letrozole treatment. Letrozole decreased serum estradiol levels and

reduced lung surface tumor numbers in intact animals. Furthermore, mice receiving letrozole had significantly fewer tumor colonies and fewer proliferative cells in the lung than OVX and intact controls based on H&E and Ki-67 staining, respectively. In conclusion, BC-inoculated OVX animals had higher tibia pathology scores than BC-inoculated intact animals and letrozole reduced BC metastases to lungs.

In summary, these findings suggest that by lowering systemic estrogen levels and/or by interacting with the host organ, the aromatase inhibitor letrozole has the potential to reduce ER-BC metastasis to lung. These studies contribute to the understanding of how the aromatase inhibitor Letrozole can reduce metastatic BC progression in preclinical BC model of late stage metastasis. The impact of the studies suggests that Letrozole may have a benefit to women with late-stage BC.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

Outcome #9

1. Outcome Measures

Identifying The Determinants Of Weight Gain Prevention As Guided By Social Cognitive Theory [SCT]

2. Associated Institution Types

- 1862 Extension
- 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)
This research program is aimed at preventing the burden of adult obesity among women. Rather than waiting until overweight or obesity has developed, this study is intended to identify the determinants of weight gain prevention and to apply principles of weight gain prevention strategies to food-based dietary guidance. To date, 81 women have initiated and 42 women have completed their participation in a randomized controlled trial regarding weight gain prevention. In

addition, 14 women who were part of the wait-list control group were randomized to the intervention group and have completed the intervention component of this program. A total of 48 women completed all components of the full study. Data collection has been completed.

What has been done
Major activities completed and experiments conducted include enrollment of 87 women in the randomized controlled trial, with 81 women having completed the first week of the food-based intervention and 42 women having completed the 12-month food-based intervention. Additionally, 14 wait-list control women began the first week of the food-based intervention, with 6 women completing the full intervention. All women have completed the weekly and monthly nutrition education sessions that focused on nutrition education, intake of fruits and vegetables, and practical weight management skills.

Data have been collected at baseline, month three, month six, month nine, and month twelve. Variables included dietary intake, physical activity, anthropometric and blood pressure measurements, biochemical markers of health, eating behaviors and health perceptions, and mediators of behavior change.

Results
Sixty-two percent of women were able to maintain body weight after one year of intervention; this did not differ by registered dietitian or counselor education group. Comparison of the registered dietitian nutrition education group to the counselor nutrition education group indicated that women in the registered dietitian group were estimated to have consumed more fruits at months 3, 6, 9, and 12 [all $P<0.01$] and non-meat protein sources at month 3 [$P<0.001$].

The wait-list control component of the study has now been completed. Women have learned about vegetable consumption, planning ahead for food intake and portion control, and general nutrition information based on Dietary Guidelines for Americans, 2010-2015 [current version at the time the study was initiated]. A group of young adult and midlife women have successfully prevented body weight gain over one year of the study. Food and nutrition professionals have been made aware of this intervention and initial findings related to the feasibility and ability for a group of young adult and midlife women to prevent body weight gain.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

Outcome #10

1. Outcome Measures

Exploring How Latino Parents Balance Old And New Ideas As They Raise Adolescents In The United States

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

Translating Scientific Energy Balance Evidence And Parenting Styles Into Practical Recommendations For Training Extension Educators

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

Number Of College Students And Adults That Increased Knowledge And Skills In Managing Income And Expenses.

Not Reporting on this Outcome Measure

Outcome #13

1. Outcome Measures

Identifying The Processes That Enhance Or Erode Relationships Over Time

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The quality of adult romantic relationships has an enduring impact on the personal and family well-being of adults and their children. Individuals in positive relationships have higher levels of life satisfaction and lower levels of mental and physical health issues. Why then do some relationships flourish whereas others falter? How do couples maintain their relationships as they transition into deeper levels of involvement? These were the questions addressed by this study. After collecting data from 220 newlywed couples, We were able to analyze the strategies used to maintain these romantic relationships.

What has been done
Findings from this study showed that partners who had more discrepant perceptions about their respective household maintenance contributions had lower marital quality. These results suggest that it is the match between what partners do and what they observe that propels them toward deeper development, and demonstrates that discrepancies between partners may be the origin of relationship problems. We also examined the role of relationship maintenance efforts by zooming in on daily life, which is important because many relationship processes [including maintenance] fluctuate on a daily basis in response to events. We found that, in general, days with conflict prevented partners from observing their partners' maintenance; however, constructive communication or problem solving mitigated this effect. Thus, conflict may blind individuals from accurately perceiving the behavior of their partners.

Additional research moved from factors that impede to those that enhance relationship maintenance. The findings showed that feelings of commitment on a particular day enhanced perceptions of relationship maintenance enacted by one's partner on that day. However, a powerful difference emerged between early daters and those who were more established. Early partners used information about the partner's maintenance strategies to gain knowledge about their relationships in order to heighten or reduce commitment. Established partners, in contrast, used their existing commitment to motivate their maintenance efforts. Thus, the motivation behind partners' behaviors changed as a function of the developmental stage of the relationship. As relationships develop a solid foundation, partners become more willing to invest.

Results
Having observed the daily processes that are associated with relationship maintenance, we then sought to study how relationship experiences add up and unfold over time by examining the pathways that lead to increasing commitment over time. Commitment is at the heart of persistence because it is one of the best predictors of whether an individual will stay in a relationship. We found four distinct pathways related to commitment [dramatic, conflict-ridden, socially-involved, and relationship-focused]. Individuals with these patterns of commitment differed as a function of important relational variables including satisfaction, love, ambivalence, worries about marriage, and leisure. Most notably, however, dramatic commitments [defined by frequent fluctuations in commitment over time and negative attributions about partners] were twice as likely as any other commitment type to break up. These findings help zero in on the processes that enhance and erode relationships over time. In long-term relationships, the process may, for example, take the form of a relational-focused or socially-involved commitment with high levels of joint leisure activity, social involvement, and love. In less healthy relationships, the process may be dramatic with rapid fluctuations in feelings of commitment and heightened levels of uncertainty. These findings are among the first to provide empirical evidence that shows that the origins of relationship success or deterioration lie in the experiences of young couples.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions, Health, and Social Services

Outcome #14

1. Outcome Measures

Determining How Prenatal Choline Status Alters Cognition In An Age-Dependent Manner

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the past year, we have improved upon the pig brain atlas and post-acquisition sequence of MRI data processing methods for analyzing and interpreting neuroimaging datasets. Combined, these efforts continue to deepen our knowledge about short and long-term effects of early-life choline sufficiency. By making use of the Piglet Nutrition and Cognition Laboratory research facility that was dedicated in April 2015, we have made significant progress toward developing, validating, and optimizing behavioral tasks pertinent to the present Hatch project, including the back test [a measure of anxiety in pigs], eye-blink conditioning [a measure of associative learning and memory], and novel object recognition [a measure of short-term memory formation]. These behavioral tests will ultimately be used to test the effects of choline status on cognitive development, and will complement the neuroimaging techniques that continue to be improved.

What has been done
In addition to the outcomes described above, our laboratory has developed cellular and molecular techniques for quantifying neurodevelopment in the pig, including Western blot quantification of pre- and post-synaptic proteins and immunohistochemical staining and semi-quantitative procedures for protein targets in the brain. Additionally, we are in the process of working with an external laboratory to enable quantification of neuronal spine density and arborization complexity in the pig. Combined with our recently-developed methods to quantify brain catecholamines using high-performance liquid chromatography methods, we now have a broad set of validated laboratory techniques to enable characterization of the developing pig brain, and we are now well-positioned to determine how early-life choline status affects these outcomes.

Results
As a result of the work that was conducted over the past year, we have experienced both a change in knowledge and action. The information gathered thus far was worthy of two publications, in that our development of a choline-sensitive behavioral paradigm of learning and

memory in the pig provides clear evidence that sensitive periods exists during cognitive development. Moreover, the development of MRI sequences for the domestic pig has generated a plethora of additional research questions that can be best tested using the translational nature of the pig brain to humans. A new shift in action will occur in 2016 upon final implementation of the eye-blink conditioning paradigm to provide another measure of learning and memory. The second shift in action is implementation of new MRI sequences, including improvements in diffusion tensor imaging [DTI] and magnetic resonance spectroscopy [MRS] sequences, which quantify neural connectivity/complexity and neurochemical concentrations in live pigs, respectively. Development and refinement of these techniques represent outcomes for assessing cognitive development, and we anticipate that use of these procedures will reveal quantitative changes in brain development induced by differential early-life choline status.

4. Associated Knowledge Areas

KA Code	Knowledge Area
704	Nutrition and Hunger in the Population
806	Youth Development

Outcome #15

1. Outcome Measures

Reducing Sodium In Snack Products

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Excessive sodium consumption can result in hypertension, diabetes, heart disease, stroke, and kidney disease. Various chips and extruded snacks, where salt is mainly applied on the product surface, accounted for almost 56% of snacks retail sales in 2010. Hence, it is important to target sodium reduction for those snack products.

What has been done
Past studies had shown that modifying the rate-release mechanism of sodium is a promising strategy for sodium reduction in the food industry. Encapsulation of salt is one possible technique to control the sodium release rate. Porous corn starch [PCS], created by enzymatic treatment and

spray drying and lipoproteic matrix, created by gelation and freeze drying, were evaluated as carriers for controlled sodium release targeting topically applied salts. Both carriers encapsulated salt and their in vitro sodium release profiles were measured using a conductivity meter.

Results
The sodium release profiles of PCS treated with different enzymatic reaction times were not significantly different. Protein content and fat content altered sodium release profile from the lipoproteic matrix. The SEM images of PCS showed that most of the salt crystals coated the starch instead of being encapsulated in the pores while the SEM images and computed tomography scan of the lipoproteic matrix showed salt dispersed throughout the matrix. Hence, PCS was found to have limitations as a sodium carrier as it could not effectively encapsulate salt inside its pores. The lipoproteic matrix was found to have potential as a sodium carrier as it could effectively encapsulate salt and modify the sodium release profile.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

Outcome #16

1. Outcome Measures

Determining The Potential Of Phenolic Compounds From A Fermented Blackberry-Blueberry Beverage To Reduce Diet-Induced Obesity

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The aim of this study is to determine the potential of phenolic compounds from a fermented blackberry-blueberry beverage to reduce diet-induced obesity and hyperglycemia in mice fed a 60% high fat diet [HFD] for ten weeks after one week of pretreatment.

What has been done

C57BL/6j mice were randomized into six groups and allowed to drink [ad libitum] an alcohol-free blackberry-blueberry beverage [AFFB, 8.4 mg ANC/kg BW/d], three doses of a phenolic extract [PAE] from AFFB at 0.1X, 1X and 2X anthocyanin [ANC] concentrations, sitagliptin [hypoglycemic positive control], or water [negative control]. Weight and fat mass gain were attenuated in mice receiving the highest doses of PAE [18.9 mg ANC/kg BW/d, $p < 0.05$]. There were also reductions [$p < 0.05$] in percent fat mass, epididymal fat pad weights, mean adipocyte diameters, and plasma triglycerides and cholesterol associated with PAE treatments.

Results
By the end of the study, fasting blood glucose for mice receiving 9 [1X] or 18.9 [2X] mg ANC/kg BW/d was significantly lower than in the water and the sitagliptin groups [$p < 0.05$]. Histological and histochemical analysis revealed an unexpected change in liver of mice fed ANC at 1X or 2X doses consisting of liver enlargement and increased lipid deposition. PAE also induced the most differential gene expression changes, including highly significant downstream effects at all doses to reduce D-glucose concentrations. Overall, phenolic compounds from the fermented blueberry-blackberry beverage had an impact to attenuate the development of obesity and fasting blood glucose in C57BL/6j mice.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

Outcome #17

1. Outcome Measures

Number Of Youth That Increased Knowledge Of Bullying And Actions to Take In Dealing With A Bullying Situation

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	42

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Violence and bullying in schools is increasing among teens in the U.S. There is a scarcity of materials focused on bystanders and targeted for junior high and high school students.

What has been done
A team of current and now-retired educators developed a research-based prevention simulation and guided discussion for junior high and senior high youth, supported by statistical research on bullying among teens in the U.S. Breaking the Code [BTC] program objectives are: [1] Youth will see the effects of bullying and understand the power of their decisions as bystanders in a bullying situation; [2] Identify options for responding to bullying, and [3] Be motivated to take a stand against bullying. BTC is a simulation that tells the story of youth observing everyday situations where bullying occurs. Eight 30-minute scenarios are played out in either narrator or skit form. Bystanders begin to realize the choices they make have a big impact on the victim, the normalcy and acceptance of bullying, and the social climate of their school. Guided discussion assists students to process the experience

Results
Data from a subset of 67 students who completed both pre- and post-program evaluations in 2016 have continued to show increases in the number of students who definitely would: [1] Help stop a bulling situation -- 42 [65%] of the students checked this on the post-test; [2] Confront a bully -- [55%] of the students checked this on the post-test; [3] Ask an adult for help -- 34 [53%] of the students checked this on the post-test; [4] Help someone who is being bullied -- [48%] of the students checked this on the post-test.

Sample responses when asked what they will do differently follow: "Stand up for the target", "Be the one to always be there for people when they need it", "I will confront a bully if a friend is nearby to help me", "Tell a teacher if I get bullied", and "I plan to stop teasing and making fun of people".

4. Associated Knowledge Areas

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

Outcome #18

1. Outcome Measures

Increased Knowledge Regarding Setting Goals To Enhance a Healthy Lifestyle

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	179

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There are many personal goals that people have that would bring joy and fulfillment in their lives but are many times delayed or never accomplished.

What has been done
Drawing on research being done at the University of Illinois and other research institutions, University of Illinois Extension Family Life Educators developed Someday is Today: Live Your Bucket List -- a workshop designed to help participants create "bucket lists" and set goals to pursue interest and fulfill their dreams. One hundred eighty-nine [189] participants attended one of eight of the Live Your Bucket List workshops conducted in June, July, and September by Extension Family Life Educators.

Results
At the end of the program, 185 participants completed an evaluation. Using a five-part rating scale with 1 = Nothing, 3 = Moderate, and 5 = A lot, all but one of the participants [99%] who responded indicated they learned something from this program. Ninety-seven [97] indicated that they learned "A Lot", 73 checked a "4", 12 checked "Moderate", two checked a "2", and one checked "Nothing". The participants were then asked to use another five-part scale to rate four additional items with respect to their self-assessment before and then after the program [with "5" being highest]. A comparison of their before program rating and after program rating follows:

171 [92%] of the respondents increased their knowledge of the difference between mini and maxi bucket list goals and the importance of self-inventory.

162 [88%] increased their understanding of various types of bucket lists.

157 [86%] increased their skill level in identifying strategies for developing their own bucket lists or action plans and in ways to reflect on those experiences.

142 [77%] increased their awareness of the benefits of setting goals throughout life.

Responses to the Live Your Bucket List workshop evaluation provide evidence that 179 of the 189 [95%] participants learned to create bucket lists, action plans, and set goals to pursue their interests and fulfill their dreams.

4. Associated Knowledge Areas

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

Outcome #19

1. Outcome Measures

Increased Knowledge Of Healthy Lifestyle Choices And Consequences Of Actions with Respect to Healthy Lifestyle Choices

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	118

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Recent statistics confirm what parents, teachers and other concerned adults suspect -- children and teens continue to use tobacco, alcohol, and drugs in significant numbers.

What has been done
University of Illinois Extension Youth Development staff implemented delivery of 4-H Health Rocks!, a national healthy living program aimed at 8-16 year olds, with the goal of bringing youth, families, and communities together to reduce tobacco, alcohol, and drug use. The program was conducted at eight sites. Trained teens and staff provided ten or more hours of educational hands-on activities in school classrooms, summer youth programs, and after school programs. In addition to learning the facts about drugs and the consequences of taking them, the youth engaged in educational activities that encompassed building life skills such as showing concern for others, making healthy lifestyle choices, managing stress, and developing refusal skills. A total of 222 of the 305 youth participants completed the 10 hours of required training. One hundred and eighty-three [183] youth completed the retrospective post-pre evaluation comprised of seventeen items.

Results
At the last session of 4-H Health Rocks! youth were asked to rate the strength of their agreement with thirteen statements regarding drug usage and life skill development using a scale of 1-4 with 1 = Strongly disagree and 4 = Strongly agree. They were instructed to provide a rating that reflected their increased agreement after the program and then provide a rating of their agreement before the program. One hundred eighteen youth [64%] increased their agreement with at least one of the statements when comparing post training ratings and pre-training ratings. One-third of the youth increased their knowledge about smoking and other drug use and agreed with the following statements: [1] "Once you start smoking, it is hard to stop"; [2] "People who use drugs sometimes see or hear things that are not really there", and [3] "Using drugs can ruin my

relationship with my family and friends". One third of the youth increased their confidence in dealing with stress and agreeing with the statement [4] "If a friend wanted to try drugs, I can talk them out of it" [concern for others life skill]. In response to the final set of four questions regarding program satisfaction and experience, 3.09 was the average rating on the four-part scale for the statement "I learned a lot during the training" [complete findings can be found in the evaluation section].

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
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

V(I). Planned Program (Evaluation Studies)

Evaluation Results

I on Diabetes

In 2016, pre- and post-evaluations consisting of four sections of questions were collected from 136 participants at the beginning and again at the end of **I on Diabetes** programs conducted in nine locations in Illinois. **I on Diabetes** is a series of 2 ½-3 hour face-to face sessions designed for anyone interested in preventing or managing diabetes. Content of the program series addresses diabetes treatment goals and self-monitoring, managing carbohydrates, sodium, cholesterol and fat intake, planning meals, and reading food labels. Food demonstrations, taste testing, and recipes assisted participants in using artificial sweeteners, low-fat products, and herbs and spices.

All but one of the 136 participants who completed all or some of the sections of the evaluation indicated increasing their confidence, skills, or practices in managing their diabetes.

Improved Ability To Manage Diabetes

One hundred and ten [110] of 136 participants [81%] who completed the evaluation indicated that they improved their ability to manage diabetes in one or more areas. Using a four-part scale ranging from "Strongly disagree" to "Strongly agree", 75 [55%] reported they could now more easily select foods that fit their meal plan, 71 of the 136 participants [52%] who completed the evaluations indicated they improved their ability to select

healthier choices when dining out, and 60 [44%] indicated they could more easily prepare healthy foods. Fifty-four [54] of 136 [40%] increased agreement that healthy foods taste good. Only 49 of 136 [36%] of the participants indicated increasing their ability to manage portion sizes and only 31 [23%] indicated feeling they had improved their ability to easily talk to the doctor about their diabetes.

Improved Confidence In Diabetes Self-Management

A second series of questions on the evaluation was designed to identify increases in the confidence of the participants to manage their diabetes using another four-part scale ranging from "Not confident" to "Very confident". One hundred and fifteen [115] of 136 participants [85%] indicated that they improved their confidence in managing their diabetes. Nearly three-fifths of the 136 who completed the evaluation indicated an increased confidence in the following:

- Selecting foods that will reduce the risk of heart disease [104 or 76%]
- Estimating the amount of food you should eat [93 or 68%]
- Knowing which foods have carbohydrates [91 or 67%]
- Following a healthy diabetes meal plan [82 or 60%]
- Preparing foods that fit into their meal plan [79 or 58%]

Only 44 [32%] increased confidence in talking with their doctor about their health.

Increased Frequency Of Recommended Actions To Manage Diabetes

A final series of questions explored increased frequency in using recommended practices by the participants. Using a four-part scale ranging from "Never" to "Almost always", 123 of the 136 participants [90%] reported increasing their frequency in taking at least one recommended action.

More than half of the participants revealed increasing the following practices:

- Using food labels to plan their meals [89 or 65%]
- Setting goals to help manage their diabetes [86 or 63%]
- Keeping track of the amount of foods with carbohydrates they eat each day [86 or 63%]
- Following a meal plan to help manage diabetes [76 or 59%]

Approximately forty percent indicated increasing their frequency in taking the following actions.

- Trying to limit fat intake [62 or 46%]
- Trying to limit salt intake [61 or 45%]
- Eating at least three regularly spaced meals a day [55 or 40%]
- Increasing physical activity [52 or 38%]

Forty-eight of the participants [35%] increased reading food labels.

Health Rocks

One hundred eighty-three [183] of the 305 youth participants in **4-H Health Rocks**!, a national healthy living program aimed at 8-16 year olds with the goal of bringing youth, families, and communities together to reduce tobacco, alcohol, and drug use, completed a retrospective post-pre evaluation comprised of seventeen items. In addition to learning the facts about drugs and the consequences of taking them, the educational activities encompassed building life skills such as showing concern for others, making healthy lifestyle choices, managing stress, and developing refusal skills. Thirteen of the 17 evaluation items addressed these skills using a scale of 1-4 with 1 = "Strongly disagree" and 4 = "Strongly agree". The youth were instructed to provide a rating that reflected their level of agreement after the program and then reflect back and provide a rating of their level of agreement before the program. One hundred eighteen youth [64%] increased their agreement with at least one of the statements when comparing post training ratings and pre-training ratings. Note: This evaluation tool has been designed for use nationally.

Data regarding the increases between before and after the program follow in the order of highest to lowest number of youth who increased their level of agreement with each of the following thirteen statements: [1] 52 of the 118 [44%] increased agreement that "Once you start smoking, it is hard to stop"; [2] 43% increased agreement that "People who use drugs sometimes see or hear things that are not really there"; [3] 47 [40%] increased agreement that "If a friend wanted to try drugs, I can talk them out of it"; [4] 43 [36%] increased agreement that "I need to think about how my choices will affect my future"; [5] 40 [34%] increased agreement that "Using drugs can ruin my relationship with my family and friends"; [6] 38 [32%] increased agreement that "When I feel stressed I am able to talk about it with people I trust"; [7] 36 [31%] increased agreement that "I would help other kids like me to stay away from alcohol or other drugs"; [8] 33 [30%] increased agreement that "I feel good about myself"; [9] 30 [25%] increased agreement that "I am able to say no if others offered me cigarettes"; [10] 30 [25%] increased agreement that "I don't have to drink or smoke even if some other young people do it"; [11] 27 [23%] Increased agreement that "I have goals for myself"; [12] 25 [21%] increased agreement that "People who smoke can die from lung cancer"; and [13] 21 [18%] increased agreement that "It is important for me to stay focused on learning at school".

In response to the final set of four questions regarding program satisfaction and experience, 3.09 was the average rating on the four-part scale for the statement "I learned a lot during the training".

Key Items of Evaluation

I on Diabetes

All but one of the 136 participants who completed all or some of the sections of the evaluation indicated increasing their confidence, skills, or practices in managing their diabetes, especially with respect to selecting healthy food choices and following a healthier meal plan to manage their diabetes.

Using a four-part scale ranging from "Strongly disagree" to "Strongly agree," 110 of the 136 participants [81%] who completed the series of questions indicated that they **improved their ability to manage diabetes** in one or more areas.

Using another four-part scale ranging from "Not confident" to "Very confident," 115 of the

136 participants [83%] indicated that they improved their confidence in managing their diabetes in one or more areas.

Using a four-part scale ranging from "Never" to "Almost always", 123 of the 136 participants [90%] reported increasing their frequency in taking at least one recommended action to manage their diabetes.

The results of evaluations comparing responses to the same questions at the beginning and at the end of participation in the **I on Diabetes** series strongly suggest that the program was impacting participants' management of diabetes.

Health Rocks!

One hundred eighteen youth [64%] increased their agreement with at least one of the statements regarding learning facts about drugs and the consequences of taking them and building life skills such as showing concern for others, making healthy life styles choices, managing stress, and developing refusal skills when comparing post training ratings and pre-training ratings.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Natural Resources And The Environment

☑ 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	25%		10%	
111	Conservation and Efficient Use of Water	15%		10%	
112	Watershed Protection and Management	5%		15%	
123	Management and Sustainability of Forest Resources	5%		10%	
132	Weather and Climate	5%		10%	
133	Pollution Prevention and Mitigation	5%		10%	
134	Outdoor Recreation	5%		10%	
135	Aquatic and Terrestrial Wildlife	5%		10%	
405	Drainage and Irrigation Systems and Facilities	0%		5%	
605	Natural Resource and Environmental Economics	0%		10%	
806	Youth Development	30%		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	0.0	0.0	6.0	0.0
Actual Paid	10.3	0.0	37.0	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**
654341	0	866217	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
654341	0	866217	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4288387	0	4634641	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included work that seeks to determine if reducing the use of water by the most water-intensive sectors would significantly damage the economy of the locality under study and whether substituting the output of such sectors by imports from water-abundant areas should be considered, the development of tools and techniques that can be used to accurately predict best management practices performance effectiveness across a range of spatial scales specific to sediment, nutrient, and pathogen transport [this will permit more informed and cost effective watershed management decision making], research focusing on quantifying the changes in watershed hydrology [water quantity and quality] under changing climate and land use conditions and how they impact ecosystem services in terms of sediment delivery and aquatic biodiversity, and a study of the effectiveness of a network framework for evaluating the capacity of environmental governance structures to accommodate multiple ecosystem services and the extent to which decentralized environmental governance networks are able to incorporate justice concerns into planning processes and outcomes.

Activities also included work to develop capacity for applied uses of eDNA in freshwater ecology and management while advancing statistical modeling frameworks for better interpretation of this new type of biodiversity data, a study to improve our understanding of atmospheric inputs in combination with fertilizer and fixation inputs to improve nutrient utilization in these ecosystems [the comprehensive nationwide monitoring system that Illinois takes part in is also an early warning system for changes in nutrient loadings through atmospheric deposition and also provides an indication of the recovery from acidification in many ecosystems], research documenting phosphorus input and output budgets in constructed wetlands receiving tile flow from adjacent corn and soybean farm fields in central Illinois, and work that will advance our knowledge of the socio-economic contribution forests and trees on farms have made in the past and may make in the future.

Activities also included a study of the implications of climate change for agricultural policies and projects with a focus on regions affected by civil conflict, the establishment of self-sustaining vegetation on the USX brownfield in South Chicago [what was once an unusable brownfield is now a lake side park thanks to the productive soils we established], the development of practical and easy-to-implement strategies that help address nitrogen leaching and N2O emission concerns in Illinois, efforts to develop a novel suite of indices that can either supplement or replace traditional restoration monitoring to improve our ability to quantify habitat restoration success, work to better understand how and when grassland birds select habitats in order to distribute habitat in the most appropriate manner across the landscape, research that seeks to build our knowledge of the factors that govern the formation of methylmercury [the most toxic form of Hg] in agricultural watersheds so that efforts aimed at mitigating water quality problems will not inadvertently worsen the problem of Hg pollution, and ongoing work under the **National Atmospheric Deposition**

Program that seeks to monitor the nation's precipitation for a range of chemical constituents, including mercury, to determine whether spatial and temporal trends in concentration and wet deposition are present.

Conference presentations included the Regional Science Association International, Association of Environmental and Resource Economists, American Society of Agricultural and Biological Engineers, Illinois Water Conference, Illinois Department of Natural Resources, Society for Freshwater Science, American Fisheries Society, Mid-South Prairie Symposium, 8th Midwest-Great Lakes Society for Ecological Restoration, Illinois Invasive Species Symposium, Illinois Prescribed Fire Symposium, North American Congress on Conservation Biology, American Association of Geographers, Northeast Universities Development Consortium, American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, U.S. Fish and Wildlife Service, National Water Quality Monitoring Conference, Association for the Sciences of Limnology and Oceanography, National Ambient Air Monitoring Conference, Tribal Air Monitoring Support Ecosystems Class, Asia Pacific Mercury Monitoring Meeting, Center for Atmospheric Sciences of the National Autonomous University of Mexico, Ecological Society of America, National Animal Behavior Society, and the Central Hardwoods Conference. Extension activities encompassed a variety of delivery methods to provide education regarding climate, soil and water management, forestry, and environmental stewardship. A description of some of these major areas of focus follows.

The annual **Soil and Water Management Workshop** for Certified Crop Advisors was hosted via webinar in 18 locations in the state with approximately 90 in attendance and included topics that addressed soil health, using drones for water management, remote sensing for soil, and water management. In addition, six pond management workshops covered aspects of pond ecology, weed management, and fish management and were attended by more than 100 participants. The **Illinois-Indiana Sea Grant** staff established eight new medicine collection programs to keep pharmaceutical and personal care product disposal from impacting water quality

An Illinois State Climatologist also presented "Extreme Precipitation, Extreme Erosion?" at the **Soil and Water Management Workshop**. Other programming addressing climate change included the **Weather Observer Course** classes that offered training for 40 individuals this year that provided information on the volunteer precipitation monitoring program that is a part of the national precipitation monitoring program. YouTube videos [17] on weather/climate topics garnered a high of 13,611 views in March.

The **Illinois Master Naturalist** [ILMN] program completed a ninth year of statewide implementation. Using the 20-chapter curriculum, training was offered in eight multi-county locations to certify new Master Naturalists. The 782 Illinois Master Naturalists were actively engaged in a wide variety of projects as environmental stewards and educators. These Master Naturalists invested 65,706 volunteer hours of which 10,489 were devoted to educational program delivery and 42,693 hours were devoted to natural resource stewardship activities. These numbers reflect a 6% growth in volunteer hours and a 17% growth in the number of volunteers as compared to the previous year. A web-based reporting site is used to collect information on all Master Naturalists and Master Gardeners' training, volunteer hours, contacts, and projects. Based on the value of a volunteer hour of $25.34 from the Independent Sector, Master Naturalists' volunteer service reflects an estimated value of $1,665,000.

Educational efforts carried out with respect to air quality included radon testing programs attended by 114 individuals. The workshops were supported using grant dollars and through a partnership with the Illinois Department of Public Health with leadership provided by an Extension staff member.

Extension campus and field staff continued to conduct six **First Detector** trainings delivered across the state this year that focused on increasing awareness of invasive plant species in Illinois [also discussed in the Plant Health, System, and Production planned program evaluation section]. The Extension **Pesticide**

Training program reached 2,618 private [farmer] pesticide applicators and 9,788 commercial applicators this past year and provided information on proper and safe use of pesticides that are vital to protecting public health and the environment.

The majority of forestry-related education focused on forest management, invasive species, agroforestry, and chainsaw safety. With the addition of a second Extension forester, 42 woodland owners were provided on-site technical assistance. Extension foresters were responsible for 3,898 direct contacts with landowners, homeowners, Master Naturalists, natural resource professionals, loggers, and students through a total of 70 conferences, workshops, field days, seminars, and training sessions. Extension's new forestry Facebook page garnered 651 followers and 100,521 views.

Youth Conservation Days with hands-on activities were held in many locations in the state that included outreach through classrooms, summer education programs, and special events. The **I Think Green** curriculum was used to engage youth in investigating how living things interact with each other and with their environment and reached 1,274 3rd-5th graders [also discussed in the evaluation section of this planned program]. A new offering was a Fresh Mussel Survey where 12 4-H Citizen Scientists were trained in protocol to collect data related to this topic.

A **Pathways to Science Through Nature** club engaged youth in the **Nature Detectives** activities. The Cook County Extension educators who focus on science, technology, engineering and math [STEM] as a priority issue continued to expand the **Inquiry Adventures** program, an inquiry-based nature exploration project for youth. A total of 332 urban youth from seven different public and private elementary or middle schools received instruction on the inquiry process [part of the Science and Engineering Practices in the Next Generation Science Standards]. The youth then had an opportunity to practice the process and develop positive attitudes toward local nature and the environment on a subsequent field trip to a nearby Cook County Forest Preserve site. Trained teachers or volunteers "coach" the field trip experience and received support from Extension staff members.

2. Brief description of the target audience

Members of the target audience included natural resource professionals, scientists interested in avian ecology and the spread of infectious diseases, ranchers and farmers, public and private landowners and managers of the Mississippi and Ohio river landscapes, soil scientists, sociologists, conservationists, wetland specialists, human and physical geographers, urban planners, public health specialists, economists, geomorphologists, geologists, hydrologists, agronomists, foresters, students, low income residents receiving urban gardening assistance, state and federal fish and wildlife management or natural resource conservation agencies [including the Illinois Department of Natural Resources, the U.S. Forest Service, and the U.S. Fish and Wildlife Service], policy makers, academic ecologists, restoration practitioners, government agency personnel involved in planning, implementing, and regulating wetland restoration programs, conservation NGO's, individuals with an interest in soil management and conservation, crop producers, agricultural consultants, academic, medical, veterinary, industrial, and professional scientists and clinicians, and graduate students involved in natural resource conservation.

Extension activities targeted pesticide applicators, forest landowners, crop producers, public officials, representatives from land management agencies, residents interested in natural resource stewardship, homeowners, youth, and Extension Master Gardener and Master Naturalist volunteers.

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	15632	60835	50967	60835

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	48	48

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2016	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number Of Individuals That Increased Knowledge Of Human Actions That Negatively Affect The Environment
2	Dissemination Of Air Quality And Atmospheric Data Through Web Hits On The National Atmospheric Deposition Program Website
3	Assessing The Feasibility Of Urban Plant Agriculture
4	Improved Development Of Conservation Strategies Through An Improved Understanding Of How The Presence Of Social Cues Affects The Occupancy And Density Of Grassland Birds
5	Estimating The Value Of Natural Resources And Environmental Amenities To Guide Resource Management Decisions
6	Number Of Pesticide Applicators Making A Decision To Avoid Harming The Environment
7	Actions Taken By Program Participants To Protect The Environment [Water Quality, Air Quality, Soil Loss, Wildlife, Natural Vegetation]
8	Determining The Optimal Use Of Water Resources
9	Predicting The Diversity Of Restored Wetlands
10	The Impact Of Climate Change On Agricultural Production
11	Improved Control Of Overland Transport Of Pathogens
12	Number Of Urban Youth Who Discovered The Value of A Forest

Outcome #1

1. Outcome Measures

Number Of Individuals That Increased Knowledge Of Human Actions That Negatively Affect The Environment

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1298

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increasing concern over degradation of the environment addresses a critical issue related to sustaining life for future generations.

What has been done
The I Think Green curriculum was developed by 4-H and horticulture Extension specialists to engage 3rd-5th grade youth in investigating how living things interact with each other and with their environment. This program includes three tracks: [1] Worms; [2] Butterflies; and [3] Insects. All three tracks follow a sequence of four 40-60 minute investigations in which youth practice observation skills, conduct hands-on investigations with living things, explore different life cycles, identify how living things function/adapt/change, and compare how living things interact with each other and with their environment. The objectives of the program include: [1] To develop youth skills in scientific observation; [2] To increase youth knowledge of concepts that explain how living things function, adapt, change and interact within the environment; and [3] To increase youth knowledge of things they can personally do to help protect the environment. The program was delivered by 4-H and Master Gardener trained volunteers and involved 1,274 youth this past year.

A graduate of Extension's Master Naturalism program coordinated a workshop for teachers on Monarch butterflies. The Teacher Monarch Network presented the two-day workshop. Twenty-four teachers attended. The workshop included information on science inquiry [developing skills and strategies for information-gathering] and problem-solving, identifying questions and making predictions that can be addressed by investigations, identifying patterns when observing the natural and constructed world, and measuring, estimating, and computing quantities when doing science.

Results

In responding to a ten-question evaluation given to the youth participants at the end of each of the tracks, 92% [938] of the butterfly track participants reported that the activities helped them learn how butterflies contributed to the environment and 82% [208] learned more about how insects contributed to the environment. In addition 87% of the youth in all the tracks [1,274] reported being more excited about helping to care for the environment and 85% [1,083] reported having more ideas about ways they could help care for the environment after participating in I Think Green.

At the end of the workshop an evaluation was distributed and completed by all 24 teachers. In response to the first question "What new ideas/strategies are you leaving with today?", nine teachers shared the obvious -- "raising monarchs" [how to handle them]. Other multiple responses included plans to use the activities that were shared during the workshop [indoor and outdoor games, building a butterfly house, resources/books/movies, art projects, songs] and teaching students to respect and appreciate of nature.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
806	Youth Development

Outcome #2

1. Outcome Measures

Dissemination Of Air Quality And Atmospheric Data Through Web Hits On The National Atmospheric Deposition Program Website

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1275841

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Please note that the number reported here represents page views or "page hits".

The impact of this project is the repeated collection of basic pollution data in precipitation, and the

use of this data in other research. The NADP repeatedly measures the flow of pollutants in precipitation and by dry deposition into ecosystems at about 350 locations in North America.

What has been done
First, 20,053 wet deposition measurements were made during this project year. Once analysis and data validation procedures were complete, we produced national maps to show the spatial variability of approximately 15 different pollutants, and these maps/figures were well used by the science/policy community. Second, this data was provided to all requesters to use for a variety of research, education, and/or policy decisions. During this project period, we had approximately 27,000 data downloads, and 247 journal articles were published using NADP data in some manner. Finally, the NADP organization and data support education through dissertations and theses uses, through providing data to K-12 educators for basic science education, and through the development of basic educational documents for use by all.

Results
Since 1978, the NADP has provided fundamental measurements to support informed decisions on environmental and agricultural issues related to the ambient concentration and wet deposition of atmospheric pollutants in North America. For the 2016 project year, NADP data were cited in 247 peer-reviewed publications, dissertations, and book chapters [see nadp.isws.illinois.edu/lib/bibliography.aspx].

Our website is the primary way that we distribute data. Data from the NADP's five monitoring networks were downloaded 26,922 times by approximately 32,791 registered data users. We recorded 24,167 downloads of our maps and summaries. These data users consistently represent federal and state agencies [40% of users], universities [36%], K-12 students and educators [16%], and others [8%]. Each year, NADP data are used by policy makers to make informed decisions on agriculturally important topics, including the impact of atmospheric pollutant fallout on the North American food supply. Data are also used in science, technology, engineering, and mathematics [STEM] curricula on the elementary, secondary, and post-secondary levels. All data are available free of charge at nadp.isws.illinois.edu.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife

Outcome #3

1. **Outcome Measures**

   Assessing The Feasibility Of Urban Plant Agriculture

   Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

   Improved Development Of Conservation Strategies Through An Improved Understanding Of How The Presence Of Social Cues Affects The Occupancy And Density Of Grassland Birds

   Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

   Estimating The Value Of Natural Resources And Environmental Amenities To Guide Resource Management Decisions

   Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

   Number Of Pesticide Applicators Making A Decision To Avoid Harming The Environment

2. **Associated Institution Types**

   - 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	12406

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Use/application of pesticides has potential adverse impacts on the environment, crops grown, and the pesticide applicator.

What has been done
Pesticide training sessions focused on pesticide characteristics, correct application procedures, problems that may occur with the use of pesticides, where information can be obtained, and the steps to take if a problem occurs with the use of a pesticide. Private applicator training was delivered by Extension staff in 17 settings across the state to a total of 2,618 individuals in 2015-2016 that included agricultural producers, agriculture and horticulture sales associates, and Extension master volunteers. Commercial applicator training was offered by Extension staff through clinics located in 25 settings across the state to a total of 9,788 individuals that included operators and applicators who apply pesticides to turf grass, field crops, ornamentals, and road right-of-ways. Following these trainings, Illinois Department of Agriculture staff administered a certification test.

Results
Based on findings from a 2013 survey mailed to a random sample of commercial pesticide training participants, 90% of this year's 9,788 Commercial Pesticide Applicator training participants likely improved one or more of their practices as a result of training participation. In addition [based on previous findings on improvements in practices], more than sixty percent of the participants most likely improved calibration procedures, improved pest control decision-making, improved mixing pesticides properly, and and improved compliance with the laws.

Based on findings from a survey of 16 practice changes that was conducted in 2010, 2011, and 2012 at private applicators safety education programs, three-fourths of this year's 2,618 private applicator training attendees will likely have: [1] Read and followed label directions for proper pesticide application; [2] Taken precautions to minimize spray drift when applying pesticides; [3] Scouted to determine proper identification of pests before determining if control is needed; and [4] Understand how pesticides can cause contamination and took steps to prevent it. Using the average figure of $11,000 from the three-year study regarding training participants' estimate of dollars saved by being able to protect their production and apply appropriate pesticides when necessary, the total estimated dollars for the six percent [196] of the training attendees last year may well be slightly more than two million dollars saved.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife

Outcome #7

1. Outcome Measures

Actions Taken By Program Participants To Protect The Environment [Water Quality, Air Quality, Soil Loss, Wildlife, Natural Vegetation]

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	28577

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
How we choose to use and dispose of pharmaceuticals and personal care products impacts the quality of the water we drink, bathe in, and use for recreation. Most of us do not use all of the medications that we buy. But using the toilet or trash to dispose of medicine can put people, animals, and the environment at risk.

What has been done
With grant funding from University of Illinois Extension, Illinois-Indiana Sea Great informed each Extension county director about medicine disposal issues and new research being conducted on pharmaceuticals in the environment. As part of this initiative, Extension educators from around Illinois to joined IISG in informing audiences about establishing medicine collection programs and other best management practices. Eight new medicine collection programs were started in Illinois and Indiana. Illinois-Indiana Sea Grant provided technical assistance on how to start a take-back program and purchased the collection boxes, which are available in local law enforcement offices.

Results
This brings the number of permanent collection programs in the two states that are assisted by IISG to 49. Altogether, these programs collected and properly disposed of 28,577 pounds of unwanted medication.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #8

1. Outcome Measures

Determining The Optimal Use Of Water Resources

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In a virtual water flow analysis, the overall objective consists of determining whether reducing the use of water by the most water-intensive sectors would significantly damage the economy of the locality under study and whether substituting the output of such sectors by imports from water-abundant areas should be considered.

What has been done
We choose Arizona as it has been less studied, and has received less media coverage, than its water scarce neighbor California. In spite of its water scarcity and expected population growth, the state of Arizona permits as much as 73% of its water to be consumed by a single sector, crop production. Since 79% of such crop production is not consumed in Arizona, it is the same as exporting up to 58% of the water available in the state to the rest of the country and abroad.

Results
Water scarcity is an especially important concern for a state expected to see its population grow and its climate get drier. We simulated three water-saving scenarios aimed at saving 19% of the water available, a figure set by the upper threshold of the first option of switching to a more efficient irrigation system. The same savings could be reached by reducing the export of crops by 26%, but at a cost of reducing output and employment by $1,836 million [0.44%] and 13,168 jobs [0.41%] respectively. These results cause us to wonder how long it will take the state to value the risk mitigating potential of its water given the state's current and future climate conditions, its expected population growth, its over-reliance on a source of water beyond its boundaries, and the inherent simplicity with which most crops grown in Arizona can be imported from well-rainfed U.S. states.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

Outcome #9

1. Outcome Measures

Predicting The Diversity Of Restored Wetlands

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
We predict that restored wetlands will have low taxonomic and functional group beta diversity [among-site turnover in species composition] compared to randomly-selected natural wetlands.

What has been done
We established standardized permanent plots in 38 restored wetlands in Illinois. In restored forested wetlands, vascular plants were sampled within 30 0.25 square meter quadrants distributed along three 50 meter transects. Additionally, a 0.1-ha plot surrounding one transect was surveyed for additional species. In restored herbaceous wetlands, vascular plants were sampled in 20 0.25 square meter quadrats located along a single transect, and a larger 0.2-ha plot was searched for additional species. In addition, along with a collaborator at the Illinois Natural History Survey, we compiled previously collected vegetation data from 146 natural reference wetlands surveyed as part of the INHS Critical Trends Assessment Program.

Results
The set of reference wetlands includes both forested and herbaceous wetlands that were randomly selected throughout Illinois and surveyed by INHS botanists between 1998 and 2013. Pairwise occurrence- and abundance-based dissimilarity metrics were calculated for the 146 natural wetlands and 38 compensation wetlands to investigate whether compensation wetlands

were more homogenous than natural wetlands. Contrary to our expectations, results indicated that compensation wetlands were not more homogenous than natural wetlands.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

Outcome #10

1. Outcome Measures

The Impact Of Climate Change On Agricultural Production

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The project will explore two main questions. First, it will examine through which mechanisms climate change affects agricultural production. The previous literature has focused on the effect of changes in average temperature and precipitation. In addition to these, the project will analyze the effect of increased weather variability, as well as changes in seasonal patterns, such as the timing of monsoon onset, as well as its intensity and duration. Second, the project will examine how agriculture can adapt to climate change. Specifically, it will analyze the extent to which farmers are already taking adaptive measures such as changes in crops and planting patterns, and whether investments in infrastructure, such as irrigation systems, can mitigate the effect of climate change on agricultural production.

What has been done
As a first step towards answering this question, the project will examine to what extent the effect

of climate change on conflict is a result of its negative effects on agricultural production. The previous literature has identified several possible mechanisms through which climate change might increase civil conflict, including non-agriculture related mechanisms such as psychological effects of warm weather and destruction of infrastructure. The project will systematically test to what extent the empirical evidence supports any of these proposed mechanisms. In addition, the project will examine whether investments in agriculture and rural economies, such as irrigation and rural antipoverty programs, can mitigate the effect of climate change on civil conflict.

Results
Changes in the seasonal pattern of precipitation [a move towards wetter wet seasons and drier dry seasons] is harmful for agriculture and exacerbates civil conflict in the Philippines. Our analysis shows that that this effect cannot be explained by psychological or infrastructure-related mechanisms, which suggests that agriculture is an important mechanism that mediates the effect of climate change on civil conflict.

In addition, we have generated new evidence that an increase in the value of export crops [such as bananas and sugar] can lead to an increase in conflict violence and territorial control by non-government armed groups. This suggests that a move towards export-oriented agriculture can have unintended adverse effects for fragile and conflict-affected states.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
132	Weather and Climate
133	Pollution Prevention and Mitigation
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

Outcome #11

1. Outcome Measures

Improved Control Of Overland Transport Of Pathogens

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soil and vegetation are two critical factors for controlling the overland transport kinetics of pathogens in a natural environment. With livestock operations moving more towards concentrated animal operations, the need to dispose of a very large amount of manure in a localized area is becoming increasingly important. Animal manure contains a substantial amount of microbial pathogens, including rotavirus, which may pose a threat of contamination of water resources. We examined the kinetics of rotavirus in overland transport, with an overall objective of optimizing the design of best management practices, especially vegetative filter strips.

What has been done
The overland transport of rotavirus was studied using three soil types [Catlin silt-loam, Darwin silty-clay, and Alvin fine sandy-loam] spanning the entire spectrum of typical Illinois soil textures. A twenty minute rainfall event was produced using a small-scale [1.07 ^ 0.66 meters] laboratory rainfall simulator over a soil box measuring [0.610 ^ 0.305 meters]. Each soil type was tested for rotavirus transport kinetics with bare surface conditions, as well as with Smooth Brome and Fescue vegetative covers. Surface runoff, near-surface runoff, soil cores, and vegetation were each analyzed for infective rotavirus particles using cell-culture infectivity assays.

Results
Results show that vegetation reduces the recovery of infective rotavirus particles in surface runoff by an average of 73% in addition to delaying the time to peak recovery. The vegetation, in general, appeared to decrease the recovery of infective rotavirus particles in surface runoff by impeding surface flow and increasing the potential for infiltration into the soil profile.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
133	Pollution Prevention and Mitigation
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

Outcome #12

1. Outcome Measures

Number Of Urban Youth Who Discovered The Value of A Forest

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	60

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Youth in urban areas have little or no experience regarding the value of a forest environment and as such are afraid of the forest. In addition, Illinois teachers are seeking assistance in ways they can provide instruction on the inquiry process [part of the science and engineering practices in the Next Generation Science Standards].

What has been done
In its fourth year, the Inquiry Adventures program continued to provide Cook County youth with a unique and academically-relevant outdoor education field trip experience at forest preserves near their schools. The program components encompassed training on the inquiry process for teachers and volunteers. Staff from each of seven schools, one community center, and forest preserves in Cook County participated in an hour-long pre-trip session at their school or center and a 4-hour field trip to a Cook County forest preserve.

Results
In 2013, evaluation of the youth experience was very informal and consisted of verbal surveying, observation, and jotting down comments [such as "It was very fun learning about nature and never have to be scared to go out in the forest"]. Pre- and post-trip data collected in 2014 were inconclusive, so surveys were shortened and revised using more age-appropriate language with a 4-5 point Likert scale. Data from 300 students at four different schools, ranging from 5th to 10th grade were collected and analyzed. The following five statements show the pre- and post-strongly agree and agree response and the percent differences: [1] 21% increase [68% pre- and 82% post-] An investigation helps me understand something better than just reading about it; [2] 18% increase [67% pre- and 79%-post-] I can design a procedure or investigation to answer a question; [3] 14% increase [56% pre- and 64%-post-] I would like to do more investigations; [4] 13% increase [59% pre- and 67% post-] It is still valuable when investigations don't turn out like I thought they would; and [5] 10% increase [68%] pre- and 75% post-] Things that I do can affect the environments and natural living things.

It should be noted that the responses obtained on the pre-survey were already rather positive [SA+A]> 50%]. The most striking results are those seen for students' confidence in their ability to design an investigation and the value of investigating something better just reading about it. Although not shown, students' ability to recognize questions that can or cannot be easily tested with a simple investigation also positively increased.

Approximately 60 urban youth indicated an increase in the value of an investigation and that things that they do can affect the environment and natural living things. Since only youth from four of the seven schools participated, it is likely that additional youth have increased their knowledge

and appreciation of urban forests.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In 2016 a total of 1,274 youth participated in the **I Think Green** program. A ten-question evaluation was completed by youth comprised of 1,020 who participated in the butterfly track and 254 in the insect track. Response tallies for the six questions that were identical for the groups follow.

Environmental Related Questions:

- 85% [1,083] of youth reported having more ideas about ways they could help care for the environment.

- 87% [1,108] reported being more excited about helping to care for the environment.

- 80% [1,006] reported that they would like to get involved in food composting, recycling, or other activities to help take care of the environment in their community.

Participation Related Questions:

- 98% [1,246] of youth reported that the **I Think Green** activities were fun to do.

- 93% [1,185] reported that they would like to do more activities like the ones in **I Think Green**.

- 80% [1,006] reported that they would like to help with a community garden project.

Responses from participants in the various tracks to an additional set of four questions follow.

Butterfly Track Specific Questions [n=1,020]

- 94% [959] of the youth in this track reported that they were encouraged to ask questions about butterflies and the environment.

- 98% [1206] reported that the activities helped them learn about butterflies and how they grow.

- 95% [969] reported that the activities help them to learn how butterflies interact with other living things.

- 92% [938] reported that the activities help them learn how butterflies contribute to the environment.

Insect Tract Specific Questions [n=254]

- 93% [236] reported that they were encouraged to ask questions about insects and the environment.

- 92% [234] reported that the activities helped them learn about insects and how they grow.

- 81% [206] reported that the activities helped them learn how insects interact with other living things.

All 24 teachers provided an overall program rating of 5, and all provided comments such as "fabulous, awesome, most valuable, amazing, and wonderful". 82% [208] reported that the activities helped them learn how insects contribute to the environment.

Key Items of Evaluation

Nearly all of the youth participants [98% and 93%] in **I Think Green** learned about how butterflies and insects grow, interact with other living things, and contribute to the environment. Although fewer youth reported changes in how they felt, ideas gained, and interest in how they could care for the environment, more than 80% of those responding

did report changes in one of the three questions related to the environment.

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Plant Health, Systems And Production

☑ 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	5%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		10%	
205	Plant Management Systems	20%		10%	
206	Basic Plant Biology	15%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	15%		10%	
212	Pathogens and Nematodes Affecting Plants	15%		20%	
213	Weeds Affecting Plants	15%		20%	
216	Integrated Pest Management Systems	15%		10%	
	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	0.0	0.0	10.0	0.0
Actual Paid	11.1	0.0	28.9	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**
316264	0	1200142	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
316264	0	1200142	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
2072720	0	11033549	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included ongoing support for the testing of waterhemp and Palmer amaranth plants for resistance to glyphosate and to herbicides that inhibit the enzyme protoporphytrinogen oxidase or PPO [information was then provided back to farmers to make site-specific weed management decisions], the identification of linkage of resistance to ALS inhibitors and to PPO inhibitors in waterhemp [this new knowledge will prove useful to future efforts of modeling the evolution of herbicide resistance], efforts to quantify and document the occurrence and distribution of herbicide-resistant weed populations in Illinois, work to define the most productive and efficient leaf area ideotype and set a breeding target for these traits, and the ongoing implementation of genomic selection to Illinois breeding programs [the advantages of genomic selection in maize breeding programs have been demonstrated, and it is expected that similar advantages will come into fruition for dedicated soybean genomic selection breeding programs].

Activities also included an evaluation of the impact of sustainable modern maize crop production practices, including fertilizers, fungicides, populations, tillage, and stover management, for maize plants grown for grain yield or high- biomass varieties for renewable bioenergy and biofuels, ongoing monitoring of seasonal and year-to-year patterns of pest abundance [regular insect collections from soybean and adjacent crop fields not only provide material to monitor established pest abundance and ecology, but can also be used to detect the local arrival of invasive species and to document significant changes in secondary pest abundance], continuing work to develop improved winter wheat varieties adapted to Illinois [development of disease-resistant, higher-yielding, high-quality, lodging-resistant varieties decreases the farmer's per unit cost of production by increasing the yield and quality without increased costs], research to identify pathogenesis proteins from major diseases of corn, soybean, and wheat [allowing us to make informed recommendations for the deployment of disease resistant varieties and chemical controls], and work to develop more reliable methods for managing bacterial spot on pumpkin or other cucurbit crops.

Activities also included ongoing research under the University of Illinois soybean breeding program to develop new experimental lines and test lines for yield, agronomic traits, and disease and pest resistance, work to determine the effect of root structure on biomass production and its partitioning in plants experiencing drought stress, work to attract more customers to the farm by helping growers identify rootstocks that will reduce tree height without compromising fruit quality [to give direct markets customers a better selection of fruits that are tree ripened and of superior quality], a long-term study and life-cycle assessment accounting for the inputs [fertilizer, compost, and pesticides], outputs [crop yield], and associated benefits [cultural and ecosystem services] of various soil management systems to provide critical scientific information about the feasibility of urban plant agriculture, work to expand the utility of pyroxasulfone by enhancing the tolerance of grain sorghum through both chemical [herbicide safener] and genetic [traditional breeding] methods, work to improve our ability to understand and manipulate flowering

time in grasses for breeding lines adapted to different growing areas and different end uses [grain, forage, or bioenergy], work to develop a rapid approach to discover new viruses in plant parasitic nematodes, the modification of Brassica phytochemical profiles to enhance human health promotion and plant defense against insects, and work to improve our understanding of the intrinsic structural, chemical, and biological changes in the corn kernel and soybean seed during storage and processing [leading to a general understanding of how to predict the nutritional value of corn and soybeans and new food processing techniques to increase bioavailability and stability of micronutrients in fortified foods].

Conference presentations included the Midwest Microbial Pathogenesis Conference, Molecular Genetics of Bacteria and Phages, Society of Nematologists, Ecological Society of America, Illinois AgMasters, Plant and Animal Genome Conference, Corn Breeding Research Meeting, Maize Genetics Conference, Tri-Societies Agronomy, American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, Fluid Fertilizer Forum, North Central Extension - Industry Soil Fertility, University of Illinois Agronomy Day, Livingston County Farm Bureau Agronomy Day, Entomological Society of America, Dow Agroscience, Soybean Breeders' Workshop, Seoul National University, Biennial Soybean Molecular and Cellular Biology Conference, Brazilian-International Congress of Genetics, Latino-American Conference on Genetics, Sorghum Improvement Conference of North America, Weed Science Society of America, North Central Weed Science Society, Joint National Plant Germplasm System Meeting, International Rice Research Institute, Workshop on Mechanisms Controlling Flower Development, and Soy2016: Molecular and Cellular Biology of the Soybean 16th Biennial Conference.

Extension activities focused on both food and non-food horticulture crops and pests. The **Ask Extension - Hort Corner** comprised of multiple topics, many of which are in Spanish, received 8,569,942 views during the past year. The site allows visitors to ask a question of a University of Illinois Extension educator or review the questions asked and answers received by previous visitors via an online web form. A series of twelve horticulture programs titled **Four Seasons Gardening** was offered via webinars at Extension offices throughout the state during the fall and spring with a total attendance of 789.

Extension Master Gardeners gave countless hours in providing horticulture information to the public. This past year, 470 new Master Gardeners completed training at various locations in the state [with 65 being trained via the online program]. In total, there were 2,816 active Master Gardeners in Illinois who made more than 164,000 direct teaching contacts and contributed 199,387 volunteer hours with an overall economic value of their contributions estimated to be over $5 million. More than half of these hours were devoted to teaching audiences how to grow gardens. Master Gardeners were also involved in making presentations, providing technical support and therapeutic assistance to individuals and facilities, and creating opportunities for children to learn about how to grow food and enjoy nature. Illinois-Indiana Sea Grant-led **Lawn to Lake** program joined with other organizations to promote natural, low-input, lawn care practices to reduce the use of lawn care chemicals and water.

An area of emphasis in 2016 was promoting pollinators -- development of gardens dedicated to bees, butterflies including Monarchs, and other pollinators and teaching others about how they can add pollinator gardens to their landscapes. **Pollinator Pocket Program** is a new statewide program designed to encourage gardeners to plan a space dedicated to pollinators in their yards as well as in common areas of subdivisions. The program involves a train-the-trainer element and a collaboration between 37 Master Gardeners and Master Naturalists who were taught how to teach others about pollinators. Pre- and post-tests revealed an increase in their knowledge about pollinators. The **Pollinator Pocket Program**, now with 110 registered gardens [including one in Missouri and one in Michigan], also features a website that includes four original landscape designs, brochures, and a speaker's bureau presentation for use by Master Gardeners and Master Naturalists. For additional information see: http://web.extension.illinois.edu/cfiv/pollinators/.

Using hands-on activities, 1,296 youth participated in the **Honey Bee Challenge.** 4-H teen members

taught youth about honey bee habitats, showed the important role honey bees have in agriculture and food production, showed the current threat to honeybee habitats, and explored ways to preserve these bee habitats.

The **University of Illinois Plant Clinic** provided service to the citizens of Illinois as a source of unbiased diagnosis of routine, unusual, and exotic plant problems and provided educational support to manage those pest issues. In 2016 the clinic handled a total of 3,478 diagnostic service contacts that included approximately 3,000 telephone inquiries, emails, and app requests, as well as 500 walk-in consultations. The Bacterial Leaf Streak was confirmed in Illinois, Iowa, Kansas, Colorado, Texas, and Nebraska. Plant Clinic personnel were invited to participate and present talks/seminars/training for numerous Extension programs including **Master Gardener Plant Disease and Diagnostic** T**raining Courses**, the statewide **Four Seasons Garden** webinar series, fruit and vegetable schools, crop protection management conferences, and trainings for the Illinois Department of Agriculture field inspectors.

Clinic staff also assisted with the six [6] **2016 Illinois First Detector** invasive pests statewide workshops conducted in conjunction with the Illinois Natural History Survey, the Illinois Department of Agriculture, and the Illinois Department of Natural Resources [also discussed in the evaluation section of this planned program]. In addition, 25 articles were prepared by staff for inclusion in one or more of the issues of the **Home Yard and Garden newsletter**. The **Plant Clinic** Facebook page is one of the top 10 most viewed University of Illinois Extension statewide social media accounts with 1,676 followers who are interested in breaking news regarding plant pests.

The Extension **Digital Diagnostic System** continued to provide outreach to homeowners and commercial producers in diagnosing and providing solutions for 249 samples of invasive and exotic species pests. The Extension **Pesticide Safety Education** training program reached 2,618 private [farmer] pesticide applicators and 9,788 commercial applicators this past year providing information on proper and safe use of pesticides that is vital to Illinois residents with respect to public health protection and environmental stewardship.

2. Brief description of the target audience

Members of the target audience included scientists in the fire blight research community and related enterobacterial areas, general microbiologists, apple growers, plant pathologists, educators, nematologists, plant pathologists, growers, crop consultants, members of the general public, policy makers at both the state and federal levels, the weed science community and practictioners of weed management, agronomic crop producers, agrichemical retail applicators, certified crop advisors, agronomic commodity organizations, professional weed science societies, agricultural media organizations, researchers working in the areas of soil ecology, microbial ecology, weed science, and agroecology, graduate students and postdocs engaged in plant breeding and related fields, corn and soybean farmers, the biofuel industry, producers growing wheat in Illinois and in the Midwestern United States and plant scientists working on disease resistance in wheat, cucurbit growers, the seed and chemical industries, breeders, Extension educators, community-based organizations [Advocates of Urban Agriculture, Growing Power, and Growing Home], and urban planners [City of Chicago Department of Housing and Economic Development].

Extension audiences included homeowners, Master Gardeners, green industry owners and employees [landscapers, nursery stock growers, lawn and garden business owners and employees, insurance adjusters, and arborists], and crop producers.

3. How was eXtension used?

Three Extension staff are members of the Consumer Horticulture or Invasive Species eXtension Communities of Practice.

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	33468	96045	25468	0

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

Patent Applications Submitted

Year: 2016

Actual: 4

Patents listed

TF13083[US] - Method And Process For Extraction, Quantification, And Characterization. TF14049-03[PRO] - A Snare-Like Protein And Biotin Are Implicated In Soybean Cyst Nematode Virulence. TF14049-04[US] - Methods For Measuring Virulence In Soybean Cyst Nematode. TF14127-03[US] - Copy Number Detection And Methods.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	65	65

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2016	9

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	More Informed User Of Pesticides
2	Improved Control Of Waterhemp
3	Development Of New Soybean Breeding Lines
4	Evaluating The Effectiveness Of Cover Crops In Reducing Disease Severity
5	Improved Resistance To Western Corn Rootworm
6	Development Of Improved Winter Wheat Varieties Adapted To Illinois
7	Documenting The Occurrence And Distribution Of Herbicide-Resistant Weed Populations In Illinois
8	Determining The Role Of Small RNA, Sigma Factors, And Protein Lysine Acetylation In Regulating Virulence Factors In E. Amylovora
9	Increased Knowledge To Detect Invasive Pests
10	Determining The Impact Of Root Structure On Biomass Production
11	Expanding The Utility Of Pyroxasulfone By Enhancing The Tolerance Of Grain Sorghum
12	Development Of A Rapid Approach To Discovering New Viruses In Plant Parasitic Nematodes
13	Number Of Individuals Increasing Knowledge Related To Detecting Invasive Pests
14	Number Of Acres Of Lawn Converted To Natural Lawn Care/Gallons Of Water Saved
15	Increased Knowledge Of The Importance Of Pollinators

Outcome #1

1. Outcome Measures

More Informed User Of Pesticides

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Improved Control Of Waterhemp

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Development Of New Soybean Breeding Lines

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The University of Illinois soybean breeding program developed new experimental lines and tested lines for yield, agronomic traits, and disease and pest resistance during 2016. The program grew almost 4,500 four-row yield test plots, over 7,900 two-row yield test plots, and over 11,000 plant row plots. These plots were planted in field locations that include the main South Farm on the University of Illinois campus, the Northwestern Illinois Agricultural Research and Demonstration Center near Monmouth, Illinois, and on land rented from farmers near Pontiac, Neoga, and Arthur, Illinois. The most advanced lines from the program were evaluated in regional tests in locations throughout soybean growing regions in the North Central and Eastern U.S. Data from these tests are being analyzed and selections will be made to decide what lines will be tested in

experiments planned for 2017. Those lines with the greatest yield and resistance over the past few years were selected and six new potential cultivars were released to a cooperating seed producer for increase and potential commercialization. All six are non-GMOs, and could be useful in filling the need for non-GMO soybean cultivars.

What has been done
About 25% of the breeding program is devoted to breeding with parents that have exotic ancestry to increase diversity for yield and other traits in the elite soybean genepool. The program makes crosses annually with parents released from Dr. Randy Nelson, a USDA-ARS breeder, who has developed high-yielding germplasm with exotic ancestry. Experimental lines with this exotic ancestry are being developed and tested by the breeding program.

The program is continuing to develop new experimental lines with resistance to soybean aphid. Using genetic markers during 2016, the breeding program tested 2,043 plants for having the combination of both Rag1 and Rag2 [Rag1+Rag2] and 319 plants with this combination were selected. In addition, 646 lines were tested for the combination of Rag1+Rag2+Rag3 and 40 plants were selected that have all three genes. Lines homozygous for the Rag genes that were selected in previous years were evaluated in the University of Illinois advanced yield tests which included 11 experimental lines with Rag1, 22 with Rag2, 40 with Rag1+2, and four with Rag1+Rag2+Rag3. In the 2016 uniform tests, the University of Illinois program submitted three lines with Rag1, seven with Rag2, and seven with Rag1+2. Some of these lines included the Roundup Ready gene, but most were non-GMOs. Three lines with Rag2 and one with Rag1 have already been commercialized and seed is being increased in 2016 for one new line with Rag1+Rag2 and a second line with Rag2.

Results
A new focus of the breeding program is the development of new cultivars with high levels of oleic acid [80%] and low levels of linolenic acid [<3%]. Soybean oil with this fatty acid modification has greater stability and therefore has greater value than normal soybean oil. Four mutated genes need to be combined in soybean lines for this quality to occur and a germplasm line with these four mutations was obtained from the USDA-ARS and from the University of Missouri. We are now developing experimental lines with this four gene combination. Marker-assisted selection is being done to identify plants with this quality and over 4,100 plants were tested with markers to identify plants with all four genes. During the summer of 2016, 642 experimental lines with the high oleic/low linolenic combination were tested in the field and approximately 150 lines were selected based on agronomic traits.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

Outcome #4

1. Outcome Measures

Evaluating The Effectiveness Of Cover Crops In Reducing Disease Severity

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Improved Resistance To Western Corn Rootworm

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Regular soybean pest monitoring activities were conducted in July and August in Urbana, Illinois soybean fields using 0.38 meters diameter sweep nets. Pest beetles were identified and western corn rootworm beetles saved for dissection and other analyses of feeding and reproductive development. Pest presence and abundance patterns were analyzed and used to compare patterns of pest activity within the season and between years as part of long-term data collection. Annual rotation of soybean with corn is a fundamental IPM tactic used manage field crop insect pests - especially the western corn rootworm, a corn pest that is now adapted to use soybean to avoid management via crop rotation. Soybean fields are principal locations for the monitoring and/or management of key corn pests like the crop rotation-resistant western corn rootworm [WCR]. Growers also face other pests that use soybean and corn, like Japanese beetles [JB], as well as specific soybean pests and beneficial insects, such as ladybird beetles that will be affected by foliar insecticide applications that are intended to target WCR, JB, or soybean insects [such as bean leaf beetles [BLB], stink bugs, soybean aphid, and ladybird beetles [LBB]]. Movement is very important to WCR and JB pest severity.

What has been done
Annual soybean pest/insect abundance monitoring has been conducted in soybean fields since 1998. The 2016 WCR abundance per sweep rebounded by almost three times compared to 2015

[which was lower than any year in recent memory]. Mean WCR abundance in soybean was still very low [0.016 ± 0.003 WCR/sweep ± SEM]; in 2014 the peak collection rate was 0.33 WCR/sweep. Peak monthly WCR abundance in soybean occurred during August, as it has every year except 1998 when it occurred in June. A total of just 52 beetles were collected in a total of 3,300 sweeps. This pales in comparison to 2005-2006 collection rates in Champaign County [0.73 beetles per sweep] and given the over 1.5 WCR per sweep in 2004, the current abundance is incredibly low. Such low abundance makes it difficult to justify use of corn rootworm Bt hybrids in rotated corn. The return to more normal conditions may have helped JB rebound by a factor of ca. two times, however BLB stayed around 2015 abundance.

Only 42 JB and 301 BLB were collected [0.013 ± 0.003 JB/sweep and 0.091 ± 0.006 BLB/sweep]. One insect that has a great potential to justify soybean treatment with insecticide is the soybean aphid; it was not a problem in 2016. However, it is apparent that many corn and soybean fields were still sprayed with insecticide as "cheap insurance" - particularly around the time of corn pollination. Excessive use of foliar insecticides for dubious insurance reasons may be keeping some of the familiar soybean pests at low abundance and reducing the number of individuals that are measured on adjacent/nearby University of Illinois field plots.

Results

Besides the slow rebound from serious soil saturation in 2015, high rates of Bt corn adoption are also likely reducing the background abundance of WCR. A survey of local cornfields found that all but 1 of 24 fields were planted with a pyramided Bt hybrid expressing Cry3Bb1 and Cry34/35Ab1 toxins. In spite of historically low populations of WCR in 2015 and evidence for local development of Bt resistance to single-traited hybrids expressing Cry3Bb1, growers still insist on using a take no prisoners approach to corn [and soybean] pest management. They feel justified, and fortunately pyramided hybrids still provide excellent WCR management. The use of these products when WCR populations are low is not "good" IPM [unnecessary/unjustified use of a management when the pest present at much less than the economic threshold] since it selects for resistance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #6

1. Outcome Measures

Development Of Improved Winter Wheat Varieties Adapted To Illinois

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Documenting The Occurrence And Distribution Of Herbicide-Resistant Weed Populations In Illinois

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Determining The Role Of Small RNA, Sigma Factors, And Protein Lysine Acetylation In Regulating Virulence Factors In E. Amylovora

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Increased Knowledge To Detect Invasive Pests

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Determining The Impact Of Root Structure On Biomass Production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

To further investigate the impact of root system architecture on plant performance we continued evaluating the diversity of primary root characteristics of the AMES maize inbred panel. This panel consists of all publically available maize inbreds [N > 2,800 inbreds]. Also, genotypic information is available for this set of inbreds allowing us to locate genomic regions carrying genes involved in root architectural traits important for stress tolerance. In a second experiment, we evaluated six hybrids with diverse root systems under high population density stress in a replicated field experiment. The focus of this experiment was the collection of plant growth characteristics for populating crop growth models.

What has been done
We continued the root evaluation of the AMES panel. By the end of the project year, a total of 500 inbred lines were phenotyped. As part of an undergraduate research project, the phenotyping was conducted by University of Illinois Crop Science student Alexander Contorno.

Using the data collected in 2015 and 2016, a GWAS analysis was performed on seven traits: Primary root length [PRL], secondary root length [SRL], secondary root number [SRN], kernel length [KLG], kernel width [KWD], kernel depth [KDP], and kernel weight [KWT]. Correlation coefficients were calculated between kernel and root traits to test for a relationship between both trait groups. In this subset of the AMES panel, we did not detect a significant effect of kernel size on root traits. Therefore, using kernel traits as covariates in the analysis of root characteristics was not necessary. The standard trait-by-trait genome-wide association study [GWAS] failed to identify significant SNPs at a 0.1 false discovery rate [FDR]. Alternatively, we extracted principal components [PCs] from the correlation matrix of the seven phenotypic traits and subsequently conducted a GWAS on the PCs with eigenvalues greater than one. These PCs were highly correlated with clusters of traits and were identifiable as a kernel [minus kernel depth] PC, a root PC, a remainder of the standardized variation in kernel traits PC, and a root complexity PC. The GWAS analysis found one SNP on Chromosome 1 at position 295,761,270 which was significant at an FDR of 0.1. Linkage disequilibrium [LD] decayed rapidly at this chromosomal position. Other promising regions in the genome are still under investigation. Applying a multi-locus mixed model [MLMM] confirmed the GWAS results.

Results
Even though all root traits showed moderately high heritabilities, neither GWAS nor MLMM could identify significant SNPs. Furthermore, genomic selection analyses indicated that PRL and SRL displayed prediction accuracies of 41% and 52%, respectively. In contrast, SRN showed a low prediction accuracy of 19.6%. These results indicate that meaningful genetic gains could be made for PRL and SRL, although probably not for SRN. Taking all of this information into account, it is most likely that PRL and SRL are highly complex traits controlled by many genes of small effect size. This would account for the high heritabilities observed for these traits and the relatively high prediction accuracies. Also, it would explain why no significant SNPs were identified using GWAS. If many genes of small effect are involved, then numerous taxa would have to be examined to have enough statistical power to detect significant markers near those causal SNPs. Genomic selection, not GWAS based marker-assisted selection, is the most efficient means of improving root complexity considering the labor involved in measuring root traits, even at early developmental stages.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
201	Plant Genome, Genetics, and Genetic Mechanisms

205 Plant Management Systems
206 Basic Plant Biology

Outcome #11

1. Outcome Measures

Expanding The Utility Of Pyroxasulfone By Enhancing The Tolerance Of Grain Sorghum

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Herbicide safeners are non-phytotoxic compounds that confer protection to cereal crops by inducing detoxification and defense systems, including massive increases in the expression and activity of glutathione S-transferases [GSTs] and cytochrome P450 enzymes, although the precise mechanisms for crop protection via induction of defense gene expression remain largely unknown. Safeners are frequently used with herbicides that normally cause injury in unsafened grain sorghum [Sorghum bicolor], and are typically applied as seed treatments to avoid safening weedy sorghum relatives such as johnsongrass [Sorghum halepense]. Preemergence herbicide x safener combinations were evaluated for their ability to selectively increase weed control in grain sorghum in the greenhouse and under field conditions.

What has been done
Greenhouse studies identified fluxofenim [Concep III] as the most effective safener to protect sorghum seedlings from the herbicide pyroxasulfone [Zidua] applied preemergence. Treatments with fluxofenim applied as a seed treatment resulted in significantly more growth of shoot and root tissues when pyroxasulfone was applied preemergence compared with pyroxasulfone applied alone. Using these greenhouse results, field studies were designed and conducted during the summer of 2016 to evaluate the effectiveness of pyroxasulfone for weed control under field conditions as well as to determine its effect on grain yield with or without fluxofenim seed treatment. Results indicated that pyroxasulfone enhanced grass and dicot weed control [relative to smetolachlor, a standard preemergence herbicide used in grain sorghum] but caused significant crop injury at the two highest rates examined and application timings [preemergence and early postemergence], even with the safener fluxofenim. However, significant effects on grain yield were not detected.

Results
Using a genome-wide association study [GWAS], 800 diverse sorghum lines were evaluated for phenotypic differences in herbicide tolerance, and the expression of important candidate genes identified via GWAS was investigated further via RTpPCR. Greenhouse studies were conducted with preemergence pyroxasulfone and s-metolachlor, plus or minus the safener fluxofenim as a seed treatment, to determine phenotypes for natural herbicide tolerance and safener-induced responses. Data analysis revealed that the molecular marker most significantly associated with safener-induced response was located on sorghum chromosome 9, where a single-nucleotide polymorphism was detected within a phi-class SbGST gene [as well as about 15 kb from a different phi-class SbGST gene]. Transcript levels of these two candidate SbGSTs were quantified in etiolated shoot tissues by utilizing RT-qPCR and gene-specific primers designed from each SbGST coding region.

Basal and safener-induced expression of the SbGSTs was examined in three sorghum genotypes from 4 to 12 HAT to quantify safener induction of these GSTs relative to three stably-expressed reference genes. Results indicated that expression of each SbGST gene increased within twelve hours following safener treatment but differed by specific gene and genotype, suggesting that these SbGSTs may play a functional role in the safening response from herbicides. Future experiments will aim to identify signaling and/or metabolic genes that may also play a role in safener induction of herbicide detoxification pathways. Identifying effective herbicide x safener combinations is an ongoing challenge that limits grain sorghum production in the U.S., but understanding the basis of safener-induced detoxification responses through conducting this research will facilitate the discovery of new crop protection chemicals to enhance herbicide tolerance in cereal crops, as well as assisting in developing marker-based assays to screen and identify sorghum lines with an increased safener response.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems
206	Basic Plant Biology
213	Weeds Affecting Plants

Outcome #12

1. Outcome Measures

Development Of A Rapid Approach To Discovering New Viruses In Plant Parasitic Nematodes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The initial goal was to develop a rapid approach to discovering new viruses in plant parasitic nematodes. A method was developed to physically disrupt nematodes and then recover viral particles on a small scale. The ability to work with small volumes was critical since it is often hard to obtain large numbers of plant parasitic nematodes. We were able to obtain 21 different isolates of root-knot nematode and then applied the viral isolation method to the samples. Using a multiplex strategy, we were able to obtain over 150 million DNA sequences from the pooled nematode samples. The sequences were analyzed by comparing them to a database containing known viral proteins. The initial results showed very significant matches to seven viruses. This project has been very successful and shows that viruses can be detected in pooled nematode samples using a fairly simple technique. This approach to virus discovery could be applied to any nematode population either in the laboratory or in the field.

What has been done
Recently 20 field populations of the soybean cyst nematode [SCN] were tested over multiple generations for the presence and dynamics of five viruses. It was found that high initial levels of viruses predicted lower virus titers in the next nematode generation. This result suggests that high levels of nematode viruses are killing the nematodes and thus the virus population drops along with the SCN population in the proceeding generation. These types of cyclical population increases and decreases are common in predator-prey dynamics and suggests nematode viruses harm nematodes in the population.

Monitoring of SCN populations in the field from Spring to Fall also showed some populations, isolated in a particular geographical region, that experienced population declines when grown on susceptible soybean. Since this is the opposite of what one would expect and the fact that these populations had SCN viruses, it suggests that a biological agent could be causing wide spread damage to SCN populations in the field. Fourteen of these collapsing SCN populations from the field were grown and the RNA was extracted from the nematodes. The RNA was converted to cDNA and then sequenced using an Illumina sequencer. The resulting 400 million cDNA sequence reads were analyzed for potential nematode pathogenic agents via BLAST and MEGAN analysis. The analysis identified all five known SCN viruses and a new SCN virus. The other microorganisms identified in the MEGAN analysis did not appear to be known nematode pathogens, so the viruses could be the main pathogenic agent that was causing the population decline.

Results
Nematode viruses have only been recently discovered, thus this approach has the potential to rapidly identify new viral species. The study of nematode viruses could be very important for understanding their impact on soil ecology, but also for controlling damaging plant nematode species. Viruses have never been used to kill parasitic nematode, thus it is well worth the effort to identify new virus species and then test them for their ability to kill plant nematodes. If successful, this approach may generate a sustainable method to manage plant parasitic nematodes in Illinois

and throught the world. A viral-based plant nematode control method could reduce or eliminate devastating nematode diseases of soybean, corn, and other important crop plants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems

Outcome #13

1. Outcome Measures

Number Of Individuals Increasing Knowledge Related To Detecting Invasive Pests

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	142

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Emerging pathogens and insects can cause serious damage and loss to Illinois trees and native plants if not detected early resulting in economic and environmental consequences related to treatment or replacement.

What has been done
One-day First Detector programs were conducted at six [6] locations in Illinois and focused on training tree care professionals, Master Gardeners, Master Naturalists, arborists, foresters, landscapers, garden center owners and employees, and conservationists. Goals of the program were to: [1] Increase participants awareness of current and emerging invasive plants, pathogens & insects; [2] Reduce potential risks from pathogens and pests; and [3] Increase rapid and affordable plant diagnostic support for local, state, and national agriculture and green industry programs and for end-users. Topics included roles and responsibilities, safeguarding and

regulation, and invasive pest pathways that included Boxwood Blight, Gypsy Moth, and Spotted Lanternfly. Extension specialists delivered course elements for pests that included the following areas of knowledge: identification, life cycle/biology, hosts, sampling, management, and regulation. Following the training, 142 of the 197 participants completed an evaluation that asked them to compare their degree of understanding of these topics before and after the training sessions using a 5-part scale [1 = Very little, 5 = A lot].

Results
With respect to knowledge gained, information on Jumping Worms was by far the topic that revealed the highest degree of understanding for 140 participants who completed the evaluation. All average scores regarding Jumping Worms ranged from 3.89 to 4.41 after the training as compared to 1.55 and below before the training. All of the respondents also indicated a change in knowledge regarding the Illinois Exotic Weed Act topic. Regarding Insect Pests, comparison of group ratings of degree of knowledge gained revealed a 75% increase 137 of 142 [96.5%] of the respondents.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants

Outcome #14

1. Outcome Measures

Number Of Acres Of Lawn Converted To Natural Lawn Care/Gallons Of Water Saved

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1000000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Predicted population growth in Northeastern Illinois could create water shortages as demand outpaces supply. The average American family uses 310 gallons of water per day, about 30 percent of which is devoted to outdoor uses. More than half of that outdoor use is wasted due to inefficient watering. Natural lawn care practices can reduce the need for lawn irrigation by up to 50 percent.

What has been done
The Illinois-Indiana Sea Grant [IISG]-led Lawn to Lake program joined with organizations across the region to promote natural and low-input lawn care practices to reduce the use of lawn care chemicals and water. Through workshops, displays, and educational materials, landscape professionals, homeowners, teachers, school groundskeepers, and master gardeners learned about natural lawn care. IISG also helped inform the Northwest Water Planning Alliance [NWPA] with outreach efforts on water conservation in the region.

Results
Between 2011 and 2015, the Lawn to Lake program reached over 300 lawn care professionals, 400 Master Gardeners, and 2,000 homeowners with training and information on natural lawn care. Surveys revealed that 25,000 lawn acres and were converted to natural lawn care, which led to a water savings of one billion gallons every year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems

Outcome #15

1. Outcome Measures

Increased Knowledge Of The Importance Of Pollinators

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1260

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There is a serious threat to our world's foods production. Nearly one in three bites of food we eat is the result of pollinators, including honey bees that account for 80 percent of all insect pollination.

What has been done
Sponsored by Monsanto and the National 4-H Council, 1,296 youth participated in the Honey Bee Challenge in April of 2016. Using hands-on activities, 4-H teen members taught youth about honey bee habitats, showed the important role honey bees have in agriculture and food production, showed the current threat to honeybee habitats, and explored ways to preserve these bee habitats. The program was conducted at two statewide events as well as in ten Southern Illinois counties.

In addition, the Master Gardeners identified an area of emphasis in 2016 focused on promoting pollinators. The Pollinator Pocket program is a new statewide program that encourages individuals to develop gardens dedicated to bees, butterflies including Monarchs, and other pollinators and to add pollinator gardens to their landscapes.

Results
At the end of the activities, the youth participants completed a short evaluation. The youth answered five questions that captured their opinion of the Honey Bee Challenge. With three response options of "Yes", "Kind of", and "No", 2,000 [93%] of the youth think it was important to work in a group to accomplish the tasks of the activity. Ninety-three percent who checked "Yes" or "Kind of" [1,193] had to use communication skills with their team in order to accomplish the Challenge. Ninety-eight percent [1,260] reported they were more interested in science and agriculture after participating in the challenge. Sixty-eight percent [876] were more interested in science and agriculture. Eight-seven percent [1,113] reported have a better understanding of how to design and create an object to solve a problem after participating in the Honey Bee Challenge.

Thirty-seven Master Gardeners and Master Naturalists who were taught how to teach others about pollinators completed pre- and post-tests that revealed an increase in their knowledge about pollinators. One hundred ten gardens have registered as pollinator gardens.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

An evaluation was distributed and collected from 142 participants in the six one-day **First Detector** programs. The evaluation asked them to compare their degree of understanding of various topics related to regulation of pests [diseases, insects and other invasive species] before and after the training sessions using a 1 to 5 scale [1 = Very little, 5 = A lot]. The topics covered the following areas of knowledge; identification/detection, life cycle/biology, hosts, sampling, management, and regulation.

With respect to knowledge related to the **Illinois Weed Act**, all of the 143 evaluation respondents increased their degree of understanding regarding at least one of the knowledge areas. Based on an average group rating score on each topic before and after the training, a comparison of the scores revealed that the topic that generated the greatest change in knowledge [189%] was the "biology" of **Jumping Worms** followed by "identification".

Respondent changes in knowledge of **Invasive Insects** "identification" and "symptoms" were 83.4% and 77.9% respectively. It is worth noting that all average scores regarding these topics were above 3.89 after the training as compared to 1.39 and below before the training.

When reviewing the knowledge areas for **Invasive Plant Diseases**, the before training average group scores for topics related to the TCD/Boxwood Blight pests ranged from 2.39-2.58 and after training scores ranged from 4.12-4.23. All but one respondent increased their degree of understanding in at least one of the **Invasive Plant Disease** knowledge areas.

Regarding **Regulation** of invasive pests, comparison of group ratings of degree of knowledge revealed a 65.7% increase by 138 of 142 the respondents. When asked to indicate the number of people they encounter involved in tree care, as many as 34,950 people might be reached by these trained first detectors.

Evaluations were completed by 1,296 youth after participating in the **Honey Bee Challenge** and learning about honey bee habitats, the current threat and ways to preserve the habitats, and the importance of the role of honey bees and their role in agriculture and food production.

The first five questions required a response of "Yes", "Kind of" or "No" and are listed in the order of highest to lowest of the combination of "Yes" or "Kind of" responses.

- 1,260 [98%] think honey bees are a good way to increase food production for our world to have more food.

- 1,201 [93%] think it was important to work in a group to accomplish the task during the Honey Bee Challenge.

- 1,193 [93%] had to use communication skills with their team in order to accomplish the Challenge.

- 1,113 [87%] reported having a better understanding of how to design and created an object to solve a problem.

- 876 [68%] were more interested in science and agriculture after participating.

A second set of questions used a 4-part scale to respond with selecting "Strongly agree", "Agree", "Disagree", or "Strongly disagree" to the following:

- 1,091 strongly agreed or agreed that science is useful for solving everyday problems.
- 965 strongly agreed or agreed that they liked science.
- 953 strongly agreed or agreed that they plan to work on projects that better their community.
- 905 strongly agreed or agreed that they are good at science.
- 830 strongly agreed or agreed that they think science will be important in their future job.
- 608 strongly agreed or agreed that they would like to have a job related to science.

Key Items of Evaluation

All 142 First Detector training evaluation respondents increased their knowledge related to invasive plant pests. Participants perceived knowledge regarding **Jumping Worms** increased by more than 175% and by more than 80% for invasive insects and the Illinois Exotic Weed Act. Average scores for management of invasive insects and invasive plants increased by 57%. Knowledge of regulations of invasive pests increased by two-thirds. The potential for sharing the knowledge they gained by people they encounter involved in tree care numbered nearly 35,000. Forty-two participants who attended the First Detector training last year responded when asked to share specific examples of actions they took which included sharing information with others and removing exotic plants.

Ninety-eight percent [1,260] of the youth participants think honey bees are a good way to increase food production for our world to have more food and 93% think it was important to work in a group to accomplish the **Honey Bee Challenge** as well as using communication skills with their team in order to accomplish the Challenge.

V(A). Planned Program (Summary)

Program # 9

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
133	Pollution Prevention and Mitigation	5%		15%	
136	Conservation of Biological Diversity	5%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		10%	
206	Basic Plant Biology	35%		10%	
402	Engineering Systems and Equipment	35%		20%	
601	Economics of Agricultural Production and Farm Management	5%		10%	
603	Market Economics	0%		10%	
606	International Trade and Development Economics	0%		5%	
610	Domestic Policy Analysis	0%		10%	
801	Individual and Family Resource Management	5%		0%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	5%		0%	
806	Youth Development	5%		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	0.0	0.0	3.0	0.0
Actual Paid	0.8	0.0	13.1	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**
21811	0	390603	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
21811	0	390603	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
142946	0	2489830	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included an investigation into the technical and economic potential for sugarcane ethanol production in Brazil and its land use implications, an examination of optimal biofuel policy and the effectiveness of alternative policies in promoting cost-reducing innovations in the biofuel sector under alternative assumptions about market and technological conditions in the oil sector, an examination of the impact of riskiness of energy crops compared to conventional crops and its implications for crop, contract, and location choices for refineries, work to identify and develop high-yielding dedicated energy crops for various land types to meet the national goal for sustainable bioenergy production using perennial grasses, the application of systems thinking to combine deconstruction, hydrolysis, and microbiology to develop an efficient, cost-effective system for converting biomass into biofuels, the utilization of mycotoxin contaminated for non-food fermentation based applications for the production of value added chemicals, and the development of a genetic modification system for the solventogenic clostridia [which has important implications for future development of strains that can produce renewable chemicals].

Activities also included efforts to develop biomass crop species that can be grown in specific and challenging environments, work to improve the utilization of water and energy and the recovery of nutrients and to develop higher values for coproduct solids in process streams during bioprocessing, efforts to identify and promote the most effective management for M. x giganteus, switchgrass, and other perennial grasses for bioenergy production, research seeking to better understand genes and their expression for traits important to both economic and environmental sustainability in crop systems, a field experiment evaluating how biofuel crops impact animal movement and landscape connectivity, the evaluation of black locust [Robinia pseudoacacia] germplasm sources for short rotation woody plant production of bioenergy, the breeding of Miscanthus cultivars with improved winterhardiness and high yield potential in the central and northern Midwest, the development of near-infrared [NIR] spectroscopy as an inexpensive and high-throughput method for evaluating quality characteristics of Miscanthus genotypes, and work designed to quantify the contribution of nitrogen-fixing bacteria to Miscanthus plant nitrogen and to identify plant and microbial traits and environmental factors that influence diazotroph colonization and activity [understanding the factors that influence plant-microbe mutualisms will allow for the optimization of associative nitrogen fixation in perennial grasses, enhancing the sustainability of these bioenergy crops].

Conference presentations included the National Center for Science Education, International Food Security Initiative, Illinois Agricultural Leadership Program, Federal Aviation Authority Workshop, Advanced Bioeconomy Leadership Conference, Eighth Berkeley Bioeconomy Conference, Advanced Bioeconomy Feedstocks Conference, International Conference of Agricultural Economists, Institute for Energy, Environment, and Sustainability Congress, Latin American Environmental and Energy Economics Workshop, Conference on Food and Energy, Corn Utilization and Technology Conference, AIChE Annual

Meeting, International Plant and Animal Genome XXIV Conference, 101st Annual Meeting of the Ecological Society of America, and the 8th Annual International Symposium on Biomathematics and Ecology.

Extension Educators interacted directly with approximately 400 of the attendees at the **Southern Illinois Sustainable Living Expo** held at the University of Illinois College of Agricultural, Consumer, and Environmental Sciences Dixon Springs Research Center and provided displays on biomass, solar, energy efficiency, and radon. Presentations on energy efficiency were also delivered in the energy tent.

An Extension educator took the lead and confirmed speakers for three biomass track breakout sessions that attracted 45 people per session for the **Illinois Renewable Energy Conference** held in the central section of the state. This same field staff member developed a display for the **Northern Illinois Renewable Energy Summit and Expo**.

The **Illinois Energy Education Council**, a cooperative effort of University of Illinois Extension and the investor-owned electric utilities, rural electric cooperatives, and municipal power suppliers, continued to promote their website as a source of information to increase energy efficiency through presentations, videos, games, and links. The council has provided support for a grant that will provide smart grid and peak and non-peak energy purchase pricing for primarily underserved clientele and improve electrical grid use to help those consumers reduce power consumption and costs. Extension Consumer and Family Economics Educators developed and delivered the **Cut Electricity Costs** presentations to various groups this past year. Enrollment in the **4-H Wind Energy** project provided an opportunity for 851 youth to learn about an alternative energy source.

Extension's work with the Illinois Department of Transportation [IDOT] in implementing a three-year roadside biomass utilization project experienced a hiatus connected with the lack of passage of a state budget. State funds have recently been released/provided and interaction with IDOT will now focus on cost reductions related to mowing bio-energy grasses and using bioenergy grasses in heating IDOT buildings that are located across the state.

2. Brief description of the target audience

Extension targeted crop producers, landowners [including forestry owners and managers], public officials, agency employees, electricity providers, individuals and families who wish to reduce energy consumption and expenses, and youth.

Members of the target audience also included plant scientists, policy makers, corn and soybean producers and their advisers, academic audiences, students, conservation biologists, local conservation groups, crop consultants, farm input suppliers, regional and national agriculture industries, local, state, and national governmental agencies, fuel ethanol production facilities, researchers working on improving the efficiency of fuel ethanol production, participants from the corn wet milling and corn dry grind industries, participants from the corn processing, biofuels, and allied industries, participants from the enzyme bioindustry, and researchers working in the areas of soil ecology, microbial ecology, plant-microbe interactions, and sustainability.

3. How was eXtension used?

One Extension faculty is a member of the Sustainable Agriculture Energy or Wood Energy eXtension Communities of Practice**.**

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2426	1776	550	0

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

Patent Applications Submitted

Year:	2016
Actual:	5

Patents listed

TF07061[DIV] - Methods And Compositions For Removing Solvents. TF14184-01[PRO] - High Purity Xylooligosaccharides Produced From Autohydrolyzed Miscanthus X Giganteus. TF15008-01[PRO] - Efficient And Precise Genome Editing And Gene Transcription Repression In Clostridium Using CRISPR/CAS9 System. TF07061[US] - Methods And Compositions For Producing Solvents [Issued Patent]. TF12043[US] - Prairie Cordgrass [Spartina Pectinata] Cultivar "Savoy" For Bioenergy Feedstock Production [Issued Patent].

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	36	36

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2016	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number Of Program Participants Increasing Knowledge Of Bio-Energy Production/Harvesting/Storage Systems
2	Identifying And Developing High-Yielding Dedicated Energy Crops For Various Land Types
3	Rapid Determination Of Biomass Composition Of Miscanthus Genotypes
4	Determination Of How Wildlife Communities Will Respond To Plantings Of Exotic Miscanthus
5	Number Of Individuals Indicating Practice Changes To Reduce Energy Use And Cost
6	Reducing Evaporator Fouling During Ethanol Production To Lower Cost And Reduce Environmental Impact
7	Evaluating Changes In Cropping Systems And The Impact Of Tillage
8	Improved Understanding Of The Economic Risks And Benefits Of Biofuel Production

Outcome #1

1. Outcome Measures

Number Of Program Participants Increasing Knowledge Of Bio-Energy Production/Harvesting/Storage Systems

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	400

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Energy sustainability is a concern of consumers as well as environmentalists and scientists who are seeking identifiable and cost-effective renewable energy sources.

What has been done
Extension educators interacted directly with approximately 400 attendees at the Southern Illinois Sustainable Living Expo held at the University of Illinois College of Agricultural, Consumer, and Environmental Sciences Dixon Springs Research Center and provided displays on biomass, solar, energy efficiency, and radon. Presentations on energy efficiency were also delivered in the energy tent.

Results
Approximately 400 individuals increased their awareness regarding sources of efficient energy.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
801	Individual and Family Resource Management
806	Youth Development

Outcome #2

1. Outcome Measures

Identifying And Developing High-Yielding Dedicated Energy Crops For Various Land Types

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Our objective in this research is to quantify the contribution of nitrogen-fixing bacteria to Miscanthus plant nitrogen, and to identify plant and microbial traits and environmental factors that influence diazotroph colonization and activity. Understanding factors that influence plant-microbe mutualisms will allow for the optimization of associative nitrogen fixation in perennial grasses, and thereby enhance the sustainability of these bioenergy crops. We hypothesize that the efficiency of plant-microbe mutualisms will vary as a function of microbial community structure and environmental conditions. We further hypothesize that the efficiency of such mutualisms vary among plant species or genotypes.

Nitrogen efficiency is important for the sustainability of crops, and is especially critical for biofuel feedstocks. Improving our understanding of the biological mechanisms governing beneficial associations between gramineous bioenergy crops and nitrogen-fixing bacteria has the potential to enhance the sustainability of biofuel feedstocks. We are currently in the early stages of breeding perennial grasses for use as bioenergy feedstocks, making this a key time to evaluate the sustainability and nitrogen efficiency of these crops. There is relatively little information on how plant genetic variation affects diazotroph associations and natural nitrogen fixation. However, our preliminary data indicates that plant genetics play an important role. Thus, the results of this study are expected to facilitate efforts to breed Miscanthus for improved efficiency of plant-microbe interactions.

What has been done
Microbial communities residing in the rhizosphere and endophytic compartment of native Miscanthus in Taiwan were assessed using both automated ribosomal intergenic spacer analysis and Illumina MiSeq sequencing. Plant compartment is the primary factor that shapes the associated bacterial communities. The majority of endophytic bacterial taxa appeared to originate from the rhizosphere soil. However, distinct bacterial assemblages were observed in the

endophytic compartments and rhizosphere soil of Miscanthus, suggesting that plants regulate their endophytic community composition. A number of bacteria taxa specifically enriched in either the rhizosphere or the plant endophytic compartment were observed and identified in this study. Local environmental factors and plant phylogenetic distances showed strong correlations with microbial community composition in both compartments. Additionally, we found that Miscanthus plants under stressful environmental conditions have different endophytic recruiting strategies.

Results
We investigated and compared the core microbiome associated with Miscanthus sinensis, a C4 perennial grass, in the plant's native [Eastern Asia] and naturalized habitats [Eastern United States]. Using Illumina sequencing targeting the bacterial 16S rRNA gene, we observed a large number of bacterial taxa shared between the native and the naturalized habitats. 20% - 30% of plant-associated bacteria were specifically enriched in the plant endophytic compartment or rhizosphere soil in both habitats. These microbes were identified as the core microbiome associated with M. sinensis. We also found that although similar bacterial members were found in both habitats, the co-occurrence patterns were distinct between habitats.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
136	Conservation of Biological Diversity
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

Outcome #3

1. Outcome Measures

Rapid Determination Of Biomass Composition Of Miscanthus Genotypes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Government mandates for renewable energy and reduction of greenhouse gas emissions for fossil fuel-fired power plants have created an increasing and largely unmet need for regionally-adapted, high-yielding cultivars of bioenergy crops, especially in the industrial Midwest. Miscanthus is among the most promising bioenergy crops identified to date. Biomass yields of Miscanthus are relatively high, having the potential to exceed those of maize and switchgrass in the Midwestern U.S. In addition, this crop exhibits remarkable sustainability via perennial growth, efficient nutrient recycling, and belowground carbon sequestration.

What has been done

There are three major constraints to the development of Miscanthus-based bioenergy production in the Midwest: [1] Only a single sterile triploid genotype is currently available for feedstock production, which is a serious potential risk because a new disease or pest could conceivably destroy all plantings; [2] Though the currently-available genotype has excellent yield potential, it is insufficiently winter-hardy for new plantings to consistently establish well in USDA hardiness zone 6 and lower; and [3] Our ability to select genotypes with the best quality characteristics [proportion of glucan, xylan, lignin, extractives, and ash] for either burning or conversion to liquid fuels is hindered by the lack of an inexpensive and efficient method of evaluation. Thus, there is a critical need to breed additional Miscanthus cultivars with improved winterhardiness and high yield-potential in the central and northern Midwest and to develop near-infrared [NIR] spectroscopy as an inexpensive and high-throughput method for evaluating quality characteristics of Miscanthus genotypes. Without the appropriate cultivars, Midwest farmers will be unable to effectively fulfill their role in responding government policies that are intended to positively impact human health, global warming, and national security.

Results

We have quantified substantial genotypic variation for winter-hardiness, flowering time, autumn dormancy, and yield in Miscanthus germplasm panels and F1 mapping populations. We have developed high-density genetic maps for four F1 mapping populations using RAD-seq to obtain thousands of single nucleotide polymorphism [SNP] markers. Using these high density genetic maps, we identified quantitative trait loci [QTLs] for each of the traits of interest [this should improve the efficiency of future breeding efforts]. An F2 mapping population was developed and phenotyped for photosynthetic tolerance to low temperature; the population was also established in a replicated field trial and is being phenotyped over several years. New sterile triploid Miscanthus x giganteus genotypes have been bred and they are being field-tested to determine their suitability for release as new biomass cultivars or ornamental cultivars. Additional diploid and tetraploid selections have been made to be used as improved parents for future crosses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
136	Conservation of Biological Diversity
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
402	Engineering Systems and Equipment

Outcome #4

1. **Outcome Measures**

Determination Of How Wildlife Communities Will Respond To Plantings Of Exotic Miscanthus

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Number Of Individuals Indicating Practice Changes To Reduce Energy Use And Cost

Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

Reducing Evaporator Fouling During Ethanol Production To Lower Cost And Reduce Environmental Impact

2. **Associated Institution Types**

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Evaporator fouling is a common, chronic problem during corn starch and ethanol production. To compensate for the consequences of fouling, capital costs are increased, operating costs are incurred, and environmental impact is increased. Despite these issues, fundamental causes of increased fouling in maize processes are not well understood. A batch system was used to simulate the evaporation process. An annular fouling probe was used to measure fouling resistance for varying test conditions of bulk fluid temperature and initial probe surface temperature.

What has been done

Experiments were conducted using commercial steepwater with different phytic acid concentrations. With phytic acid addition, the phytic acid concentrations of the samples were adjusted to vary from 25 to 75 mg/g sample. Fouling resistances were measured using an annular probe with a 7 L batch system. Mean fouling rate, maximum fouling resistance, and induction period characterized fouling behavior. The results will provide a better understanding of phytic acid effects on wet milling fouling and provide possible solutions to fouling mitigation in the wet milling process.

Results
Research related to protein effects on thin stillage fouling is limited despite its relatively high concentration in thin stillage [approximately 33% db]. Protein contributions to fouling have been verified in the dairy industry. Whey proteins, together with phosphate-calcium, interact with each other and with other proteins to form aggregates deposited on heated surfaces. Proteins have been detected in milk and thin stillage fouling deposits. Maillard browning, which involves proteins, is another potential.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
601	Economics of Agricultural Production and Farm Management

Outcome #7

1. Outcome Measures

Evaluating Changes In Cropping Systems And The Impact Of Tillage

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
While farm policy in theory provides for considerable cropping flexibility for Illinois producers, the mandate to produce fuel ethanol to blend with gasoline has meant an increase in effective demand and higher prices for corn. This price signal has increased the amount of corn at the

expense of soybean area in Illinois; in 2001, farmers in Illinois produced 10,850,000 acres of corn and 10,700,000 acres of soybean, while in 2012 corn was planted on 13,000,000 acres and soybean on 8,860,000 acres. With limited acreage of other crops, the high proportion of corn means that corn follows corn on some 20% of corn acres. In recent years, we have found that corn following corn has lower yields than corn following soybean, especially when there is stress during the growing season. This has lowered corn profitability, and has producers considering a return to more soybean acres or to trying to find another rotation that increases corn yields. The rotation studies we have in place are one of very few sources of information to help make such choices.

What has been done

The 2016 growing season was very favorable and resulted in high yields of corn and soybean at the experimental sites and record-high Illinois corn and soybean yields of 12.7 and 4.2 t/ha, respectively. Winter wheat yields were also record-high in Illinois, at 5.0 t/ha. At the Monmouth site in western Illinois, corn, soybean, and wheat yielded 14.7, 4.9, and 4.1 t/ha, respectively, averaged over rotations and tillage. At this site, soy-wheat-corn [SWC] and WSC yielded the same, and corn in the corn-soy [SC] rotation and continuous corn yielded 4 and 9% less, respectively, than corn in three-year rotations. No-till corn yielded 6% less than corn with tillage, but the yield penalty to no-till was much larger [14%] in continuous corn than in rotated corn, where no-till corn yielded only 3% less than tilled. The yield penalty to no-till has typically been larger in continuous corn than in rotated corn, but over years has only averaged about 7% [half the penalty we found in 2016]. Continuous soybean yielded 16% less than soybean in the corn-soybean rotation, more than double the average yield penalty to continuous soybean in this study. Soybean in the WCS and CWS rotations averaged 7% higher yield than soybean in the SC rotation. No-till soybeans yielded the same as tilled in continuous soybean and soybean following wheat in the CWS rotation, but averaged 12% less in the two rotations where soybean followed corn. Wheat in both three-crop rotations yielded the same, but no-till wheat yielded 19% less than with tillage.

At the Perry site, yields were affected by dry weather early in the season, and average corn, soybean, and wheat yields were 11.9, 3.8, and 6.2 t/ha, respectively. Corn in the CS rotation yielded 13.0 t/ha, continuous corn yielded 18% less than SC, and corn in SWC and WSC yielded 8 and 5% less than in the SC rotation, respectively. Soybean following corn in WCS yielded 3.9 t/ha, and continuous soybean yielded 9% less; the other rotation treatments yielded the same as WCS. Wheat following soybean in the 3-year rotation yielded more than wheat following corn. Tillage effects were small and non-significant for all crops and rotations at this site.

Results

These findings are adding invaluable data to our knowledge base concerning the effects of changes in cropping systems and whether or not tillage affects the outcome of such changes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
601	Economics of Agricultural Production and Farm Management
603	Market Economics

Outcome #8

1. Outcome Measures

Improved Understanding Of The Economic Risks And Benefits Of Biofuel Production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
We first investigated the technical and economic potential for sugarcane ethanol production in Brazil and its land use implications. Second, we examined optimal biofuel policy in cellulosic biofuel production and the effectiveness of alternative policies in promoting cost reducing innovations in the biofuel sector under alternative assumptions about market and technological conditions in the oil sector. Third, we examined the impact of riskiness of energy crops compared to conventional crops and its implications for crop, contract, and location choices for refineries.

What has been done
Brazil has pursued a mix of policy interventions in the fuel sector to achieve multiple objectives of economic and social development, promoting biofuels, and reducing dependence on oil. We developed an economic framework to provide insight on the fuel policy choices in Brazil and to analyze the trade-offs they have engendered in the fuel and sugar sectors. We also examined their distributional impacts on producers and consumers in the sugar, oil, and biofuel sectors and on government revenues. Additionally, we undertook a normative analysis for the purpose of comparing the welfare and environmental impacts of existing policies with those justified by the goal of maximizing social welfare and addressing market failure.

The ex-post analysis of the outcomes for different stakeholders in the fuel and sugar sectors provided insights into the likely political-economic factors guiding policy choices. We found that the status quo policies are likely to have been motivated by the objectives of increasing oil exports, raising government revenue, and promoting rural development through the sugarcane sector and have had a significant adverse impact on fuel and sugar consumers, aggregate social welfare, and greenhouse gas emissions in Brazil.

Results
Perennial energy crops are a promising source of bioenergy given that production involves

production risks, long term commitment of land, and need for crop-specific investments without the coverage of crop insurance potentially available for conventional crops. We conducted a choice experiment in five states in the Midwestern and South-central regions of the U.S. to examine the effect of crop-contract attributes on the joint discrete-continuous choice decisions to adopt an energy crop and convert acres to it from a status quo use, while controlling for the effect of various farmers' risk and time preferences, sociodemographic characteristics, and availability of crop insurance for conventional crops. We found robust evidence that high discount rates, high upfront establishment costs, and need for crop-specific investments create disincentives for adoption and allocation of land to energy crop production. The effects of riskiness of returns and risk aversion were less robust across specifications. The effect of conventional crop insurance on energy crop adoption differed across types of insurance; in particular, farmers with revenue insurance were significantly less likely to adopt an energy crop. Our results have implications for the design of effective contracts and policy incentives to induce the production of energy crops.

We also examined the effectiveness of policies to encourage a shift to renewable energy and to mitigate greenhouse gas [GHG] emissions. Various policies have set sector-specific technology standards, such as the Renewable Fuel Standard [RFS] and the Renewable Portfolio Standard [RPS] for the transportation and the electricity sectors, respectively. The welfare effect of each of these policies is, however, not sector specific. When implemented jointly these policies can interact in complex ways through a common reliance on bioenergy feedstock with cross-sector effects on social welfare and GHG emissions. We examined the welfare costs and effectiveness of GHG abatement with each of these policies implemented independently and jointly and compared them with those under a carbon tax over the 2007-2030 period using an integrated, dynamic, open-economy, price-endogenous model of the electricity, transportation, and agricultural sectors for the U.S. We found that the welfare costs of these policies differs across these sectors and for the U.S. vs the rest of the world. The domestic welfare cost of the RPS and RFS jointly is $109 billion while its global cost is $525 billion; corresponding values with a $19 per ton CO2 tax that achieves the same level of GHG abatement over 2007-2030 are [-] $18 billion and $33.5 billion. Compared to a no-policy baseline, the global welfare cost per ton of GHG abatement of the RPS and RFS is $171 billion while of the carbon tax is $7 billion.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
601	Economics of Agricultural Production and Farm Management
603	Market Economics
606	International Trade and Development Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

No evaluations have been conducted this past year.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

4-H Youth Development

☑ 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	0.0	0.0	0.0	0.0
Actual Paid	70.9	0.0	0.0	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**
2003908	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2003908	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
13329736	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

4-H Club enrollment in Illinois totaled 26,524. Slightly more than 167,000 different youth were involved in some type of 4-H program such as clubs or programs offered at the community level to address a special interest, during school, at a partner site, or at a military installation. Youth also had opportunities to

experience 4-H through conferences and camps. Efforts continued to focus on expanding these 4-H opportunities to underserved youth including those in metro areas of 100,000 or more to meet the needs of urban youth. The Youth Development Extension Educators, as well as local program coordinators, also focused on creating opportunities for inclusion of youth of Hispanic ethnicity and in expanding opportunities for teens to assume leadership roles as advocates for change, planning activities, promoting 4-H impact, advising partnering councils, mentoring peers, or teaching others. Educational priorities for all 4-H delivery systems remain focused on: [1] College and career readiness; [2] Food access; [3] Environmental stewardship; [4] Leadership; and [5] Health. A few examples of programs these priority areas follow.

Activities and programs focused on youth career exploration and workforce preparation included the **Illinois Summer Academies** conferences held on the University of Illinois campus. High school teens [310] spent three days exploring the college campus and engaging in hands-on workshops conducted by professors and graduate students in career fields of their choice. **Welcome to the Real World**, a multi-disciplinary curriculum and simulation that allows youth ages12-18 to explore careers and money management [balancing income and expenses] in adult life, was ongoing [also discussed in the Agricultural and Consumer Economics planned program].

Illinois 4-H responded in amazing ways to the hunger/food insecurity challenge facing their communities. In 2016, 2,052 youth and adult volunteers provided responses directed toward solutions to the problem that included community gardens, meals for food pantry patrons, weekend backpack program, canned food drives. and meal packaging events. Through individual and collective efforts **Illinois 4-H Feeding & Growing Our Communities** outreach program assisted 1,439 families and 125,000 individuals were impacted by those efforts.

The **I Think Green** curriculum was developed by 4-H and horticulture Extension specialists to engage 3rd through 5th grade youth in investigating how living things interact with each other and with their environment [also discussed in the Natural Resources and the Environment planned program]. The fourth year of training **4-H Citizen Scientists** raised the total youth participants from 100 junior and senior high youth in 2015 to 130 in 2016 who gained skills needed to complete scientific practices in monitoring water quality in their community and then contribute to the Illinois RiverWatch data collection site.

For a third year, **4-H Food Smart Families** partnered 4-H with the **Supplemental Nutrition Assistance Program Education** [SNAP-Ed] in supporting 464 teens who taught the grant-funded **Junior Chef** program that engaged 2,934 youth, and 47 teen teachers who taught the **Health Jam** program that reached 2,979 youth. Through after school programs and summer camps youth learned about healthy food choices and other healthy behaviors.

Illinois has continued to place strong emphasis on engaging youth in science. **The 2016 4-H National Youth Science Day Challenge -- Drone Discovery** allowed youth to explore how remote sensing can be used to solve real world problems while learning concepts like flight dynamics, forces of flight, basic computer coding, as well as following federal regulations while operating drones. The 4-H robotics project increased in enrollment with 7,466 youth enrolled in one of five project options. Sixty-five teams [450 youth] participated in the eighth annual **Illinois 4-H State 4-H Robotics Team Competition. 4-H Tech Wizards**, an initiative designed to establish mentoring programs for at-risk, underserved youth in an after-school setting, continued to engage youth participants at seven multi-county sites this past year. State and national partners played an important role in providing grants to support these science experiences and opportunities for awarding college scholarships. The **4-H Incubation and Embryology** program engaged youth in experiencing hands-on science concepts while caring for and observing the growth process of chicken embryos. **Science Siesta**, designed for youth in grades 4 thought 6, introduced them to fun hands-on science activities and career opportunities. This past year two programs were conducted--one for boys and one for girls.

Building **youth leadership skills** is both a national and Illinois area of focus. At the state level opportunities and training were provided for the state **Youth Leadership Team** members to plan and conduct conferences and to articulate the impact of the 4-H program to legislators. Youth participants in **Speaking for Illinois 4-H** also demonstrated their skills in articulating the impact of the 4-H program to legislators. Illinois 4-H is also focusing on developing teens as teachers. **Youth Science Ambassadors** were involved in leading and facilitating the **Drone Discovery 4-H National Science Day** event and a group of 20 youth Illinois **4-H Livestock Ambassadors** who are charged with telling the story of Illinois agriculture assisted in conducting the **4-H Livestock Conference**.

Volunteer Training -- Volunteers are key in delivering 4-H Youth Development programs and are instrumental as caring adults who create an environment that is a critical element of positive youth development. This past year 20,556 volunteers gave their time and talents to the 4-H Youth Development program in Illinois with approximately 4,325 serving as club leaders. Leaders had instant access to seven online courses to help them carry out their role. In addition to a basic course orienting new volunteers, other course topics included an overnight chaperone orientation, child protection, parliamentary procedure, working with committees, club program planning, and public presentations.

2. Brief description of the target audience

4-H youth development has broadened its target audiences to include urban, Hispanic, and military family youth between the ages of 8 and 19, youth leaders [paid and volunteer], teen teachers, adult leaders of 4-H clubs and other youth-serving organizations, parents, and community members.

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	145490	0	344859	617067

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	1	0	1

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Increased Knowledge About Science And Health Careers

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Business leaders in Illinois are struggling to find the science, technology, engineering, and mathematics [STEM] talent they need to stay competitive. Students need more exposure to challenging and engaging science content.

What has been done
The 4-H Incubation and Embryology project has been carried out in elementary school classrooms for over two decades using hands-on science concepts in caring for and observing the growth process of chicken embryos from the inception of the eggs through hatching of chicks. The majority of youth participants were in K-2 classrooms, but youth in grades 3-12 were also engaged in the activities this past year. Curriculum development and training was provided by the Extension poultry faculty member and local educators. Evaluations were collected from 174 teachers in eight counties in Northeastern Illinois to determine their perceptions of impact related to their 9,925 students' science ability gains.

Results
Using a scale of 1-4 [1 = Not at all, 2 = Sometimes, 3 = Usually, and 4 = Always], grades K-2 teachers were asked to rate their students' level [as a group] with respect to five [5] science abilities, and grades 3-12 teachers were to rate their students' level on ten [10] science abilities after participating in the multi-week 4-H Incubation and Embryology project. Observed increases in at least one of these skills were reported by 87% of the 174 teachers who answered these questions [discussed in more detail in the evaluation section].

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #2

1. Outcome Measures

Number Of 4-H Youth Applying Leadership And Teaching Skills

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	52

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Youth need positive experiences in developing into productive adults.

What has been done
Teens were recruited and trained as teachers to conduct programs. Materials related to teaching summer nutrition programs and agriculture awareness of where food originates. In addition to being trained to conduct educational activities related to these topics, the teens were engaged in formal training that addressed learning about leadership, BIG M, technology, and teaching techniques. At the end of their teaching experience, the teen teachers completed a questionnaire that included 20 4-H Common Measures statements designed to describe the impact of their experience as a teen teacher.

Results
The responses to the evaluations were collected from 52 teen teachers who taught preparation of nutritious food and agriculture awareness of food origins. Using a four-part scale with "Always", "Usually", "Sometimes", and "Never" response options, all but one who completed the evaluation indicated that through this teaching opportunity they "Always" or "Usually" do the following "I take responsibility for my actions" [52].

The teen teachers were asked to rate additional statements as "Strongly agree", "Agree", "Disagree", or "Strongly disagree". All of the teen teachers [52] reported that they "Strongly agree" or "Agree" that "I am someone who wants to help others" and "I learned things that helped me make a difference in my community". All but one [51] indicated that "I have talents to offer to others".

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #3

1. **Outcome Measures**

Number Of Youth Participating In Extended Positive Youth Development Experiences

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

4-H Incubation And Embryology Program

Using materials developed by the University of Illinois poultry specialist in conjunction with state and local 4-H staff, 232 teachers in ten Northeastern Illinois counties responded to a survey asking them to share their perception of the impact of the multi-week **4-H Incubation and Embryology Program**. A reported 5,502 students were enrolled in grades K-2 and 4,423 students were enrolled from grades 3-12. Two surveys were tailored around grade level science skills learning standards for the two grade level groupings [5 science skills for K-2 and 10 for Grades 3-12].

With respect to the science abilities of students in grades K-2, 85 [86%] of the 99 teachers who answered this question indicated a perceived increase in at least one of five [5] science abilities. More than one-half of the teachers reported perceived increases in their students' observation ability [71% of the teachers], hypothesizing ability [67%], predicting ability [63%], comparing/contrasting ability [59%], and organizing/ordering/classifying ability [56%].

With respect to students in grades 3-12, 40 [89%] of the 45 teachers who answered this question indicated a perceived increase in at least one of the ten [10] science abilities. Three-fifths of the teachers reported perceived increases in their students' observation ability [69%], data collecting ability [60%], and hypothesizing ability [60%]. More than half and less than three-fifths of the teachers reported perceived increases in their students'

ability to predict [58%], ability to evaluate [58%] and communication/demonstration ability [56%]. More than one-third and less than one-half of the teachers reported perceived increases in their students' interpreting/analyzing/reasoning ability [47%], ability to summarize [45%], question [44%], and problem solve [42%].

Students were asked to hold up their hands in responding to science-related statements. More than 90% of the teachers sharing the information indicated that more than half of their students like science and would like to do more activities like this incubation and embryology program in the future.

4-H Teens As Teachers

Illinois 4-H is focused on creating positive experience in developing youth as leaders including providing opportunities to be trained and then engaged in a teaching experience. At the end of the teaching experience, the teens teaching STEM, agriculture awareness of where food originates, and healthy living were asked to complete a questionnaire that included 4-H Common Measures statements designed to describe their experience as a teen teacher. Using a four-part scale with "Always", "Usually", "Sometimes", and "Never" response options, slightly more than 80% the 52 youth who completed the questionnaire indicated that through this teaching opportunity they "Always" or "Usually" do the following:

- 52 "I take responsibility for my actions"
- 48 "I work well with other youth"
- 43 "I use information to make decisions"
- 41 "I set goals for myself"
- 41 "I can work things out when others don't agree with me"

The teen teachers were asked to rate additional statements as "Strongly disagree", "Disagree", "Agree", or "Strongly agree". Slightly less than [95%] of the 52 youth rated the following statements as either "Agree" or "Strongly agree" as a result of their experience in the Teens as Teachers 4-H program experience.

- 52 "I am someone who wants to help others"
- 52 "I have adults in my life who care about me and are interested in my success"
- 52 "I have friends who care about me
- 52 "I am connected to adults who are not my parents"
- 52 "I am comfortable making my own decisions"
- 52 "I learned things that helped me make a difference in my community"
- 52 "I don't let my friends talk me into doing something I don't want to do"
- 52 "I can work successfully with adults"
- 52 "I can change my plan when I need to"
- 51 "I have talents to offer to others"
- 50 "I like to work with others to solve problems"
- 50 "I have a plan for reaching my goals"
- 49 "I know how to deal with stress in positive ways"
- 48 "I can explain my decisions to others"
- 48 "I helped with a project that made a difference in my community"

Key Items of Evaluation

After conducting the **4-H Incubation and Embryology** program in their classrooms, nearly two-thirds [101] of the K-2 and 3-12 teachers perceived increases in their students' observation skills. More than one-half [58] of the K-2 teachers also reported observed increases in their students' comparing/contrasting, hypothesizing, predicting, and organizing/ordering/classifying abilities. In addition, more than half of the grades 3-12 teachers [25] reported observed increases in their students' ability to collect data, hypothesize, evaluate, and communicate/demonstrate.

All the **4-H Teen Teachers** indicated that through their teaching activity they always or usually take responsibility for their actions. The teen teachers also indicated that through their teaching experience they strongly agreed or agreed with an additional ten statements.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
2934	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 whit 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)	
18	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
13	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.